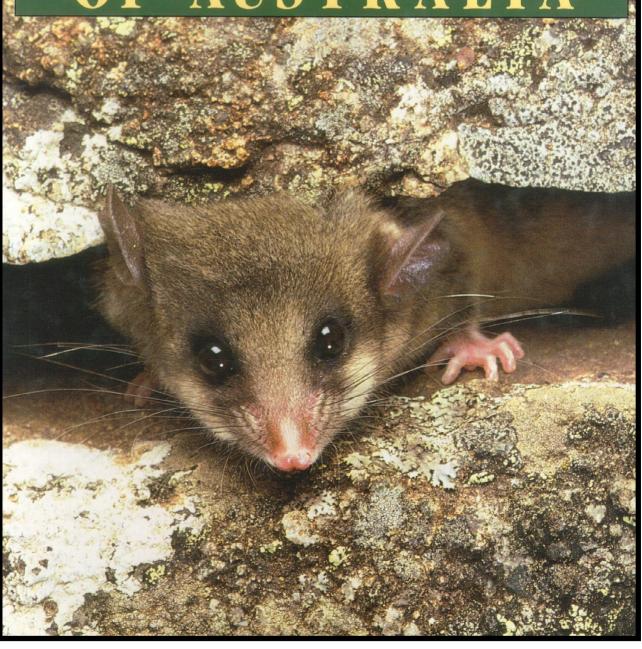


# ENDANGERED ANIMALS OF AUSTRALIA



This book is the first ever published that gives detailed descriptions of all vertebrates currently known to be endangered in Australia.

It contains detailed descriptions of more than 120 species, accompanied by the best photographs or illustrations known to exist, from the collections of professional photographers, artists and institutions throughout Australia and overseas.

One of the aims of this book is to enable the lay person to correctly identify an endangered animal in the field. As well as the excellent illustrations, the author has provided the most up-to-date descriptive information to aid the reader in identification.

Each species description also deals with aspects of the animal's life cycle, causes of its decline, the known remaining population and the principal actions required to secure the species' future. This information has been compiled from scientific literature, wildlife experts and other sources.

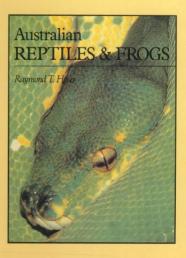
The book also deals, in more general chapters, with the major threats to Australian species, including habitat destruction, introduced species that have become pests, hunting and other forms of exploitation by humans, including smuggling. This gives a broader perspective of the problems faced by individual species. The early chapters also indicate the magnitude of the problems faced by Australia's threatened species.

This book presents the facts about Australia's endangered animals in a refreshingly objective manner and is essential reading for anyone who is concerned about the plight of our vanishing wildlife.

RAYMOND HOSER has been involved in the conservation cause since he first arrived in Australia in 1967 at the age of five. He was an early protester against the commercial over-exploitation of whales, and was among the first to bring to media attention the threat to Australian wildlife of introduced animals such as Cane Toads, introduced fish and feral mammals.

Raymond was one of the first to voice concern about Australia's endangered animals. He has always maintained that, for many species, the only hope for survival in the long term lies in the establishment of large breeding colonies in captivity. He developed some of the most impressive reptile captive breeding facilities in this country, and has played a major role in the recent expansion of captive breeding of other types of endangered wildlife.

His first published paper appeared in a scientific journal when he was thirteen, and Raymond has since become an internationally known authority on Australian wildlife. Besides publishing numerous scientific papers and articles in popular magazines, he is the author of Australian Reptiles and Frogs, now regarded as a definitive work on the subject. It is with the hope of increasing the general public's knowledge about endangered animals, and promoting the conservation cause, that he has written this second book.



# ENDANGERED ANIMALS OF AUSTRALIA



Raymond T. Hoser

PUBLISHED BY PIERSON & CO

Front cover. Mountain Pygmy-possum *Burramys parvus* (see page 216). Photograph by Jean-Paul Ferrero/AUSCAPE International.

Back cover. Orange-bellied Parrot *Neophema chrysogaster* (see page 140). Photograph by Dave Watts/ANT Photo Library.

Title page. Shark Bay Mouse *Pseudomys praeconis* (see page 177). Photograph by A. G. Wells/NPIAW

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Innumerable keepers of wildlife, including a large number of zoo managers, also assisted me in my quest for information, as did a number of people outside Australia who have played a role in conserving our endangered fauna.

The following people read sections of the manuscript and offered valuable criticism: Michael Tyler, John Scanlon, David Andrew, Robert Warneke and Tarmo Raadik.

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It was Charles Pierson who initially badgered me to write this work, sharing a concern many Australians have for their environment and the plight of endangered animals. Without his back-up in many crucial ways, this project would never have been undertaken, and I hope that his efforts for the wildlife conservation cause do not go unrecognised.

My parents, Len and Katrina Hoser, as always provided unfailing support.

To the large number of people who have given assistance in this project and whom I have not named I wish to offer my thanks.

### FOREWORD

Australia has some of the most attractive wildlife in the world. Its native animals and superbly plumed birds reflect the richly diverse nature of their dynamic environment.

In developing this bountiful country of largely unspoiled beauty, we have changed forever the natural habitat in which many of our plants and animals once thrived. Sadly, it now appears that some animals have been lost forever, and that for others the future is in doubt.

If we are to ensure the survival of the animals and birds so beautifully illustrated in this book, new ways will need to be found to protect their natural habitats from the demands of those who most threaten their future—Australians themselves.

In this book, Raymond Hoser has clearly established the reasons for the decline in some species. He explains succinctly why for many of these animals it is no longer enough to leave them simply to fend for themselves.

His text also identifies the perhaps irreparable habitat changes, including the introduction of that feral faunal assassin, the cat, which in the wild has decimated small mammals and so many of the birds.

It's clear that if we are to truly conserve our endangered species, we must put real commercial value into our wilderness areas and their animals, then manage them in such a way that they both generate sufficient funds to effectively ensure their future, for at the end of the day conservation is essentially a financial matter. Its success largely depends on what people are prepared to pay.

Perhaps the first step is to decide what it is we wish to conserve, and that which we would choose

to preserve. We would, I'm sure, wish to preserve—that is, to keep safely in its present state—our old photographs, furniture, our mementoes, maybe some national parks and wilderness areas. How best to conserve—that is, to protect—other things, including our flora and fauna, remains an issue of some public debate.

However, around Australia people are now increasingly coming to realise that the groups with the most sustained interest in conservation and those who will be its most vehement activists will be those who have the greatest vested interest.

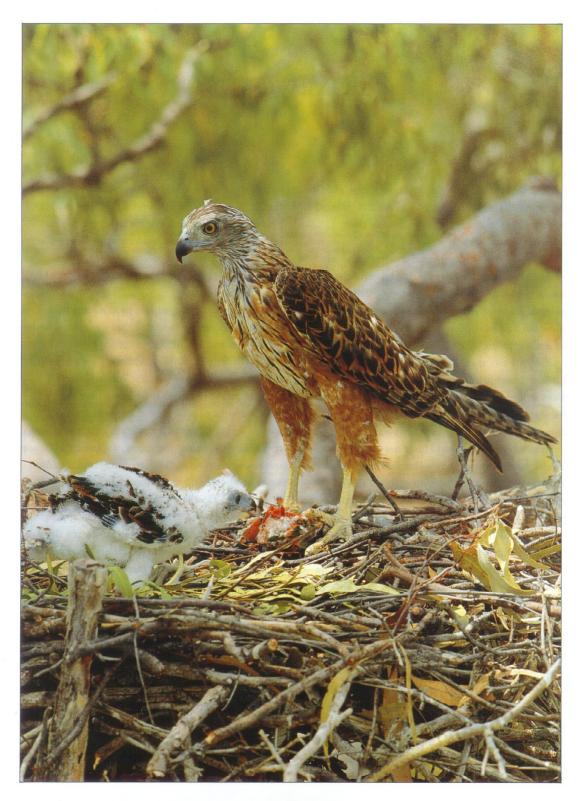
It follows therefore that when we have decided what we want to preserve for future generations to look at and admire and learn from, as distinct from those things we want to protect, we must seek those in the community with the resources and the interest, who are willing to take up the challenge.

Raymond Hoser refrains in this book from emotive language in his argument for a fresh approach to conservation management so as to ensure the survival of our birds and animals. He argues effectively and persuasively for governments to assist in the preservation of endangered species by offering reasonable economic incentives to individuals and companies willing to take on the task.

A move in this direction, encouraging those in the community willing to take on the task, together with governments who can set the rules, will be an important first step in ensuring that our flora and our fauna not only survive, but flourish.

IAN McLachlan, mp

PARLIAMENT HOUSE, CANBERRA



## Introduction

 $E_{
m xtinction}$  is forever. Once an animal disappears from the face of the earth, it never returns.

Since the earth was formed a few billion years ago, many species have come and gone. In fact, extinction is sometimes looked on as a natural evolutionary process. Primitive forms are often superseded by more advanced forms or those better able to cope with environmental conditions, which are themselves subject to constant change. However, many simple and primitive forms persist to the present day, indicating that complexity isn't necessarily a recipe for survival. It is thought that less than 1 per cent of the species of living things that have ever lived on earth still exist.

If extinction is a natural process, one might ask what the big deal is about a few more species disappearing into oblivion. A brief explanation of some previous extinctions, to provide a historical perspective, is necessary.

At certain times in the past, global catastrophes have caused mass extinctions. These extinctions occurred almost overnight in geological terms, and the reasons for them are still a matter for speculation. One well-known wave of extinction occurred at the end of the age of the dinosaurs, some sixty-five million years ago, when almost all types of land-dwelling reptiles, and many other groups of animals disappeared.

The greatest mass extinction of species ever to

A Red Goshawk at the nest with a chick and the remains of a kookaburra. The Red Goshawk feeds mainly on other birds, preferring waterbirds and cockatoos, but it will also eat small mammals, snakes and lizards.

Jack and Lindsay Cupper/AUSCAPE International

have occurred in this planet's history began about a million years ago and is continuing today. Sole responsibility can be traced to the effects of a single animal, *Homo sapiens*.

Human beings have drastically altered the landscape on every continent, and their activities now affect every part of the globe. Their actions, and the consequences of these actions, have led to the elimination of many species in recent times, with increasing numbers being threatened with extinction.

With the increase in human populations world-wide, the fortunes of many species have correspondingly declined. Human beings are apparently the first species on this planet with an ability to shape their own destiny, and now they control the fate of every other living species on earth.

Humankind has now become the custodian of all other living things. Bearing in mind that virtually all extinctions of species now occurring are a result of human or human-initiated actions, and that they would not have occurred without those actions, the question of why preserve a species comes into sharp focus.

Although aesthetic reasons are commonly given for preserving a given species, remarkably few endangered species are widely regarded by humans with any real degree of affection. Even among the mammals, few endangered species are cute or cuddly. Some are aggressive killers, while a huge number are rat-like, and many humans seem to have a strong dislike for rat-like animals.

In order to capitalise on the human affection for cuddly animals, the World Wildlife Fund adopted the Giant Panda as its emblem, to enlist support for the plight of all endangered species. If the organ-



isation used a rat as its emblem, it is doubtful if the Fund would obtain as much public support.

Some endangered animals are clearly more valuable alive than extinct. Examples include marine turtles and whales, both of which have potential as major food resources for humanity if properly utilised. Most species at this point have little economic worth, however, and it can be argued that some endangered species actually compete against human beings' economic interests. Although it may be argued that if those species disappeared it would be no great loss, such a judgment is very short sighted.

As science and technology develop, new ways are being found to utilise resources, non-living and living. Every species has its own unique genetic makeup, and this, in combination with environmental features, gives each species its unique characteristics.

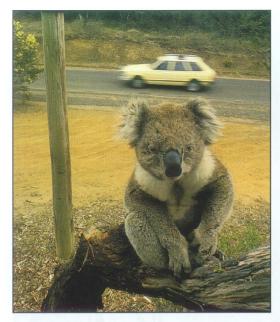
A Blue Whale skeleton at Martell Inlet on King George Island. Although Blue Whales are no longer commercially exploited, their worldwide population does not seem to be recovering from human beings' earlier depredations.

Jean-Paul Ferrero/AUSCAPE International

What cannot be utilised for the benefit of humanity at present may well be a valuable resource in the future. If a species is exterminated, that resource is lost forever and the potential loss to human welfare could be huge.

From a purely economic viewpoint, it is clear that the maintenance of as many different species as possible and the preservation of genetic diversity are therefore essential to the well-being of our own species.

To date, no animal's medical potential for humans



Koala populations have suffered a number of setbacks since Europeans settled Australia. Koalas were hunted for their skins in the 1920s, and in recent years many have been affected by the disease Chlamydia. They are also beset by all the dangers that accompany human settlement.

Jean-Paul Ferrero/AUSCAPE International

has been fully explored, and already some life-saving treatments have been developed using the tissues of rare and endangered animals.

No species should therefore be condemned by human-related activities to extinction. It is obvious that every living species on this planet is of potential use to humans. No animal has ever plundered to extinction those species on which it depends, without itself becoming extinct. Therefore, if humans continue to exterminate species, the message is clear.

The decline in species is well documented. In Australia the first settlers, the Aborigines, exterminated many species, and the first European settlers accelerated the pace of change.

At the time of European settlement, the mammal fauna, for example, was only a fraction of that which existed prior to the arrival of the first Aborigines from the islands to the north, some 40 000 years earlier. By their hunting methods, including excessive

burning and the introduction of the dingo, the Aborigines accelerated the extinction of many larger species of marsupials, including giant macropods and diprotodonts (wombat-like animals the size of a small cow).

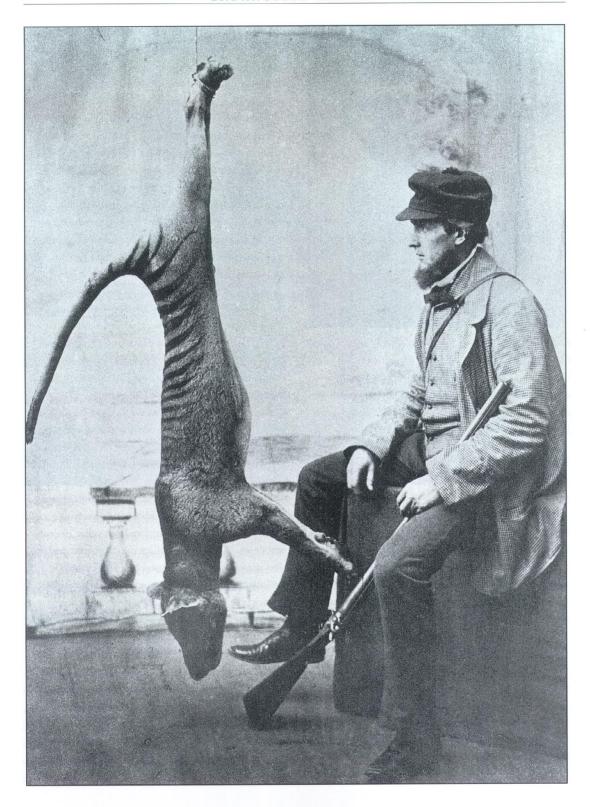
About two-thirds of the mammal species in Australia when the first Europeans arrived are either extinct or in a state of decline. This pattern is repeated for most other groups of animals and plants.

The main subjects of this book are endangered animals, more specifically endangered vertebrates, that is, the fish, amphibians (frogs), reptiles, birds and mammals that are likely to disappear from Australia in the not-too-distant future if the factors causing their decline continue to operate. More than a hundred species are dealt with in detail, but they represent just the tip of the iceberg. Even if humans stopped their destructive actions tomorrow it would still be too late for many species, which would continue to suffer because of irreparably changed conditions, such as the threat from an introduced predator or habitat change.

Although these endangered species are dealt with individually, it must be realised that they are merely components of a very complex array of ecosystems, the whole of which must be preserved in order to preserve the different species. The various ecosystems link up globally and are all interconnected. Human beings cannot expect to be able to adversely affect ecosystems around the world and not suffer the consequences. Within Australia, environmental destruction through soil degradation cost this country's agricultural industries some ten billion dollars in lost income in 1989 alone.

To preserve a given species often requires the preservation of its remaining habitat. However, because of the effects of an immense human population and introduced species that have become pests, it is not sufficient to lock away an area and hope that it will take care of itself. We must actively manage and protect remaining habitats.

Before dealing with individual endangered animal species, it is essential to outline the effects, on the extant forms, of human-related actions.



# THE HUMAN IMPACT

The first human arrivals in Australia found a land teeming with wildlife, dominated by species substantially larger than those found today. In order to make it easier to catch food the Aborigines burned large areas to clear undergrowth, resulting in widespread and permanent habitat change.

The giant species present in the Pleistocene epoch became extinct as a result of hunting by man, habitat alteration by frequent burning and the introduction of the dingo, which became a dominant predator. This extinction of giant forms mirrored a pattern seen in other parts of the world, including Eurasia and the Americas.

Giant herbivorous mammals were common and included a number of types of diprotodont, some of which resembled hippopotamuses or South American tapirs in appearance, and which are the largest marsupials known to have lived. *Diprotodon optatum* was a typical heavy browsing species, while *Palorchestes azael* was a more lightly built grazing form, similar in size to a modern heifer.

Other herbivorous marsupials eliminated since the arrival of the Aborigines include *Phascolonus*, a donkey-sized wombat; *Protennodon*, a huge wallaby; *Sthenurus* and *Procoptodon*, 4-metre-tall kangaroos. *Thylacoleo*, a large marsupial lion, was an impressive-looking animal, but it is not certain whether it was a

A total of 2184 Thylacines were killed and presented for generous Tasmanian government bounties between 1888 and 1909, but, as private owners of many properties paid up to five times more for Thylacine scalps, this figure probably does not represent even half the quantity killed in that period. This specimen was shot in 1869. Tasmanian Museum and Art Gallery

predator or a scavenger, or both.

The Thylacine *Thylacinus cynocephalus* and the well-known Tasmanian Devil *Sarcophilus harrisii* were both eliminated from the mainland and restricted to Tasmania. It is believed that as recently as 12 000 years ago the Thylacine ranged throughout most parts of mainland Australia.

A number of giant mound-building birds, including *Progura gallinacea* and *Progura naracoortensis*, along with emu-like *Genyornis* and *Dromornis*, also disappeared before European settlement. A giant monitor lizard, *Megalania prisca*, which reached up to 8 m and dwarfed all living lizards, disappeared during the Pleistocene epoch, possibly as a result of human-initiated factors. It occurred over a wide area of continental Australia. The largest living lizard, the Komodo Monitor *Varanus komodoensis* (also known as the Komodo Dragon), does not exceed 5 m.

The abundance of these giant forms is well documented in the fossil record. In fact, diprotodont remains are so common in some fossil beds that they are called 'diprotodont beds'. It appears that large numbers of these animals became trapped in muddy areas and perished.

Other animals, such as some types of wombat, also declined sharply in numbers and distribution after the arrival of Aborigines. The Northern Hairynosed Wombat *Lasiorhinus krefftii* is one such example.

The effects of Aboriginal settlement and of the dingo were still being felt by the Australian fauna when European settlement commenced at the end of the eighteenth century. In fewer than two hundred years the impact of modern man and of non-native



This diprotodon exhibit at the Australian Museum has been reconstructed from the fossil record. The diprotodon was one of the giant mammals probably eliminated by the Aborigines.

Anthony Farr/Australian Museum

species liberated in Australia has been immeasurably more severe than that of humans over the previous 40 000 years. It is this European impact that has led to the sharp decline of so many indigenous species and to the endangerment of most if not all species listed in this book.

Few endangered or declining species are in that state as a result of a single factor such as hunting. Typically, species decline results from a combination of adverse factors coupled with unique features of the given species, habits or distribution.

Major adverse factors leading to the decline of most threatened animals in Australia are: habitat destruction or modification; introduced species; and deliberate hunting or killing by human beings.

Factors apparently beyond human control, such as climate change, are not a major cause of decline in

many species, either in Australia or elsewhere.

Overpopulation by humans and its negative environmental impact are without doubt the greatest threats facing wildlife in most parts of the world, including Australia, which, although by world standards it has a relatively small population, is still grossly overpopulated.

Although the overpopulation issue is not directly discussed in this book, it is an inescapable fact that it is the core of the problem facing many endangered species.

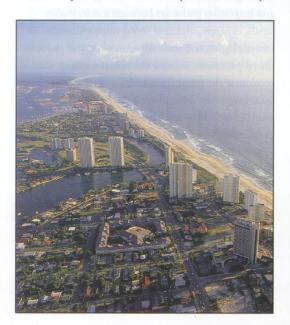
The three factors above are listed and dealt with separately, but are often interconnected. The above division has been made to simplify the picture of species declines. For example, pollution may be the cause of habitat destruction, killing off a particular type of vegetation. An introduced species, such as the rabbit, may eat vast amounts of vegetation, also causing habitat destruction. Introduced species may also spread disease among native forms, making them rarer or even endangering them. The interconnection of factors leading to reduction in native species populations should never be overlooked.

# HABITAT DESTRUCTION AND MODIFICATION

Most animal species have very strict habitat requirements. If those habitat requirements are not met, the species in question ceases to exist. For example, the Leadbeater's Possum *Gymnobelideus leadbeateri* requires open, mature forests of mountain ash *Eucalyptus regnans* and alpine ash *Eucalyptus delegatensis*. These trees have hollows in their trunks and branches, which provide essential nesting and shelter sites for these animals. If these trees are removed, usually by logging, the species cannot exist in the cleared areas.

For most terrestrial animals, habitat destruction is usually a matter of alteration to the vegetation present. For example, many ground-dwelling marsupials depend on thick undergrowth for shelter. If this is removed, the susceptible species will also disappear. The tolerance of a given species to different types of habitat destruction or alteration plays an important part in its long-term survival prospects.

Most animals will not usually move out of an area as the habitat is destroyed; instead, they will remain and perish. Those that move into nearby areas of suitable habitat typically compete with members of their own species, with a mortality rate sufficiently



high to prevent an overall increase in population density in the remaining habitat.

For example, between 1962 and 1967, 1033 Greater Gliders *Petauroides volans* were marked and tracked as the 4300 acres (1740 ha) of forest in which they lived was clear-felled. Few animals died as a direct result of the tree cutting. Most remained in their original home territories and starved to death, dying about a week after their home territory had been cleared. The only survivors were some whose territories included uncut areas.

Habitat destruction or alteration is carried out principally by two means, which commonly occur together, namely, direct human interference, such as land clearing, and the introduction of animals, such as grazing cattle, or plants by human beings.

#### Urbanisation

Urban settlement is incompatible with the habitat requirements of virtually all endangered species. In Sydney's central business district, for example, the only native mammal one is likely to encounter is the Common Brush-tailed Possum *Trichosurus vulpecula*. It is not just the habitat alteration entailed in urbanisation that is dangerous for most native species. Those that are tolerant of habitat alteration usually fall victim to humans or their cats and dogs.

As Australia's population increases, urbanisation will pose a greater threat to many species. The Broad-headed Snake *Hoplocephalus bungaroides* has its centre of distribution in Sydney and its environs, and is not found in any location more than a few hundred kilometres from the city centre. Continued construction of housing on Sydney's outskirts poses a threat to this species. The spread of Perth and its suburbs similarly threatens the Western Black-

Few native animals or plants are able to tolerate the conversion of their habitat into bitumen roads, areas of foreign plant species and houses built on quarter-acre allotments. Urban development, such as this along the Gold Coast in Queensland, can spell extinction to species with limited geographical distributions.

Robert Little/AUSCAPE International

striped Snake *Neelaps calonotus*, a species found nowhere else and unable to survive in built-up areas.

#### Logging

Since the First Fleet arrived, most of Australia's forests have been cleared to create farmland. In recent years, however, a greater threat has emerged from continued forestry activities. The main problem has been that, as timbered areas have been destroyed by logging activities, little effort has been made to replace missing trees. Consequently, loggers have had to constantly go in search of new areas to cut. Today only a small percentage of the original forests remains, and much of this is now under threat. In general it is not the trees themselves that are endangered at a species level, but rather the species that depend on those trees.

Clear-felling of timber also destroys the understorey, which allows non-native grasses and other plants to overrun the forest floor before the trees regenerate. The non-native grasses prevent the original types regrowing, and they consequently become extinct. Likewise some types of fungi, insects and other species die out. Native animals that feed on these species become threatened as a result.

The prospects for endangered plants are apparently worse than they are for animals, possibly due to the lack of public interest in endangered plants compared to that in animals. Unfortunately, these plants are essential to the survival of many animals, and their disappearance will pre-empt that of those animals.

Typically, all the larger trees are felled when a forest area is logged. 'Selective logging', a nice-sounding term commonly used by loggers, essentially means chopping down any trees worth chopping and leaving the rest. Selective logging does not leave important nesting trees standing, or clusters of nesting and other trees from which native animals can recolonise the logged area.

Clearing extensive forests has an adverse effect on the forests remaining, for a number of reasons. Pests and diseases are able to overrun them more easily. Phasmids and stick insects have been able to defoli-



The Victorian Branch of the Australian Timber Workers Union demonstrates outside Parliament House in Melbourne in 1990. Confrontation between the logging industry and conservationists has become commonplace as public awareness of Australia's dwindling forest resources increases.

ate extensive areas of mountain ash and alpine ash forests in eastern Victoria. The lerp insect is also responsible for large-scale defoliation. The principal factor causing these plagues of insect pests is believed to be the elimination of native birds by the clearing of their habitat. The cutting off of habitat and migration pathways between forests makes small, isolated patches of forest more vulnerable to insect plagues and their consequences, and to introduced predators. Because the affected species cannot recolonise the forest from an adjacent forest area, the local extinction is permanent. In the longer term, a number of local extinctions can lead to the general extinction of a species.

#### Woodchipping

Woodchipping is a relatively new forestry method, and without doubt is the most potentially harmful to wildlife. All the hardwood trees in an area of forest are felled and chewed into fragments (woodchips), principally used for making paper. Woodchipping is possible in areas that would be unsuitable for other types of forestry activities, including areas that lack tall, straight trees.



A pine plantation in the Kuranda Range, North Queensland, cleared from eucalypt forest. At the same time, areas of the South American Amazon jungle are being cleared and burnt so that eucalypts can be planted. These eucalypt forests are as devoid of native wildlife as are pine forests in Australia.

D. Parer and E. Parer-Cook/AUSCAPE International

A forest that is woodchipped is immediately converted into a wasteland that may take years to recover, if it ever does. Certainly any regrowth has a different composition of flora and fauna from that of the original native forest.

Most of the world's remaining forests are under threat from woodchipping, including those hardwood forests remaining in the tropics. Already the Philippines, and Java and most other parts of Indonesia, have been exhausted of forests for woodchipping, and at current rates of woodchipping few tropical forests will remain by the year 2010.

In Australia the picture is equally depressing. The Tasmanian government has granted woodchipping licences to three major companies to woodchip forests covering 1.7 million hectares, nearly two-thirds of that state. The chips are to be exported to Japan, by far the world's largest consumer of wood-

chips. In recent years the governments of Western Australia, Victoria and New South Wales have also rushed to give out permits to companies to clear-fell and woodchip forests on crown lands. At the time of writing, more than half the remaining publicly owned coastal forests were earmarked to be woodchipped.

More so than other forestry activity, wood-chipping results in loss of soil fertility, erosion, the silting of waterways, the reduction of water quality in potential water catchments, the reduction of species diversity of plants and animals and an increase in the risk of fungal dieback disease because of soil disturbance. Woodchipping tends to immediately eliminate all tree-dwelling and most other types of native animals from the logged areas.

After woodchipping, browsing animals such as wallabies or livestock move into clear-felled areas and further prevent regeneration of native vegetation by feeding on it. Non-native grasses and other plants overrun the habitat. The damage becomes permanent and effectively irreversible.

There are three types of woodchipping. The first is a once-only operation, in which no attempt is made to renew the forest resource. The second method involves 'forest rotation'; royalties paid by

the chipping companies to the government are used to help establish a second generation of trees for chipping. The third method involves planting a replacement crop of a different type of tree, such as pines, which are also later harvested.

The continuing practice of substituting pines for scarce native forests in national estate areas is having adverse effects on many forms of native wildlife. Pine forests have a dense canopy, and therefore lack the undergrowth found in most native communities. Often the canopy is so dense that even hardy grasses have difficulty in growing. Plantations typically consist of only one type of tree, such as *Pinus radiata*, and these trees are not suitable for most native mammals and birds. Most native species seen in pine forests are vagrants from adjoining native bushland or survivors from relict bushland patches within the forests, particularly immediately along watercourses, where pine trees are not often planted.

Pine plantations, though they are biological deserts in Australia, are extremely useful in that they take logging pressure off native forests. The essential materials provided by these forests would otherwise have to be found in native forests.

Politicians and companies have been attracted to woodchipping by the view that it converts 'useless bush' into export dollars, and that no other use for these areas has ever been proposed. The long-term costs, both economically and otherwise, have rarely been calculated. For example, a number of rivers in south-eastern New South Wales now have severe and costly siltation problems as a direct result of woodchipping in their catchment areas. Local extinction of wildlife species through woodchipping is often the precurser of more widespread problems.

#### Agriculture

The growing of crops for human consumption has taken a huge amount of habitat from native species. Directly farmed areas tend to be monocultures, with few if any native vertebrates present, and the only plants present are those being cropped.

Currently some 67 per cent of Australia's land surface is used for grazing or other farming activ-

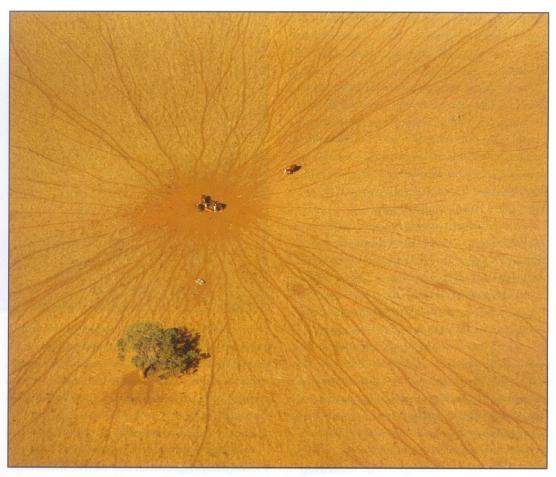
ities. About 96 per cent of habitat has been directly modified since white settlement. Such modification has a strong influence on how many and which native species survive in given areas.

The most dramatic effect of agriculture is the almost complete removal of native vegetation. For example, Australia's wheat-growing areas are huge treeless expanses. Prior to settlement these areas were generally covered by stunted eucalyptus woodlands, though many were more open woodland. The only native mammals capable of surviving in wheat-growing areas appear to be a few larger macropods, which take refuge away from planted fields.

Irrigation areas and relatively intensely farmed zones along large inland rivers, such as the Murray and Murrumbidgee in New South Wales, have been so intensively altered that the decline in native species has been even more pronounced. For example, at the junction of the Murray and Darling rivers, where there were at least 27 species of native mammal recorded at the time of settlement, as few as eight species are believed to remain.

Irrigation, though of short-term benefit to many farmers, has caused some significant problems in this country. Prolonged irrigation has tended to raise the water table and cause the ground to become so saline that no crops can be grown, and neither can native animals survive in the salty environment. The increased salinity also affects adjacent creeks and rivers, with a corresponding decline in fish and frogs that cannot tolerate salty water, and in the animals that feed on them. Salinisation, which has rendered useless many thousands of acres of formerly productive farmland and destroyed large tracts of adjacent habitat for wildlife, has become a major problem in the lower reaches of the Murray River system in New South Wales, Victoria and South Australia. In this area, it is a major factor contributing to the general decline of wildlife.

The construction of dams along many rivers, for the irrigation of farms, has lessened the impact of flooding in many areas. Many species of fish and bird depend on these floods to breed, and the lessening of flooding in some areas has led to their subsequent



extinction. Many billabongs are dependent for their existence on the flooding of adjacent rivers, and will dry out without it, with consequent elimination of animal inhabitants.

#### Grazing

The grazing of large animals such as cattle has had a serious impact on many native species. Overgrazing of stock has long been a problem in this country.

Farmers keen to maximise income have tended to run as much stock on a property as they think it can carry. The carrying capacity is dictated by the growth of grass and other feed.

During droughts, however, this growth declines and most land tends to be overgrazed. Stock consume almost all the ground cover, and farmers in crisis will often chop down trees and feed the green

An aerial view of an overgrazed cattle pasture in Western Australia. Removal of all ground cover usually means the removal of all wildlife.

Jiri Lochman/Lochman Transparencies

material to starving stock. Without vegetation as a refuge, many native species are unable to survive.

Those animals that take refuge in rocky areas have tended to be less badly affected by farming practices. Hilly and rocky areas do not tend to be as useful for most agricultural pursuits and have tended to be left alone. In recent times their relatively untouched nature and their natural beauty have tended to make them the first choice for national parks and public reserves.

The recent increase in the farming of Angora goats has been a very worrying development. These ani-

mals prefer dry, hilly and rocky areas, and seem to eat most types of vegetation. Native species confined to this habitat are now under threat in many parts of Australia.

Overgrazing of some areas has resulted in deep gully erosion, so that previously traversable country has become impassable. Farmers have in some cases stopped using this land and it has become a new refuge for some wildlife, but as it bears little resemblance to the original habitat, not all the species previously present are able to recolonise these areas, even if they survive in adjacent areas.

Removal of vegetation deprives some native species of plant food. Others feed on the insects that feed on such vegetation, while most need the vegetation to provide shelter from birds of prey and other wide-ranging predators.

In Australia, the greatest removal of vegetation has occurred in the southern half of the country, west of the Great Dividing Range, excluding arid parts of South Australia and Western Australia. This is also where the greatest number of small mammal species have become rare or extinct, presumably because of the lack of ground cover.

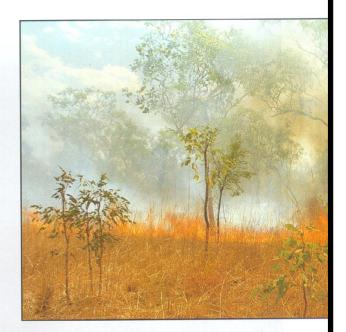
The rapidity with which native species disappeared from large areas of inland New South Wales in the wake of farming activity was noted by many biologists last century. Krefft noted in the middle of last century the decline in numbers of several mammal species, including stick-nest rats, bilbies and Lesueur's Rat-kangaroo.

#### Fire

Fire is a natural event in all vegetated parts of the planet. Without human interference, however, it is not a terribly common occurrence in most areas.

Each year in Australia there are several thousand fires, the majority of which are deliberately lit by human beings. Every summer, severe bushfires blacken extensive areas of bushland and destroy adjacent human habitation, particularly in the south-east and south-west of the country.

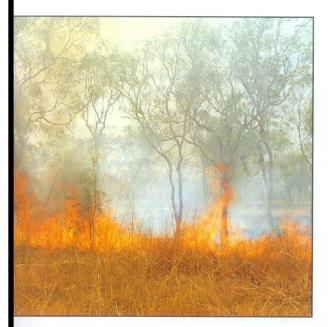
Although bushland regenerates after fire, some plant species are able to recover more quickly than



others. Indeed, some plants can only reproduce after being burnt by bushfires, so that their survival is dependent on fire. This leads to a distinct succession of plants within a given wildlife community. Some animals can only survive at certain stages within this succession, and will die out if their habitat is not burnt with the right frequency.

An example is the now endangered Heath Rat *Pseudomys shortridgei*, which only survives in recently burnt heath areas. As the heath matures it is forced to move into adjoining areas of newly burnt heath. If such are unavailable, this species dies out. Because its potential habitat has been reduced to a series of 'islands', and because these areas have a high probability of having a uniform fire history, the future of this species looks bleak unless a programme of fire management is undertaken in areas where the Heath Rat remains.

The Aborigines were the first Australians to use fire as a land management tool. Any given area may have been burnt up to seven times more frequently by Aborigines than would have otherwise occurred, removing most of the undergrowth and making hunting for wildlife easier. This no doubt led to the elimination of some species and an alteration in the abundance of others. It also prevented the build-up



Bushfire in the Kimberleys, Western Australia.

Although a fire itself may not eliminate a species from an area, its effects—the destruction of food and shelter—may do so within a short time.

G. E. Schmida

of fuel on the ground, so the fires that did occur were of lower intensity than the less frequent fires that would have otherwise occurred. Frequent low-intensity fires had a different effect on plant species composition than the less frequent, high-intensity burns. This translated into different compositions of animal species.

Contrary to popular belief, not as much wildlife perishes in bushfires as was once believed. A reasonable number flee the flames or take shelter in places where they can avoid the full impact of the flames, such as in rock outcrops or inside large, damp, hollow logs. However, many of these animals may perish shortly afterwards from lack of food or fall victim to predation due to the resultant lack of ground cover. In the period immediately following fire, numbers of predatory birds in an area usually increase to take advantage of the new conditions.

Prior to European settlement animals would be able to colonise burnt areas at a later stage from adja-

cent unburnt areas, but this is no longer always possible. Remaining habitats are often isolated patches separated by farms and roads. Once a species disappears from one of these relict patches of habitat, it no longer has any hope of recolonising it.

Human management of fire is essentially motivated by the desire to protect property. So-called control burning is usually an effort to keep fuel levels low enough to prevent a major fire that could cause substantial property damage. In many areas repeated control burning is allowing the rapid colonisation of habitats by non-native grasses, causing a marked decline in some native species. On Sydney's northern outskirts some bushland areas are burned every winter to prevent any major summer fires. The resulting permanent reduction in ground cover has eliminated many formerly common species and increased the abundance of a few others. In other parts of Australia controlled burnoffs every three to seven years are more common.

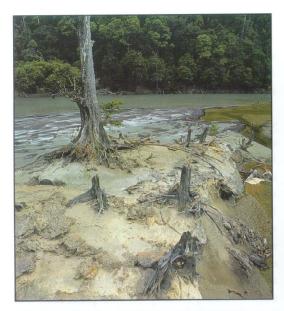
Because of the perceived risk of burning some areas, and the effectiveness of modern fire fighting and fire prevention methods, some bushland areas are never burned. Again, species composition will alter in the longer term, perhaps endangering some species.

Queensland sugar-cane farmers annually burn their fields, and these fires frequently also burn the adjacent hills. In many areas the burning has been so frequent as to reduce their former rainforest cover to woodland with a grassy understorey. The original wildlife populations have been decimated, and there has been a corresponding invasion by some new species.

Many graziers burn dry grasses in order to promote new growth of green vegetation with higher nutritional content for stock. This practice occurs in all parts of Australia, and many formerly common species that rely on dry grass tussocks for shelter and nesting have since become rare or endangered as a result.

#### Mining

Shaft mining tends not to have a very disruptive



Toxic wastes from the Mt Lyell copper mine in Queenstown, Tasmania, have had devastating effects on the surrounding temperate rainforest, polluting the King River and destroying vegetation.

Jean-Paul Ferrero/AUSCAPE International

effect on the environment, unless harmful wastes are deposited in nearby waterways. Open cut mining is a different proposition, however. Occasionally open cut mining occurs in an area that is critical to the survival of a given species. The area of the mine itself is the home of the animal and mining directly destroys this area.

Although the effects of open cut mining are relatively minor compared with those of other land uses, damage to wildlife habitat still occurs. Dust raised by open cut mining can damage a wide area of adjacent habitat, rendering it unsuitable for many species. The silting up of nearby waterways can sometimes also pose problems.

Toxic by-products that seep into watercourses can kill substantial amounts of wildlife. Fears have been expressed that wastes from the Jabiru uranium mine could seep into the Alligator River system, with a huge loss of native species, many of which are rare or little known.

Mining also brings people into otherwise unin-

habited regions, with associated harmful consequences. Mining towns in remote areas are a known source of feral cats, house mice and rats, all of which destroy indigenous wildlife. Rubbish disposal in remote mining townships typically involves dumping in open rubbish tips a short distance from the township. Toxic wastes and other harmful materials are able to freely leak into the environment, with harmful consequences to wildlife.

Australian beach sands contain substantial quantities of heavy minerals, including rutile, zircon, ilmenite and monazite, of which Australia is by far the world's largest producer. Fragile dune vegetation is removed in the mining process, and it is only with great difficulty that this vegetation can be restored to anything like its pre-mining form. Long-term studies have failed to ascertain the effects of sand mining on dune-dwelling species.

Drilling for oil on the Barrier Reef has long been a contentious issue. The risk of oil slicks and related problems that can cause widespread loss of marine life is regarded by many as unacceptable in this area of extreme biological importance. A single sizeable oil slick in the area could easily damage important nesting beaches for endangered marine turtles, not to mention causing direct loss of life.

At the time of writing, most offshore oil drilling in Australian waters was in Bass Strait and the Timor Sea. A major slick in the Timor Sea could easily kill large numbers of marine turtles, dugongs and other fauna.

The mining of the limestone caves at Mount Etna in central eastern Queensland is currently destroying the habitat of one of the largest Little Bent-winged Bat *Miniopterus australis* colonies known, consisting of hundreds of thousands of bats. The caves, which are being substantially damaged by the mining and face total destruction, are also the home of the largest known colony of the rare Ghost Bat *Macroderma gigas*, consisting of hundreds if not thousands of individuals. Mount Etna also houses bats of other species, as well as unusually large numbers of Spotted Pythons *Bothrochilus maculosus*, which feed on the bats

#### Pollution

The role of environmental contamination or pollution in the decline and ultimate extinction of species is relatively little known, but it is still of importance with regard to a number of species. Occasionally 'environmental disasters', such as a leak of toxic material into a waterway, can have instant and dramatic effects such as the elimination of all aquatic life. The more subtle and long-term effects of pollution are harder to detect and measure, and often manifest themselves in very unlikely ways.

Many of Australia's inland waterways have suffered from eutrophication. This arises when nutrients accumulate in excessive amounts. Agricultural fertilisers are a principal source of such nutrients, which cause an excessive growth of algae, bacteria and other small organisms. This reduces the oxygen level of the water, and fish and larger animals can die from this lack of oxygen, with local fishing industries tending to suffer. Waterbirds that feed on these fish are forced to look elsewhere for food or die of starvation.

Pollution of waterways by untreated sewage is a particularly bad problem in some parts of Australia, notably along the New South Wales coastline near Sydney, where untreated sewage is regularly pumped straight into the ocean, close to the popular surf beaches. This is a potential breeding ground for many diseases, some of which are hazardous to humans, including hepatitis and typhoid fever. The sewage material may also be hazardous to some wild-life.

Toxic metal residues in water and residues from toxic man-made substances, including chlorinated hydrocarbons like DDT and chlordane, chlorinated napthalenes like dieldrin, aldrin and endrin, and organic phosphates like parathion and malathion, all cause serious problems for wildlife and in some cases for humans who feed on affected wildlife.

More than 400 different man-made pesticides are known to be toxic to vertebrates, with slightly more than a third of those being insecticides and the balance being roughly equal numbers of herbicides and fungicides. Less than 1 per cent of pesticides have

been investigated for their toxic effects on vertebrates.

Common man-made toxic residues, such as DDT, persist in water, soil and air for many years, and tend to accumulate in animal tissues rather than being excreted. Consequently, the higher a species is in its food chain, the greater the concentrations of toxic substances in its body. It has been shown that even when DDT is sprayed at very minimal, 'safe' levels to control mosquitos and other insects in swamps and elsewhere, DDT levels in animals increase to such an extent along a food chain that the bodies of large birds may contain up to 80 000 times the concentration originally sprayed.

For birds the effects of toxic materials are a much greater susceptibility to disease and a thinning of eggshells in newly laid eggs. When egg shells are too thin, the bird incubating the eggs may crush them with its own weight. Whole colonies of sea birds have been known to die out in some parts of the world because of thinning eggshells, and the problem seems to be becoming more widespread and severe.

In the remotest parts of Australia and elsewhere animals have been found with accumulations of toxic substances in their cells, the effects of which are rarely known. A recent study in Western Australia showed that people had thirteen times the permissible level of dieldrin in their fat cells, as set by the United States Food and Drug Administration.

In Victoria, severe decreases in numbers of birds, including Flame Robins *Petroica phoenica*, Welcome Swallows *Hirundo neoxena*, Pallid Cuckoos *Cuculus pallidus*, White-plumed Honeyeaters *Lichenostomus penicillatus* and Yellow-faced Honeyeaters *Lichenostomus chrysops*, have been attributed to high concentrations of dieldrin and other pesticides found in dead birds. Birds from parts of all other Australian states have been similarly affected.

The lack of research into the effects of insecticides on many vertebrates can hamper conservation efforts. In trying to conserve a given habitat by a given means, the medicine may have a more adverse effect than the problem being treated.

In the period up to 1967–68, phasmatids were found to be responsible for large-scale defoliation of trees in the Mount Beenak area near Powelltown in central Victoria, so it was decided to spray some 70 000 hectares of forest with malathion in January 1969. According to herpetologist Peter Rawlinson, the area had a large number of forest-dwelling reptiles, including small insectivorous skinks, including the Southern-water Skink *Eulamprus tympanum* (Cool Temperate Form), *Leiolopisma metallica* and *Leiolopisma entrecasteauxii* (form unknown), prior to spraying.

Two months after the spraying the area an intensive search revealed that reptiles had become almost nonexistent, one Blotched Bluetongue *Tiliqua nig-rolutea* being the only specimen found. The effects of the malathion spraying on other vertebrate wildlife was not ascertained, but was presumed to be similarly devastating.

It is common for insect pests to become resistant to poison sprays, and in many cases farmers have resorted to increasing concentrations of the pesticides used, thereby worsening potential hazards to wildlife. Modern techniques of insect pest control include changing the pesticide used once insects become resistant to one type, and a greater reliance on biological control methods, including providing favourable conditions for an increase in numbers of insect-eating birds. In a few parts of Australia studies in the 1980s showed a decline in pesticide residues in the tissues of live birds, compared to residues found in similar studies in the 1960s. This decline is probably due to more advanced farming methods in some areas that rely on less destructive means of pest control.

The powerful organic poison sodium fluoro-acetate, usually called 1080, has been widely used in Australia to control pest rabbits and dingoes. The poisoning of dingoes with 1080 has become a major conservation issue in recent years, particularly the baiting methods used. 1080 baits are dropped in remote rugged areas by plane and are intended to kill dingoes, but any native carnivore may feed on these baits, and areas being baited include important

refuges for rare and endangered native carnivores, such as native cats. Elimination of those populations by 1080 poisoning could mean elimination of the species. And not only is the animal that eats the bait affected, but so too are those that feed on its carcass, increasing its potential damage to wildlife.

The farmers' rationale for the baiting of these remote areas is that dingoes from these areas raid adjoining farms. Specific shooting of pest dingoes has been put forward as a means of killing the pests without affecting other wildlife.

Oil slicks have become commonplace worldwide with the increased shipping of crude and refined oil around the world. Where they occur, these slicks may smother and kill most marine mammals, sea birds and other wildlife. Entire populations may be permanently eradicated.

In 1978, an oil slick on a Sydney street ran into the local stormwater system and into a nearby creek. The creek's entire population of fish was eradicated and the mortality among frogs, Water Dragon Lizards *Physignathus lesueurii* and birds was also critically high. The slick ran into the harbour and no effort was made to clean up the mess.

Human activity causes a wide variety of airborne pollutants, which, when noticeable, are called smog. Smog components include products of burning, such as carbon dioxide, carbon monoxide, ozone, sulphur dioxide, nitrogen oxides, lead and ash, all of which are harmful to plants and animals, including humans. The action of sunlight on some emissions causes photochemical smog, which is often more harmful to animals and plants than the original emissions.

Areas downwind of where the smog originates may suffer from the effects of the pollution, with important ramifications for native animals. Some plants are particularly sensitive to atmospheric pollutants and die out when subjected to excessive amounts. Dependent animals subsequently disappear

Acid rain, caused by a build-up of acid residues in rainwater, has harmful consequences to many trees and is a major problem across wide areas of North



America and Europe, where huge expanses of forests and lakes have lost their dominant trees and other vegetation. Wildlife has been drastically affected by the decline in food and shelter. The acid rain problem is an example of how areas not directly affected by human activity can be decimated by human activity elsewhere.

The discharge of 'greenhouse gases' from human industrial activities and the burning of forests may in the long term have an important impact on the climate of the world. This climatic change could affect many species of wild animal, and will hasten the extinction of many. Rising sea levels resulting from the melting polar icecaps and the thermal expansion of the seas will drown many low-lying islands. Terrestrial wildlife restricted to these islands will also disappear. Australian examples include the Pedra Branca Skink *Pseudemoia palfreymani* and the Lancelin Island Skink *Ctenotus lancelini*. Potential nesting beaches for already endangered marine

The long-term threat of pesticide residues for vertebrate wildlife is very serious, but is little known, with almost no research on the subject having been carried out in Australia to date. Most evidence of the effects of toxic residues has been anecdotal and not a result of detailed specific research projects.

S. Strickland/Australian Picture Library

turtles will also be reduced in number.

Species restricted to cool alpine areas may find their potential range shrinking to the point where no suitable areas remain for them to live. The Mountain Pygmy–possum *Burramys parvus* in the last ice age occupied a wide area of south-eastern Australia. Global warming in the last 20 000 years has led to a sharp contraction in its range; it is now confined to alpine areas of New South Wales and Victoria. If these remaining areas become significantly warmer, the Mountain Pygmy–possum will become completely extinct.

#### **INTRODUCED SPECIES**

Since European settlement a huge number of non-Australian species of plant and animal have been introduced into this country. Many have become established in the wild, and all of these have competed with or affected native species. Almost without exception, the effect of introduced animal species on native animals has been destructive, as have the effects of introduced plants. Thus, any species that has established itself in the wild since European settlement as a result of introduction by man may be regarded as a 'pest species'.

Early settlers brought with them livestock and other animals as a source of food. It was only a matter of time before some escaped from captivity and feral herds roamed the countryside. Most of the cattle brought to Australia by the First Fleet in 1788 escaped and rapidly established a large herd in the Camden area south-west of Sydney. Although this herd was eventually brought under control, its for-



Aborigines probably brought the dingo to Australia about 12 000 years ago. It can now be regarded as an established component of the Australian fauna.

mation formed a pattern repeated throughout Australia over the next two hundred years.

Plants brought for agricultural purposes also escaped. Grasses used for gardens, and other garden plants, became established in native habitats and in some cases overran the native plants, with disastrous consequences for wildlife. Lantana and privet, which were used for hedges in England, soon became rampant along watercourses in the Sydney area and today have overrun huge tracts of bush along the east coast.

Black and brown rats were unintentionally brought to Australia on ships, and also caused devastation of local native species.

In remote parts of the country, many grazing animals established wild herds after unsuccessful pioneer farmers turned the animals loose. It is by this means that donkeys and camels became established in outback areas.

Many early settlers wanted to deliberately introduce species familiar to them in England and elsewhere for nostalgic reasons or for the purposes of hunting game. Introduced species provided 'delightful reminders of our English home', according to Frederick McCoy of the Victorian Acclimatisation Society in the middle of last century. Acclimatisation of non-indigenous species, begun when the First Fleet arrived with some rabbits, reached its zenith with the formation of the Victorian Acclimatisation Society in 1861 and similar less significant organisations in other states and colonies.

The objectives of the Victorian group were 'the introduction, acclimatization and domestication of all innocuous animals, birds, fishes, reptiles, insects and vegetables whether useful or ornamental...the spread of indigenous animals, etc., from parts of the colonies where they are already known to other localities where they are not known'. For about ten years systematic attempts were made to introduce a huge number of plants and animals to Australia from elsewhere and even from one part of Australia to another.

Kookaburras were successfully transplanted to south-western Australia, presumably with an adverse



Lantana Lantana camara is one of a host of plants that has overrun the wetter areas of the east coast of Australia, directly competing with native flora and affecting the wildlife that depends on that flora. It was introduced from England as an ornamental garden plant.

Kathie Atkinson

impact on the local avifauna. As recently as 1934 the Superb Lyrebird *Menura superba* was successfully introduced from the mainland to Tasmania.

Many early settlers failed to see how introduced species could compete with native wildlife. It was commonly believed that introduced species merely inhabited the spaces that resulted from human development of the land. As late as 1906, the President of the Royal Australian Ornithologists' Union, in his presidential address, noted that 'Our native birds have only seen houses for a comparatively few years, hence they retire to the bush as buildings increase. But not so most of the imported ones; these find a retreat among suburban gardens...' Even now there are some who still wish to see the introduction of certain foreign game birds, claiming that they will only occupy open fields that lack native species. Considering that the open fields still contain native species, and the ease with which birds can move about, such a proposition is clearly ludicrous.

It is only in a few cases that introduced species do not appear to compete with native varieties: the European House Sparrow *Passer domesticus*, and the Goldfinch *Carduelis carduelis*, are two such species.

When acclimatised species have similar ecological requirements to native species, and the native species

is unable to compete successfully, it may be faced with elimination from many areas in the long term, and perhaps with extinction. The Norfolk Island Grey-headed Thrush *Turdus poliocephalus* is apparently threatened with local extinction as a result of competition from the more successful European Song Thrush *Turdus philomelos*. Feral cats appear to replace native dasyurids in many areas.

The effects of pest species often go far beyond direct competition with native species. Grazing cattle and other hoofed animals do untold damage to the environment. The resulting drastic alteration to the vegetation regime in large areas has an immense impact on the local fauna.

A pest species may prey on native animals, resulting in extinction of species. Foxes have been implicated in the elimination of many ground-dwelling mammals. Cane Toads are likewise responsible for the elimination of many frogs and small reptiles.

Often the effects of introduced species on natives are very hard to gauge. For example, a pest species may multiply and provide food for a particular type of native species, allowing that species' numbers to increase. This huge population may overflow into adjoining areas unaffected by the pest, and the native species may be able to overrun the 'unaffected' habitat, eating it out and perhaps eliminating similar native species less successful at adapting to change.

Escaped pets are another form of introduced exotic species. Cats were probably the first species to escape and become established in native habitat in Australia. Numerous exotic tropical fish and some birds could be introduced into the Australian bush as a result of escapes and misguided liberations by keepers. Several species of non-indigenous tropical fish have recently been recorded in waterways around Brisbane, Queensland.

These introduced species may spread exotic diseases through populations of native animals, and destroy them by this means. It is believed that disease was a major factor hastening the elimination of Thylacines and other predatory marsupials from large areas of Tasmania.

In a few cases it has been deemed necessary to



Adult Cane Toads Bufo marinus, some of which exceed a kilogram in weight, feed on almost any animal that is small enough to fit in their mouths, including native frogs, reptiles and small mammals. Because of their great numbers, the toads threaten those smaller species of vertebrate, and the young of larger varieties.

introduce a species to control another introduced species that has gone wild and is causing damage. The motive for introducing the Cane Toad into Queensland was the desire to eliminate the destructive introduced Sugar Cane Beetle and other pests. The introduction of Cane Toads was a notable failure due to the lack of proper preliminary research into the biology of both the toad and the pests it was meant to feed on. The toads multiplied dramatically and now present a threat to many native species.

Introduced plants have caused as much damage to Australian wildlife as have introduced animals. The destruction of native wildlife by introduced plants has often been accomplished in combination with introduced animals.

A classic case of an introduced plant wreaking havoc on local indigenous wildlife was that of the South African prickly pear cactus *Opuntia* spp., which plagued the open forest country of inland Queensland.

Prickly pears, which were originally imported for gardens in urban areas, spread to bushland areas and completely overran habitat across a wide belt of inland Queensland. These areas became so heavily infested that few other ground plants remained.

Native species were eliminated and large areas were

made unsuitable for both wildlife and farming activity. By the mid-1920s the prickly pear problem had become so severe that the government of the day had to look for some form of biological control. A natural predator from South America, the moth *Cactoblastis cactorum*, was introduced to prickly-pear-infested areas. The larvae of this moth feed primarily on prickly pear.

Within eighteen months of their introduction most plague populations of prickly pear had been decimated; however, the problems for wildlife had not ended. Although many native animals had already been eliminated because of the change in vegetation and food supplies, some species had been able to utilise the impenetrable prickly-pear-infested areas as shelter from predators, stock and humans. The rapid elimination of the prickly pear and the creation of large bare expanses of land spelt the end for even more native species. Death Adders Acanthophis spp., which had managed to survive in prickly pear areas, disappeared from most areas formerly plagued with the plant; roaming domestic and feral livestock, birds of prey and other introduced predators eliminated Death Adders and several species of small indigenous mammals from these areas. Those species have since been unable to recolonise these areas

Numerous plant species have overrun nearly every part of the continent and offshore islands. Just forty years after settlement in Melbourne, a group of biologists noted the difficulty of finding a single specimen of native grass in pastures on the basalt plains to the north of the city. That pattern has now been repeated to varying degrees across a wide area of Australia.

Plants that have invaded Australian habitat since European settlement include: water hyacinth, Paterson's curse, clover, Monterey Pine, ryegrass, barleygrass, oatgrass, lantana, privet, mimosa bush, African boneseed, St John's wort, ragwort, veldt grass, Cape tulip, dandelion, wild hops, golden gorse, Scotch thistle, Noogoora burr, kikuyu and blackberry.

Introduced plants displace native plants, so their



'Piercing Prickly Pear Plant with a steel bar and spraying with a diluted solution of arsenic', one of a number of methods recommended for the eradication of the pest in the Town and Country Journal of 22 January 1908.



The Mosquito Fish Gambusia affinis was introduced to waterways throughout many settled parts of Australia to control the breeding of mosquitoes. However, this fish generally prefers tadpoles, and the eggs and young of native fish, to mosquito larvae, and thus poses an immense threat to the native wildlife of our watercourses.

G. E. Schmida

effect is easily monitored. The effects on native animals that may use native plants as food sources, shelter or nesting material is harder to measure. In rare cases some native species actually seem to benefit from human-induced changes to the environment, including the introduction of new plant species. Those species do not run any risk of becoming endangered, but by becoming overpoweringly

numerous may threaten competing native species and hasten their extinction. Certain small skinks of the genus *Lampropholis* seem quite adaptable to human-induced changes in vegetation regimes, and it is believed that their numbers have increased sharply as a result. Competing skinks of different species not as adaptable to vegetational changes are not only suffering from the reduction in habitat, but also from competition from large numbers of skinks from adjoining areas.

With the increased trend toward keeping wild animals in captivity, the greater mobility of people and the greater movement of materials between Australia and other countries, the risk of introducing some animal and plant types is actually increasing. This is despite increased quarantine restrictions both between Australia and elsewhere and within parts of Australia. Recent liberations of formerly captive highland Cunningham's Skinks Egernia cunninghami cunninghami in Sydney's suburbs are having an adverse effect on the radically different, and smaller indigenous Sandstone Cunningham's Skinks Egernia cunninghami krefftii. In a part of Belrose, the highland form has already replaced the smaller form and the problem will no doubt spread.

The Spotted Marsh Frog Limnodynastes tasmaniensis of south-eastern Australia, has recently established a large viable population in the vicinity of Kununurra in the East Kimberleys, Western Australia. This population now threatens several native species and is spreading. The introduction of the Spotted Marsh Frog was accidental, and is believed to have resulted from the frogs stowing away in transported building materials. The frogs moved to Kununurra, survived and were able to found a new colony. Certain species of tree frog (Genus Litoria) that stow away in fruit boxes, including in clusters of bananas, have been transplanted to several parts of Australia where they were formerly absent.

Insects and other invertebrates are so little known that it is often difficult to gauge whether a given species is introduced or native. Certainly many of these introduced forms pose a hazard to local wildlife. The threat may be through further alteration of

habitat by their consumption of plant material; they may be poisonous to native species if eaten, and may act as vectors for disease. Parasitic forms are often imported with animals and may later spread to wildlife

Species of fish and barnacles are inadvertently transported in the hulls of ocean-going ships in water taken on as ballast and even on the hulls themselves. The effects of these introductions are little known or studied. The human-initiated invasion of Australia by foreign species is occurring by multiple means, and the long-term significance of this invasion cannot be underestimated.

It is thought that more than a hundred species of vertebrate have become established in Australia from elsewhere to date. More than 1500 plant species are regarded as having become naturalised in Australia. Naturalised or established species are defined as those able to continue surviving and reproducing without any further direct human intervention or assistance. The number of introduced species is still increasing and their effects on native plants and animals will no doubt worsen.

#### Disease

The long-term effects of diseases on wildlife, particularly those species threatened with extinction, are little known. Even less is known of the effects of disease outbreaks resulting from human or human-related activity.

In the early part of this century, both koalas and Brush-tailed Possums suffered severe declines in number, not only because they were hunted but also as a result of an epidemic of some little-known disease. Possum numbers recovered over a relatively short period, but koala numbers have remained low, with remaining populations confined to widely scattered localities.

In the 1980s, a large number of koalas on mainland Australia were found to carry the sexually transmitted disease Chlamydia, which, among other things, causes ovarian cysts and makes many females unable to successfully reproduce. The result of this disease has been a further decline in koala numbers

in many areas. Whether the koalas have always had this disease or whether it was introduced into populations by European settlers is not known, although it is known that populations in more heavily settled parts of the south-east are more likely to be affected by the disease.

Interestingly, some koalas that have had long-term infections of Chlamydia can still reproduce, so the long-term threat of this disease is not yet known. Some researchers have postulated that it is the combination of Chlamydia and other human-related stress factors that results in koalas becoming non-reproductive.

Earlier this century Thylacines and other marsupial predators suffered a severe population crash in Tasmania as a result of a distemper-like virus. Thylacine populations did not recover, and the species is now probably extinct, but populations of native cats and Tasmanian Devils have completely recovered. The possibility of this virus having been introduced by humans or their introduced animals is thought to be likely.

The effects of introduced diseases on reptiles, frogs and fish is not known, although the global population crash of frogs during the 1980s, currently unexplained, may be a result of some new and unknown disease or diseases.

Imported animals remain a source of infection for wild populations in Australia, despite the fact that major zoos and animal parks are supposedly quarantine zones from which diseased stock cannot be released.

The risk of infection of wild populations by captive animals that carry exotic diseases is regarded as so great that many wildlife parks prefer to kill excess stock rather than release it into the wild and risk causing epidemics among wild populations.

In some rivers, large numbers of fish have been noted as dying from fungal infections, although many scientists regard these epidemics partially as a secondary effect of excessive pollution in these rivers. However, the epidemics may spread from polluted to non-polluted areas with similar effects on fish numbers.

#### HUNTING

Direct hunting and killing of wild animals by human beings has been a major cause of decline for many species. Some killing is done for sport, such as fishing and duck-shooting. Other killing is done to reduce the numbers of a species that is perceived to be a pest, including species that prey on livestock, or feed on crops. Many wild animals are killed to provide food or other products for consumption by human beings or their pets.

#### Game hunting

Hunting 'game wildlife', usually fox, rabbit or kangaroo, is a major leisure pursuit for some people. Although game shooters usually confine themselves to abundant and non-endangered designated game species, the shooter's lack of identification skills, and the difficulty of identifying wildlife moving rapidly at some distance, can result in rare and endangered species being accidentally killed.

Substantial media attention is focused each year on confrontations during the duck-shooting season in the southern states between animal rights activists and duck-shooters. The former allege that Freckled Ducks *Stictonetta naevosa*, which are subject to strict protection, are routinely shot by shooters unable to distinguish this species from other unprotected types of duck. They cite shooting as a major cause of the rarity of the Freckled Duck.

In some areas where shooters regularly congregate to shoot birds, the native birds have been driven away. Some of these may not find suitable habitat and consequently die of starvation. Other birds, although they may survive, are unable to nest, so that their populations still decline.

Sport shooting of kangaroos is commonly conducted at night from moving cars with spotlights directed into the adjacent bush. On some occasions threatened species, such as the Yellow-footed Rock Wallaby *Petrogale xanthopus*, are accidentally shot.

The effects of sport shooting are not completely harmful to native wildlife, however. Within Australia the bias is definitely towards the shooting of

common, introduced species, which to some extent alleviates the stress on populations of native species caused by the introduced animals.

The desire of some hunters to preserve habitat for the game they seek has had benefits for native species. Duck-shooters have been an important lobby group helping to preserve inland wetlands where their ducks breed. The habitat is under threat from continuing agricultural demands and is a vital refuge for many bird and animal species.

The formerly common Murray Cod Maccullochella



At Moama in New South Wales in 1938, Walter Newton (wearing hat) and friends exhibit a large catch of Murray Cod. The large fish on Newton's right weighed 65 lbs (29.5 kg).

Mitchell Library

The results of one night's rabbit trapping around Yass in 1912—almost 2000 rabbits. By the beginning of the twentieth century, rabbit hunting had become more than a sport for gentlefolk. Sydney Mail, 28 August.



This Wedge-tailed Eagle was a victim of a sodium fluoroacetate (1080) bait intended to eradicate dingoes. Any native carnivore may feed on such baits, and areas being baited include important refuges for rare and endangered species.

Graham Robertson/AUSCAPE International

peeli has suffered not only from competition by species introduced to provide game for sport fishermen but also from the predations of the fishermen themselves, and has become threatened as a result. The fact that the Murray Cod is itself a good sport fish could be the key to its survival: fish hatcheries are currently trying to increase numbers of Murray Cod for the purposes of sport fishing.

#### 'Pest' extermination

Many native species are regarded by farmers and others as pests that are best eliminated. Large numbers of macropods are shot annually on the grounds that they compete with livestock for grass. Although most species of macropod shot on these grounds are common, such has not always been the case. The formerly abundant, but now possibly extinct Toolache Wallaby *Macropus greyi* was killed in large numbers

last century because it competed with stock for feed.

Thylacines preyed on sheep in large numbers during the first 150 years of settlement in Tasmania. They were relentlessly hunted to extinction, with the very last specimen taken from the bush being shot. Statutory protection and the outlawing of Thylacine hunters came too late for this species.

Rare native cats are eliminated in many areas because of their habit of preying on poultry. Marine mammals that feed on fish are commonly killed by fishermen. At the time of writing (1990) Australian conservationists had been protesting to the Japanese government over the large-scale slaughter of dolphins that were feeding on an important fisheries resource.

Large numbers of birds are killed because of their grain feeding habits, and some rarer species are commonly shot by farmers unable to identify them. In the early 1960s large numbers of now endangered Scarlet-chested Parrots *Neophema splendida* were shot in South Australia by farmers keen to protect their feed. A few specimens were caught to supply the pet trade, and their descendants are still breeding in large numbers in aviaries throughout Australia.

Some species of birds can only survive when in large flocks, and programmes by farmers to reduce their numbers to more 'manageable' levels may, if not properly researched, lead to the decline and extinction of those birds.

Formerly endangered Cape Barren Geese *Cereopsis novaehollandiae* were initially made rare by relentless hunting by Bass Strait islanders, who were sick and tired of these birds feeding on their crops.

Snakes and other reptiles have also suffered declines in numbers because of their perceived threat to human beings and their property. Most Australians are unable to identify different types of snake, and many snakes are killed on sight on the dubious grounds that they may be venomous and a threat to either humans or their livestock. Snake round-ups in rural areas are commonplace and involve the large-scale extermination of snakes, sometimes including rare forms.

Because of the vital role of snakes in pest control



(they feed on house mice and rats) their removal allows numbers of these pests to increase, with corresponding damage to other wildlife, including native mammals.

Goannas or monitor lizards are common raiders of chicken sheds, where they feed on fowl and eggs.

The death of the lizard if detected by the farmer is almost inevitable.

Freshwater tortoises (terrapins) caught in rivers by fishermen are often killed in the mistaken belief that they feed on large numbers of young fish. Although only one species of freshwater tortoise is currently listed as endangered in Australia, the lack of knowledge about this group could well mean that other species, not yet scientifically described, are also endangered.

In built-up areas breeding sites for frogs have sometimes been poisoned in a bid to eradicate the frogs. The sole justification for this has been that the croaking frogs have kept people awake at night.

#### Commercial exploitation

Most commercially exploited wild animals are taken straight from the wild. The wild population is expected to recover under 'natural' conditions in the areas from which animals are taken. The uses of wild

Freshwater tortoises trapped in a fishing-net. These animals are often killed by fishermen in the mistaken belief that they feed on young fish.

John Cann

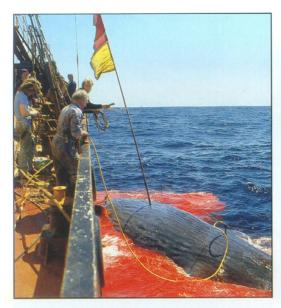
animals in Australia are varied but include the provision of food, pet food, industrial materials including oils, medical substances, leather and fur, and pets.

Over-exploitation of wildlife resources has repeatedly led to the decline of many species and continues to be a principal cause of decline for many species. Australia's record of causing severe wildlife decline through unsustainable commercial exploitation is not good.

#### Whales

Australia was one of the last countries in the world to cease whaling and did so not because the great whales were nearly extinct, but because the last whaling station was unable to make a profit.

In most parts of the world whale numbers had been reduced by the eighteenth century, but the Australian whale resource was relatively untouched, and Australia's first commercial fishing industry was based on the exploitation of that resource.



By 1830 some 35 whaling stations were operating in Tasmania alone, and stations were also set up along the east and west coasts of the mainland to prey on the tens of thousands of whales that migrated through Australian waters every year. The number of whales taken clearly exceeded that which was sustainable by the whale populations, and they declined sharply. This photograph was taken in 1978 on a whaling boat operating out of Albany, Western Australia.

John Butler/Lochman Transparencies

As numbers of one species were reduced, attention turned to another until all the whale resource declined to such an extent that whaling became unprofitable by the 1970s. Eight of the great whales, namely the Blue, Fin, Sei, Sperm, Bowhead, Right, Humpback and Grey, had been listed as globally endangered by then, and since that time Japanese and Soviet fleets have accounted for more than 90 per cent of whales killed, most of which are taken in southern waters by large ocean-going whaling fleets.

Most whaling now is of smaller, more common varieties, including the Minke Whale, under the guise of 'scientific whaling'. 'Scientific whaling' is the killing of whales allegedly for scientific research; the dead whales are then utilised commercially. At the time of writing the International Whaling Com-

mission (IWC) had imposed a moratorium on whaling, and 'scientific whaling' was seen by many as a loophole exploited by Russian and Japanese whalers to allow them to continue exploitation of the resource. All products originally obtained from whales can now be produced by alternative means, and it is often cheaper to do so.

Since the Second World War Japan has been the largest consumer of whale products; other nations' whale products, including the Soviet Union's, are usually exported directly to Japan. Most other nations, including Australia and the United States, have a total ban on the use or importing of whale products.

It has been estimated that, even if whaling were to cease completely, it would take hundreds of years for whale numbers to be restored to the level they had reached before the commencement of whaling. Some species of whale have increased in number since global statutory protection, but others, including the Blue Whale, do not appear to be recovering in number, possibly because too few whales remain.

Oddly enough, by far the greatest commercial exploitation of whales is carried out by the tourist industry, in the United States, Australia and elsewhere. In protected coastal whale breeding areas and along migration routes large numbers of people flock to catch glimpses of these large mammals. Boat operators often have profitable businesses, taking visitors into waters occupied by breeding and migrating whales. The profit made by 'whale tour' operators and associated industries such as hotels and shops far exceeds that made by those killing and eliminating the resource through commercial or 'scientific' whaling.

#### Other mammals

In 1990, the annual 'kangaroo quota' was set by Australian government authorities at four million animals. This is the number of kangaroos allowed to be killed by professional kangaroo shooters. The total number actually killed for commercial and other purposes throughout Australia is harder to estimate, but all available evidence shows the annual



cull of kangaroos, legal and otherwise, to be a sustainable figure. In fact, the removal of kangaroos from agricultural areas for commercial purposes at a controlled level has been shown to assist the population, reducing wild and cyclical swings in population in response to droughts and rains, and allowing for further growth of vegetation in some areas, with a corresponding improvement in habitat for rarer native species. The kangaroos harvested throughout grazing areas provide pet food, a limited amount of meat for human consumption, and skins, which are used for a variety of purposes.

Unfortunately, not all Australia's native mammals have been exploited in a sustainable manner in the past. Koalas, possums and other smaller native mammals were heavily poached in the past to provide skins, and many local extinctions of native mammals occurred. In the early 1920s about two million koala skins a year were exported, which gives some indication of the former numbers of this species. Rarer mammals were also incidentally killed and skinned and the effects of this activity on present populations are not known.

#### Reptiles

The hunting of crocodiles in northern Australia until

Arnhem Land Aborigines with a Saltwater Crocodile Crocodylus porosus skin for sale to a skin trader. The hunting of these animals before they were awarded statutory protection brought them to the brink of extinction. Although the species continues to decline in most areas, it is secure in some remote parts of Australia and elsewhere.

Michael Jensen/AUSCAPE International

the 1960s, and in Queensland until the early 1970s, reduced the numbers of the two formerly common local species severely, and both are now listed as threatened. Crocodile skins were the sought-after commodity, with hunters being able to earn many times the average annual wage in a few months of shooting crocodiles in suitable areas. Many local extinctions of crocodiles occurred.

The major known nesting beach in the Australasian region for the endangered Leathery Turtle Dermochelys coraicea is at Trengannu, Malaysia. For about twenty years before 1980 most eggs laid by the thousands of nesting turtles were being taken and eaten by the local inhabitants, with dramatic effects on numbers of this species. The lack of young turtles resulted in a steady reduction in the numbers of nesting turtles, and it was thought that the turtles were headed for extinction. Protection became an

alternative to extinction. Policing of the beach is difficult, so poachers still take some newly laid eggs.

Combined with other hazards, such poaching may lead to the Leathery Turtle's extinction.

Green Turtles are exploited for food and the manufacture of 'turtle soup'. Hawksbill Turtles are the source of 'tortoiseshell', while the eggs of all species are used for food. Within Australia exploitation of marine turtles for any purpose by humans has not been terribly heavy, and Australia's populations of marine turtles, all of which are threatened, are more secure than most. A disturbing trend is the catching of adult turtles for food by Asian fishermen who fish along Australia's coastline. As more Asians fish in Australian waters the human threat to our marine turtles will undoubtedly increase.

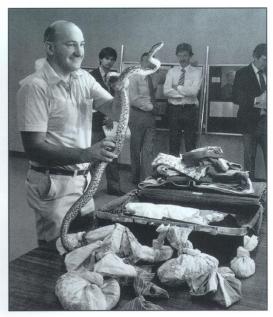
#### The Pet Trade

In the past the hunting of wild animals for pets has caused severe declines in the numbers of certain species, in particular some native birds. The pet trade is certainly one of the more lucrative means of exploitation of many native species.

In combination with habitat destruction and other problems, the removal of specimens from the wild to satisfy the pet trade has hastened the decline of some species. This practice was most widespread in the late 1800s and early 1900s when the keeping of wild animals increased in popularity but knowledge of most species was insufficient to allow captive breeding to take place.

Large numbers of Paradise Parrots were removed from the wild in the late 1800s but no one was able to breed them in captivity. The species is believed to have become extinct in the first half of the twentieth century. Poaching of specimens for the avicultural trade also reduced numbers of the closely related Golden-shouldered and Hooded Parrots, which now have very restricted distributions. Particularly disturbing in the obtaining of the Paradise, Goldenshouldered and Hooded Parrots, was the frequent destruction of important nesting sites used by the parrots.

In the 1960s large-scale collection of Broad-



A customs official unpacks a shipment of reptiles being smuggled through Tullamarine Airport.

Herald and Weekly Times, 1985

headed Snakes Hoplocephalus bungaroides by Sydney snake-keepers resulted in the local extinction of this now-endangered species on Mount Westmacott, south of Sydney. Most specimens taken into captivity died shortly after capture and none of those snakes or their offspring is believed to have lasted a decade in captivity. Many collectors, after lifting the flat sandstone rocks under which the snakes sheltered, dropped and smashed them, eliminating potential habitat for this snake and further reducing numbers in the long term.

Within the fields of animal husbandry, including aviculture and reptile keeping, huge advances have been made in recent years, and now large captive populations of any species, including the Goldenshouldered and Hooded Parrots, can be maintained and bred if desired. In many cases aviculturists and reptile breeders are producing more specimens than they can possibly use and are using the surplus stock to replenish formerly depleted wild stocks.

Due to advances in keeping methods, and conservation methods in general, the risk of over-



Apparatus for smuggling a consignment of birds by air note the holes drilled around the rims of the cases for ventilation, and the ice packs designed to prevent the birds overheating.

Herald and Weekly Times, 1989

exploiting of wild stocks of rare and endangered species to supply the pet trade is far less likely than it was in the past.

#### Wildlife Smuggling

Illegal trafficking in wildlife, or wildlife smuggling for the overseas pet trade, although in general not the principal cause of the decline of most species, has been a significant factor in the decline of a few notable species, including the endangered Goldenshouldered and Hooded Parrots.

The ways in which wildlife smuggling is further threatening endangered species are threefold: specimens are being removed from the wild; viable captive breeding stock is under direct threat of theft by smugglers and their agents; and the knowledge that the captive breeding of wildlife makes one a target for such people is discouraging scientists and potential keepers from engaging in wildlife keeping and breeding, which hampers the accumulation of knowledge about endangered species.

Wildlife laws usually restrict the taking of rare or endangered species from the wild, except in exceptional circumstances; however, these circumstances may include allowing licensed private keepers to take specimens from the wild for a variety of purposes. Most keepers of threatened wildlife have as

their main purpose the breeding of specimens in captivity, to preserve the species and often for financial gain also.

Endangered animals, although a significant proportion of smuggled animals, are not the major portion. Most species smuggled are rare only in terms of their availability to their purchasers, and this may not necessarily reflect their abundance in the wild. For example, some parrots that are shot in their thousands as pests in Australia are deemed rare in the United States, and may sell there for many thousands of dollars.

Australian wildlife is for a number of reasons among the most sought after in the world, with Australian reptiles and birds commonly being the most expensive animals overseas. For a number of reasons, including our relatively small domestic market, the quantity of wildlife leaving this country is several times greater than that being brought in. Australia is regarded internationally as a 'source' country for wild species rather than as a big importer. Illegal importation of wildlife into Australia is not currently as great a problem as wildlife exportation.

Official smuggling has been estimated to account for more than 90 per cent of fauna leaving Australia. Easily the most sophisticated and largescale smuggling operation, it relies on the corruption of government and law enforcement officials. It is widely known and documented that senior government officials have a pivotal role in organising these operations. In New South Wales alone the National Parks and Wildlife Service has extremely detailed information about some 20 000 licensed fauna keepers, including lists of the species they hold, and the officials with access to that information are prime targets for corruption by anyone wanting to export specific types of wildlife. Those who carry out official smuggling are not the ultimate keepers of the animals, and the operation has become so sophisticated that given species can be supplied to order.

Splinter smuggling encompasses all unofficial forms of smuggling, including well-organised smuggling syndicates. There are three basic types.

Private smuggling involves persons smuggling fauna for themselves or for a few friends only, not for the purpose of commercial sale or gain. Often private smuggling is a 'one-off operation.

Retail smuggling includes all unofficial operations by which wildlife is smuggled for commercial gain. Usually involving more than one person (for example, an exporter and a seller or dealer at the final destination), retail smuggling rackets are often run by syndicates. Larger retail smuggling operations may involve the corruption of government officials and thus be difficult to distinguish from official smuggling.

Counter smuggling involves wildlife being smuggled by experts and enthusiasts specifically for the purpose of breeding rare and endangered species in captivity, into countries where the same species is available through offical smuggling channels. Most official smugglers carry out X-ray sterilisation of wildlife at some stage of their operations, which renders the stock useless to animal breeders so that high prices can be maintained by smugglers, and counter smuggling has been established to by-pass this practice.

Most wildlife is smuggled out of Australia by air mail, in luggage or on a passenger on a commercial flight, or by private plane. Reptiles, which are relatively easy to smuggle, are usually placed in bags inside boxes, while birds are either tranquillised and placed in well-ventilated plastic tubes in suitcases or transported in cages. Smuggled fish are usually transported in water-filled plastic bags; frogs, too, need to be kept moist.

Birds and mammals are the most difficult to smuggle, being noisy if untranquillised, prone to overheating if confined (a problem sometimes combatted by placing ice packs in the consignments), and often in need of regular feeding. They are tranquillised with one of a variety of drugs; Valium appears to be the most widely used.

Most wildlife smuggled out of Australia is not taken directly from the wild, but is stolen from private keepers and zoos within Australia. The problem

of wildlife theft from keepers is so great that keepers employ elaborate security measures to thwart potential thieves. Many keepers of native wildlife refuse to register with state fauna authorities because of the known correlation between registration and theft of animals by smugglers.

Reptile enthusiasts have a global database (the 'herp' crimes register) to counter the problem. The major Australian birdkeepers' association has proposed publishing details of stolen birds in major metropolitan newspapers on a weekly basis to combat thieves.

A recently developed means of identifying wild-life is 'genetic fingerprinting', by which an animal's genetic structure is recorded on a database and can be called up if there is any doubt about the ownership of the animal. Avicultural clubs in particular have been pushing for the use of such a system by fauna authorities, as no fail-proof ringing system has yet been developed.

Laws enacted to protect wildlife, such as those forbidding captive breeding, are often counterproductive and can assist in making wildlife smuggling a commercially viable practice. Many species of wildlife have suffered greatly as a result of 'protective' legislation, including some endangered species.

Despite public protestations by numerous government officials about the problems involving wildlife smuggling, effectively nothing is being done to prevent the rackets from continuing. Statutory penalties for smuggling are rarely, if ever, applied to the principals of the major rackets.

Australia is signatory to a number of international treaties involving wildlife protection, perhaps most notably the Convention in Trade in Endangered Species (CITIES). Most countries of the world are signatories to this agreement, and it gives limited legal protection to a country's wildlife after it leaves that country. Originally put in place to reduce smuggling of wildlife, the treaty has apparently failed; neither the CITIES secretariat nor participating nations appears to have the power to enforce it.

## CONSERVATION

The dangers in drafting legislation to protect rare and endangered species are great. United States representatives of Zoovival, one of the largest wildlife captive breeding and conservation organisations in the world, noted in a recent newsletter that 'Leaving the survival of a species to the mercies of politicians has been tantamount to signing the species' death warrant'. Concerned members of the public, they say, should mobilise public opinion in favour of more rational law-making and enforcement procedures.

The drafting of wildlife protection laws should be done by people who have a knowledge of the species involved, and unnecessary regulation should be avoided whenever possible. For example, by concentrating permit laws on those species that are at risk through direct exploitation or collection, the number of wildlife permit holders in Australia could be reduced to less than a tenth of the current number.

A number of wildlife laws are contradictory to or at variance with other laws. For example, the wildlife laws of New South Wales are currently being used to prevent the free trade of legally held wildlife between holders in New South Wales and other states. This is in direct contradiction to section 92 of the Constitution, which guarantees free trade between states.

Habitat protection, pollution control, quarantine laws and introduced pest regulation are all areas that need to be looked at in legislative terms, and delays will only worsen existing problems. It is often the outdated laws that cause the most destruction; laws that are no longer needed, even if not enforced, should be revoked.



Young, orphaned kangaroos and wallabies in a specialised wildlife nursery. Some of the information gained in the husbandry of these more common species can be applied in the conservation of endangered species.

Kathie Atkinson/AUSCAPE International

As the population at large becomes better educated on conservation issues, concern for the environment, including endangered animals, increases. Membership of environmental activist groups such as Greenpeace, the Australian Conservation Foundation and the Wilderness Society is at record levels and continues to grow, indicating the increasing importance of environmental matters to the community. That concern for the environment has become a major political force in Australia was demonstrated in the 1990 federal election, in which both major political parties developed detailed environmental policies, the first time this had ever occurred.

A survey published in 1989 in the Melbourne *Age* showed that some 87 per cent of the population felt some concern for endangered species.

The participation of the general public, in the election of governments with environmentally friendly policies and in the vigilant monitoring of those entrusted to preserve endangered animals, is essential to the long-term survival of many species. Without widespread public support and action, many more species will become extinct.

Captive breeding plays an important role in the long-term preservation of many species. Unfortunately to date most wildlife laws have tended to discourage captive breeding by anyone at all.

Even if such laws were all revoked, it is doubtful whether many people would undertake significant captive breeding programmes without the prospect of some financial gain resulting from their efforts. Governments in Australia and elsewhere should therefore be encouraged to provide economic incentives for companies and individuals to assist in the conservation of endangered species. For example, if people were allowed to buy and sell legally obtained fauna within Australia, keepers might be encouraged to breed wildlife for profit.

#### RESEARCH

With the aid of modern facilities and equipment, research into wildlife and its conservation has improved in many ways, often acting to save many species formerly thought to be doomed.

Research on wildlife may involve several scientific disciplines. An ecologist may study an animal in relation to its environment; a geneticist may study its chromosomes in order to establish its evolutionary past; a biochemist may assess the effects of pollutants on an animal; a population ecologist may take on the task of counting all the individuals in a given population. It is only after integrating the information obtained by researchers from all relevant disciplines that the best conservation methods can be devised. Quite often seemingly irrelevant information may hold the key to saving a given species.



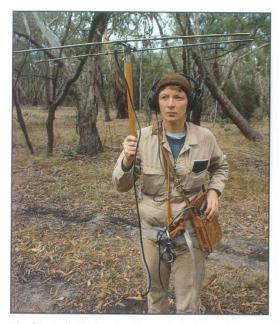
A scientist from Monash University in Melbourne fits a radio transmitter to a Victorian koala to track its movements as part of detailed research project on this species.

D. Parer and E. Parer-Cook/AUSCAPE International

Although a detailed explanation of techniques used by researchers and conservationists is beyond the scope of this book, a brief mention of a few methods is useful.

Radio-transmitters that keep track of animals in the wild have become an essential tool for many wildlife workers in the field. A recent study of Diamond Pythons *Morelia spilota* by Drs Shine and Slip, on the outskirts of Sydney, involved the implanting of radio-transmitters into the snakes. The snakes were thought to be relatively uncommon in the area before the study was carried out.

Monitored snakes made contact with other snakes that had been invisible to the researchers. Those snakes were in turn implanted with transmitters and they too made contact with other snakes. It was soon clear that the species was far more abundant in the area than was originally thought. Quite clearly the potential use of radio-transmitters in assessing populations of species thought to be rare or endangered is great.



Tracking a koala fitted with a radio transmitter.

D. Parer and E. Parer-Cook/AUSCAPE International

Helicopters and light planes have been widely used in aerial surveys of fauna populations. They have allowed accurate assessments of the numbers of kangaroos and stock over large areas as well as assisting in the culling of animals before they cause environmental degradation. Aerial surveys have been used to map river systems in remote areas in order to establish likely populations of certain threatened animals.

Satellites have been used to map Australia's surface and analyse vegetation and geology across the continent. This information, when combined with habitat knowledge of a given species, may be used in determining areas where it may still occur.

Infra-red photography techniques have allowed the filming of nocturnal animals active in the wild at night, a feat previously impossible.

Field workers have devised new ways to trap animals, which is a means of establishing their existence in many areas. 'Pit-fall traps' have been widely employed by collectors of nocturnal mammals in recent years, with great success. Some previously unknown species have been discovered using these



Bird handing is an important means of identifying individual birds and tracing the movements of species. Here, a Grey Fantail Rhipidura fuliginosa is having a band placed on its leg.

Esther Beaton/AUSCAPE International

traps, while other species formerly regarded as rare have since been found to be more common. 'Invisible nets' are used to catch large numbers of birds when their flight pathways have been established. It is by this method that many wild specimens are brought into captivity.

Sound recordings of frogs and birds are sometimes played in the wild to attract members of the same species. It has been by sound analysis of certain calls that some frogs and birds, previously regarded as being of a single species, have been distinguished from one another.

Chemical analysis techniques have been used to establish a link between toxic substances and health problems in some wild animals. The need for advanced techniques can be appreciated when it is realised that some substances may be toxic at concentrations of just a few parts per million.

### CAPTIVE BREEDING

Although not everybody subscribes to the idea that keeping wild animals in captivity is desirable, most people would agree that captivity is a better option than extinction. For many species there is now no other option. The number of Australian animals for which humanity will have to choose between captiv-

ity or extinction is certainly going to increase.

The advantages of keeping wild animals in captivity are many. Wildlife can be kept in climatically controlled cages that provide temperature conditions superior to those found in the wild state. Species that may fight in the wild and injure one another may be separated in captivity. The enormous advances in human medicine are to a large extent directly transposable to native animals, and techniques may be used to treat captive specimens that fall ill. It is for these and other reasons that captive animals tend to outlive their wild counterparts.

Initiating breeding in fauna was once a major difficulty. Today this is no longer the case. Artificial insemination and in vitro fertilisation (IVF) techniques can be used to initiate reproduction. Artificial insemination methods are most commonly used with mammals, as individual specimens are often reluctant to mate

The young may be raised in an environment free from any potential hazards, thereby ensuring a substantially higher survival rate than would otherwise be possible. Some species of animal are known to kill or even eat their young, and this can be prevented by separating captive animals.

By various means it is possible to dramatically increase the usual breeding rate of animals in captivity. For example, many birds are known to lay a second clutch of eggs if they lose the first, in a given breeding season. If the first clutch of eggs from a breeding female is removed shortly after laying, she will then produce a second clutch. By artificially incubating the first clutch, and allowing the bird to maternally incubate the second clutch, twice as many birds can be born in a single season. This practice can in some cases be extended to allow female birds to produce unprecedented numbers of fertile eggs.

Although the extra young can be raised by hand, the most common rearing method is fostering, whereby the first clutch of eggs is given to a second bird to incubate and raise. The second bird is also nesting, but is of a more common species. Its own eggs are discarded.



Phil Pain, founder of the Society for the Preservation of Raptors, with the first ever Black Kite Milvus migrans born in captivity.

Jiri Lochman/Lochman Transparencies

Breeding activity in reptiles is commonly initiated by merely cooling the specimens for between four and twelve weeks. Some breeders are able to have snakes reproduce every nine months in captivity. The same species may only breed every year or two in the wild.

Growth rates for captive animals may exceed those of wild animals, enabling sexual maturity to occur more rapidly and further increase captive production of animals. Breeders of Death Adders *Acanthophis antarcticus* are able to raise newborn females to sexual maturity within eighteen months; this usually takes three years in wild specimens. This is done purely by maintaining the snakes at a substantially warmer average temperature than occurs in the wild, and keeping the snakes well fed.

The fact that captive animals are under near-constant scrutiny by their keepers also results in substantial biological information being gathered about the species. Such information may be impossible to obtain in field studies. For example, in the wild most animals mate in places where they are unlikely to be observed, so much of the information gathered to date on the reproductive habits of native species has been derived through the observation of captive specimens.

None of the breeding activities of some species of snakes, including snakes mating, having young or incubating eggs, has ever been recorded with wild specimens. Even with a huge expenditure of resources, it would be unlikely for a given person to be able to see those animals breeding in the wild. This is also the case with mammals and birds.

#### THE FUTURE

The prospects for the future of Australia's endangered species and wildlife in general are most definitely mixed. Certainly, if all harmful human input into the Australian environment were to stop tomorrow, the effects of human activity would still be felt for some time.

But there is still reason to express some optimism. For perhaps the first time in history, Australians at large are being made aware of and are concerned at the plight of the environment. As well, Australia has access to modern technologies that could be applied to the task of mending some of the damage done and

averting further crises. Outside pressure on Australians to look after the continent's indigenous wildlife, which clearly should be treasured for all future generations, is being and will continue to be applied.

Australia's advantage, in terms of its relatively low level of overpopulation and its lesser degree of environmental degradation, should not be lost through inaction now.

The progress made — acquisition of more national parks, establishment of areas free from direct destructive economic activity, substantially wiser utilisation of other areas in terms of our native wildlife — augurs well for the future. This is particularly true of farming practices, forest industries and mining throughout Australia.

The reduced rate of introduction of noxious plants and animals also gives hope that many past mistakes will not be repeated.

To save species from extinction it is important that we all learn from the past, look to the future, and act in the present.





Above. A female Anthill Python incubating eggs in captivity. Reptiles are particularly easy to breed in captivity. Species that breed only every year or two in the wild can be made to reproduce every nine months in captivity.

Left. Captive snakes copulating. The difficulty of observing reptiles' breeding behaviour in the wild means that often the only sources of biological information about breeding are observant reptile keepers.



## CLASSIFICATION OF THREATENED SPECIES

The degree to which a species is threatened is of critical importance in deciding which species are truly endangered, and despite the widespread standardisation of procedures used to define the term 'endangered', the individual nature of the problems faced by different species means that consensus on what is endangered is no easier to achieve than consensus on the classification of different species. The decision-making process is highly subjective, and the relative consensus among lists of endangered species stems as much from a reluctance to alter lists already accepted as from the changing statuses of the species involved, in terms of either their abundance or their taxonomic status.

For example, an endangered subspecies of a common widespread species may become listed as an endangered species if it becomes reclassified as a species, or if there is some dispute as to the real status of the animal in question. The Helmeted Honeyeater *Lichenostomus cassidex*, often regarded as a subspecies of the widespread Yellow-tufted Honeyeater *Lichenostomus melanops*, is one such case.

Attempts to use standardised criteria (such as numbers of individuals left, total biomass of a species, geographical range, percentage rate of decline, future likely rate of decline or nature of remaining distribution) in establishing whether a species is endangered have so far been clearly futile, as there

Vulnerable: The koala Phascolarctos cinereus is commonly reported in the media as being endangered. Even though its numbers are significantly lower than they were at the time Europeans arrived in Australia, it is more correctly termed 'vulnerable'.

Kathie Atkinson

are numbers of cases where species do not appear to conform to accepted trends, and therefore have to be analysed on a subjective case-by-case basis. There are cases, for example, where species may exist in large numbers but still be clearly endangered due to factors that threaten the entire population.

The lack of clear critera available to define the term 'endangered' also applies to other classifications of threat, and few lists of endangered or threatened fauna are consistent either in component species or in their reasons for placing species in different categories.

The fact that the status of a given species can change rapidly can also add to the variability of lists. A species formerly regarded as common may suffer a rapid decline over a short period, perhaps due to some new form of commercial over-exploitation or through the effects of an introduced pest. Conversely, an endangered species may become much more abundant due to large-scale and widespread captive breeding.

The International Union for the Conservation of Nature and Natural Resources (IUCN) has created various categories for determining the levels of threat to different species. In this book those categories are used because of their widespread, worldwide usage. The term 'threatened' is not used by the IUCN as a category, but is useful in describing all species threatened in any way with extinction.

In defining various levels of threat I have used the term 'species' instead of 'taxa', which is used by the IUCN and tends to be inconsistently applied. Lists of endangered animals prepared by the IUCN and others seem to inconsistently include some species or subspecies and not others. Because of the general



Extinct: The Thylacine is now widely regarded as extinct. Numerous unconfirmed reports of sightings of the species have been made, however.

ANT Photo Library

lack of agreement on the classification of many forms as subspecies or otherwise, I have chosen to ignore subspecies in most cases. This includes all cases where a listed form, although perhaps endangered, is quite clearly a subspecies of a more widespread and less threatened species.

Where endangered forms are sometimes regarded as subspecies and at other times as species and there is currently a reasonable argument for either classification, I have given them the benefit of the doubt and treated them as full species, and included them in this book, an example being the Norfolk Island Grey-headed Thrush *Turdus poliocephalus*.

As with the IUCN definitions, in this book the level of threat to a given species is determined on the basis of its entire known range and not in relation to local threats.

The significance of captive populations, including captive breeding activity, is also assessed when assigning a level of threat to a given species. Clearly species with large captive breeding populations must be regarded as more secure than similar species without these populations.

The categories used are given below, and where the definitions vary from those of the IUCN those differences are noted.

Extinct Species that are no longer known to exist in

the wild or captivity after repeated searches of all likely places. A fifty-year rule is sometimes applied in assigning species to this category, whereby a species is not listed as extinct unless it has not been seen alive for at least fifty years. Quite clearly the fiftyyear rule fails to show the true situation in many cases. For example, relatively innocuous species from remote places may be unseen for more than fifty years but not be extinct. The Christmas Island Shrew Crocidura trichura and Noisy Scrub Bird Atrichornis clamosus are two examples of 'rediscovered species' once thought to be extinct. In other cases, the exact dates of death of the last specimens of some species are well known and the use of the fifty-year rule to list them as endangered for up to fifty years is quite inappropriate. The fifty-year rule is not applied in this book.

Endangered Species in danger of extinction and those whose survival is unlikely if the factors causing their endangerment continue operating. Included are species whose numbers have been reduced to a critical level or whose habitats have been so drastically reduced that they are deemed to be in immediate danger of extinction. Also included are species that are possibly extinct. (In this book species possibly or probably extinct are indicated as such.) Included are species that may be eliminated by proposed human or human-related activity, for example, a species restricted to forest area that is earmarked to be logged and for which licences to log have already been issued.

Vulnerable Species believed likely to move into the endangered category in the near future if the factors causing their vulnerability continue operating. Included are species of which most or all the populations are decreasing because of over-exploitation, extensive destruction of habitat or other environmental disturbance; species with populations that have been seriously depleted and whose ultimate security is not yet assured; and species with populations that are still abundant but are under threat from serious adverse factors throughout their known

range. Species often recorded in some lists being in 'serious decline' fit into the vulnerable category.

Rare Species with small world populations that are not presently endangered or vulnerable, but are at risk. These species are usually localised within restricted geographical areas or habitats or are thinly scattered over a more extensive range.

Indeterminate Species known to be extinct, endangered, vulnerable or rare, but where there is not enough information to say which of the four categories is most appropriate.

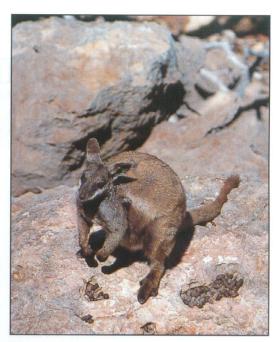
Insufficiently known Species that are suspected but not definitely known to belong to any of the above five categories because of lack of information.

Out of danger Species formerly included in one of the above categories, but which are now considered to be relatively secure because effective conservation measures have been taken or because the previous threat to their survival has been removed.

In need of monitoring A catch-all category used in some lists, but not by the IUCN, to include those species of concern that do not fit into any of the above IUCN categories.

In this book are descriptions of all species known from Australian territory that appear to conform to the status 'endangered' as just defined and in the context of other levels of threat also defined.

This compilation will certainly not be, in the opinion of many Australian zoologists, definitive; numerous additions and deletions will no doubt be desired by various people. The choice of species to include was a difficult task, and the final selection was based largely on consensus views of workers in the relevant fields, not on my own researches. I have had little, if any, contact with many of the species described in the text and in ascertaining the con-



Vulnerable: Because of its rapidly contracting range, and a sharp decline in numbers in many areas, the Black-footed Rock Wallaby Petrogale lateralis is listed as vulnerable. In the long term the species could become endangered if current trends continue.

Kathie Atkinson

servation status and other aspects of these species I have had to rely heavily on the opinions of other zoologists and on published material.

Put simply, this compilation represents my most accurate assessment of the situation as it stands in 1990, based on the necessarily inconsistent criteria I used to assess each species that could have been listed as endangered.

The relative shortness of the list is partially due to my almost total exclusion of a huge number of forms described within the last twenty years, many of which are still only known from a few specimens and some of which are no doubt endangered. On current information, however, these species would be categorised as indeterminate, insufficiently known or in need of monitoring.

# ABOUT THE SPECIES DESCRIPTIONS

All descriptions of species here conform to a standardised format for the sake of clarity. A number of general comments are necessary, however.

Some species have been placed in the 'endangered' category on the basis of proposed threats or alterations to habitats, although they would previously have been regarded as rare or vulnerable. Some species have been placed there largely on the basis of few specimens known to science in spite of intensive searches for them, while others are categorised as endangered purely on the basis of well-known but pitifully small extant populations.

For a few lesser-known species described here, there is a possibility that further population surveys will reveal that they are in fact more numerous and secure than is presently thought, and although they are described here, some may say that their status would be better defined as indeterminate or insufficiently known.

The species are discussed in systematic and sequential order, namely: fish first, then amphibians (frogs only), reptiles, birds and mammals. This order reflects their so-called evolutionary line, from the most conservative to the most advanced forms of vertebrate.

Within this sequence, the groupings in each class are dealt with in purely alphabetical order, and within each successive classification level, namely: order, family, genus, species, and selected sublevels within these groups. Descriptions of closely related animals tend to be placed near one another; however, in strictly conforming to alphabetical order within each class, some groups that are dealt with together in most other texts are separated here by other more distantly related or dissimilar species.

The common or colloquial names given for species reflect those in widest usage. Many species are known by several common names, in different areas.

Likewise, the scientific names used here reflect those agreed upon by most workers within their field. It should be noted, however, that many Australian animals have been reclassified in recent years, hence the scientific names used in this text differ from some earlier works. No doubt, as more is found out about Australian animals, further reclassification will result in more alterations to scientific names.

#### SIZE

Sizes quoted for animals are average adult sizes only and not maximums. The first quoted measurement is the total body length, outstretched and including a tail if present. In some cases, known average measurements are also quoted, as are known ranges of measurements for adult specimens.

#### **IDENTIFICATION**

Text that identifies and describes the appearance of a given species is minimised and illustrations are provided in many cases to help identify species. Information that enables one to distinguish the animal from similar and related species is given here. Where coloration is used as a principal identifying feature, particularly for some types of bird, it is described in some detail. Occasionally I have had to resort to technical terminology to differentiate between species, but I have tried to avoid this. An aim of this book has been to enable a lay person to identify endangered species when confronted by them. Obviously this aim cannot always be fulfilled.

Miscellaneous information that may further aid

identification, such as egg size and shape, nest construction, or the pouch and teat structure of some mammals, is given in the notes about those species.

I have assumed that the reader will have a basic knowledge of the types of animals being described. This information can be derived from more specific fish, frog, reptile, bird and mammal texts, many of which are cited in the Bibliography.

#### CALL

For some animals, notably frogs and birds, vocalisation in the forms of songs and calls is an important means of identification, and when this information has been available it has been included. For frogs, the call described is usually the mating call of the male, not the vocalisation that may occur when the frog is attacked. Most birds have more than one type of vocalisation. Typically this includes mating calls or 'songs', a contact call when birds meet or communicate in flight, and a distress call, often made when fleeing a predator.

#### DISTRIBUTION

Distribution given is only a guide to the area in which a species may occur where there is suitable habitat, if, and only if, other factors have not eliminated it from this habitat. In many cases known distribution may not be the full range of a given species. In other cases, the actual range of a given species may have contracted to occupy an area less than that shown on the map.

On the maps, the shaded area is that of the current known distribution of a given species. Other



areas with recent questionable records of the species, or where there is a possibility that the species is likely to occur, are marked with a question mark. The areas

may extend for several hundred kilometres around the place indicated by these question marks.

Birds in particular are noted to stray from their usual areas on some occasions. For this reason it is

effectively impossible to draw a distribution map for most bird species that is more than 90 per cent accurate, even for very well-known species.

It should be noted that virtually all species only occur at scattered localities within their range. Some gaps in distribution are of many kilometres. As these gaps generally do not show up on the distribution maps, it should be realised that the maps tend to give an inflated impression of a given species' range.

Although in the text I give complete distribution information about a given species, including that outside Australia, the maps are only of Australia or immediately adjacent waters. The distribution of species occurring in these waters is shown by a thickening of the coastline boundaries.

#### HABITAT

The habitat information given refers to the preferred habitat of a species. Most species will also occur in adjacent habitats, but in lesser numbers in certain circumstances. 'Preferred habitat' is habitat in which most specimens are found, either active or resting.

#### **NOTES**

When there is little biological or other information given about a particular species, this is due to a lack of available information on that species. All in all, too little research has been done on the overwhelming majority of these species.

When discussing reproductive patterns for given species, abnormal cases, in which, for example, one or two young are produced instead of a typical number of four to ten, are ignored. Rare out-of-season breedings initiated in captive specimens are also ignored when discussing breeding seasons.

#### **CAUSES OF ENDANGERED STATUS**

When outlining the causes of the current endangered or extinct status of a species, I am in some cases doing no more than making an educated guess. Causal factors of the decline of a species are not always known. In most cases they are known, but the problem is how important each factor is relative to the others. In outlining causes of current status for

most animals, I have only identified the known principal causes and omitted lesser factors.

#### NUMBER LEFT

Where I have indicated the size of the remaining population, the number given is the best possible estimate based on all available information. For some species with very restricted ranges, such as a single colony on a small island, my estimate would be very accurate. However, for a species such as the Brush-tailed Bettong *Bettongia penicillata*, known from four widely separated and little-studied forest populations, my population estimate may be erroneous by a fairly large degree.

The attempt to indicate the size of a species' population in each description was made at the suggestion of many people when I was writing the book. However, as already implied, the number of individuals of a species left is not necessarily a good indication of how secure that species is. For example, the Pedra Branca Skink *Pseudemoia palfreymani*, with a population of little more than 200 individuals, is probably more secure than the Pebble-

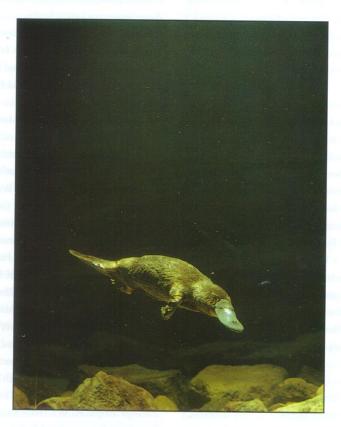
mound Mouse *Pseudomys chapmani*, still probably numbering thousands. Some species, including many frogs, can number thousands one year, and apparently be extinct a few years later, for no known reason. The Lesser Bilby *Macrotis leucura*, which originally occurred in very large numbers over a wide area, apparently died out very rapidly.

#### PRINCIPAL ACTION REQUIRED

The suggestions for principal action required to conserve a given species are merely my opinions, based on available facts. In most cases I have not outlined all that can be done to preserve a given species, instead concentrating on one or two key measures for the conservation of that particular species.

It should also be noted that all species described are afforded statutory protection, for what that is worth. Being written into the conservation laws will have little benefit for a large number of the endangered species described, however, as they are small, innocuous and of little, if any, commercial value. Their ultimate fate will depend on more practical protective measures.

## ENDANGERED VERTEBRATES OF AUSTRALIA



The Platypus Ornithorhynchus anatinus is commonly regarded as endangered, perhaps because its shyness, and the fact that it is mainly active at dusk, mean that it is rarely seen in the wild. In fact, the Platypus is more correctly termed 'threatened', and is fairly common in most watercourses in south-eastern Australia.

Jean-Paul Ferrero/AUSCAPE International

#### SPECIES DESCRIBED

#### **FISH**

Galaxias fontanus Swan Galaxias
Galaxias johnstoni Clarence Galaxias
Galaxias parvus Swamp Galaxias
Galaxias pedderensis Lake Pedder Galaxias
Melanotaenia eachamensis Lake Eacham Rainbowfish
Maccullochella ikei sp. nov. Clarence River Cod
Maccullochella macquariensis Trout Cod

#### FROGS

Litoria longirostris Long-nosed Tree Frog
Litoria lorica Thornton Peak Tree Frog
Arenophryne rotunda Sandhill Frog
Philoria frosti Mount Baw Baw Frog
Rheobatrachus silus Gastric Brooding Frog
Rheobatrachus vitellinus Eungella Gastric Brooding Frog
Taudactylus diurnus Mount Glorious Torrent Frog
Taudactylus eungellensis Eungella Torrent Frog
Taudactylus liemi Liem's Torrent Frog
Taudactylus pleione Kroombit Creek Torrent Frog
Cophixalus concinnus Elegant Microhylid
Cophixalus neglectus Bellenden Ker Range Microhylid
Cophixalus saxatilis Rock-dwelling Microhylid

#### REPTILES

Pseudemydura umbrina Western Swamp Tortoise
Dermochelys coriacea Leathery Turtle
Aprasia parapulchella Pink-tailed Legless Lizard
Ophidiocephalus taeniatus Bronze-backed Legless Lizard
Ctenotus lancelini Lancelin Island Striped Skink
Lerista lineata Lined Burrowing Skink
Pseudemoia palfreymani Pedra Branca Skink
Tiliqua adelaidensis Adelaide Bluetongue
Morelia carinata Rough-scaled Python
Hoplocephalus bungaroides Broad-headed Snake
Neelaps calonotus Western Black-striped Snake

#### BIRDS

Erythrotriorchis radiatus Red Goshawk Falco peregrinus Peregrine Falcon Podargus plumiferus Plumed Frogmouth Anous tenuirostris Lesser Noddy Pedionomus torquatus Plains-wanderer Tricholimnas sylvestris Lord Howe Island Woodhen Turnix melanogaster Black-breasted Button Quail Fregata andrewsi Christmas Island Frigatebird Sula abbotti Abbott's Booby Aphelocephala pectoralis Chestnut-breasted Whiteface Dasyornis brachypterus Eastern Bristlebird Dasyornis broadbenti Rufous Bristlebird Dasyornis longirostis Western Bristlebird Atrichornis clamosus Noisy Scrub Bird Amytornis dorotheae Carpentarian Grasswren Amytornis goyderi Eyrean Grasswren Amytornis textilis Thick-billed Grasswren Malurus coronatus Lilac-crowned Fairy-wren Stipiturus ruficeps Rufous-crowned Emu Wren Lichenostomus cassidix Helmeted Honeyeater Manorina melanotis Black-eared Miner Xanthomyza phrygia Regent Honeyeater Turdus poliocephalus Norfolk Island Grey-headed Thrush Pardalotus quadragintus Forty-spotted Pardalote Erythrura gouldiae Gouldian Finch Psophodes nigrogularis Western Whipbird Zosterops albogularis White-breasted Silvereye Pterodroma leucoptera Gould's Petrel Pterodroma solandri Providence Petrel Cyanoramphus novaezelandiae Red-fronted Parrot Geopsittacus occidentalis Night Parrot Neophema chrysogaster Orange-bellied Parrot Neophema splendida Scarlet-chested Parrot Pezoporus wallicus Ground Parrot Polytelis alexandrae Alexandra's Parrot Psephotus chrysopterygius Golden-shouldered Parrot Psephotus dissimilis Hooded Parrot

Psephotus pulcherrimus Paradise Parrot

#### **MAMMALS**

Balaenoptera musculus Blue Whale Megaptera novaeangliae Humpback Whale Eubalaena glacialis australis Southern Right Whale Crocidura trichura Christmas Island Shrew Conilurus albipes White-footed Rabbit-rat Leporillus apicalis Lesser Stick-nest Rat Leporillus conditor Greater Stick-nest Rat Melomys hadrourus Thornton Peak Melomys Notomys amplus Short-tailed Hopping-mouse Notomys aquilo Northern Hopping-mouse Notomys fuscus Dusky Hopping-mouse Notomys longicaudatus Long-tailed Hopping-mouse Pseudomys chapmani Western Pebble-mound Mouse Pseudomys desertor Desert Mouse Pseudomys fumeus Smoky Mouse Pseudomys gouldii Gould's Mouse Pseudomys johnsoni Central Pebble-mound Mouse Pseudomys occidentalis Western Mouse Pseudomys pilligaensis Pilliga Mouse Pseudomys praeconis Shark Bay Mouse Pseudomys shortridgei Heath Rat Xeromys myoides False Water-rat Zyzomys pedunculatus Central Rock-rat Antechinus godmani Atherton Antechinus Parantechinus apicalis Dibbler Phascogale calura Red-tailed Phascogale Sminthopsis douglasi Julia Creek Dunnart

Sminthopsis longicaudata Long-tailed Dunnart Sminthopsis psammophila Sandhill Dunnart Myrmecobius fasciatus Numbat Chaeropus ecaudatus Pig-footed Bandicoot Perameles bougainville Western Barred Bandicoot Thylacinus cyanocephalus Thylacine Macrotis lagotis Greater Bilby Macrotis leucura Lesser Bilby Bettongia lesueur Burrowing Bettong Bettongia penicillata Brush-tailed Bettong Caloprymnus campestris Desert Rat-kangaroo Potorous platyops Broad-faced Potoroo Potorous longipes Long-footed Potoroo Lagorchestes hirsutus Rufous Hare-wallaby Lagorchestes leporides Eastern Hare-wallaby Lagostrophus fasciatus Banded Hare-wallaby Macropus greyi Toolache Wallaby Macropus parma Parma Wallaby Onychogalea fraenata Bridled Nail-tail Wallaby Onychogalea lunata Crescent Nail-tail Wallaby Petrogale persephone Proserpine Rock-wallaby Burramys parvus Mountain Pygmy-possum Cercartetus lepidus Little Pygmy-possum Gymnobelideus leadbeateri Leadbeater's Possum Petaurus australis Yellow-bellied Glider Wyulda squamicaudata Scaly-tailed Possum Lasiorhinus krefftii Northern Hairy-nosed Wombat

### SWAN GALAXIAS

Galaxias fontanus Fulton 1978

SIZE 70 mm (largest known about 100 mm) IDENTIFICATION More than 22 galaxiid species are known from Australia. These distinctive small and scale-less fish are also known commonly as native trout and whitebait. The erroneous term 'native trout' has persisted in the literature. They are elongate and spindle-shaped in appearance, often with broad and slightly depressed heads and thick, fleshy fins.

Galaxiids of the genus Galaxias are distinguished from closely related fish of the genera Paragalaxias and Galaxiella by the fact that the dorsal fin is posterior in origin, being located behind the pelvic fin bases, more or less above, but not behind, the vent.

The Swan Galaxias is distinguished from other Galaxias species by the following characteristics: from below the eye to the anterior nostril are five to six pores in series (most other Galaxias species only have four such pores); tail fin not distinctly rounded, being slightly forked to notched at the margin with rounded fin tips.

The colour is a dull greenish olive with fine, irregular brownish markings; ventrally it is silvery olive. DISTRIBUTION Known only from the upper



reaches of the Swan River in eastern Tasmania.

HABITAT The Swan Galaxias collected to date have been found free swimming or sheltering

beneath rocks or marginal cover in a gently to moderately swiftly flowing, spring-fed stream flowing through low dry scrub; the fish were most common in the less swiftly flowing waters.

NOTES Although little known, this species, like other galaxiids, is presumed to feed principally on a wide variety of intertebrate food items, including insects, crustaceans, polychaetes and molluscs. Specimens have been known to jump from the water to catch insects flying above the water.

Juvenile fish measuring 15-25 mm were seen swimming with adults in January and February, indicating a spring to summer spawning. The entire life cycle of the Swan Galaxias is completed in fresh water, although details are still not completely certain. It is believed that some migration of this species occurs for spawning in response to seasonal heavy rainfall, which encourages upstream migration of fish. Galaxias have been seen jumping up small waterfalls and wriggling over dry land and up slopes. Such behaviour has been noted in G. brevipinnis. In some species, such as G. maculatus, eggs are laid on grassy banks, and fish have been known to wriggle out of the water to lay the eggs, which possibly hatch next time the creek waters swell. CAUSES OF ENDANGERED STATUS Very restricted known range, and the risk of human intervention in the habitat of this species, including introduction of pest species such as trout and English perch, which appear to eliminate galaxiids. NUMBER LEFT Probably thousands. PRINCIPAL ACTION REQUIRED Further biological research, and searching for further populations of Swan Galaxias. Exotic fish introduced into

the Swan River system must be removed.



Swan Galaxias Galaxias fontanus Wayne Fulton

## **CLARENCE GALAXIAS**

Galaxias johnstoni Scott 1936

SIZE 75 mm (largest known about 100 mm) IDENTIFICATION Distinguished from other galaxiids by the following characteristics: the tail fin forked to notched at the margin; four pores in series from below eye to the anterior nostril; gill rakers short and stout; origin of anal fin is usually below the middle of the dorsal fin or further back; internally, two pyloric caecae of moderate length are attached to the stomach.

The Clarence Galaxias is most closely related to the Lake Pedder Galaxias *G. pedderensis*, from which it is distinguished by a number of characteristics, including its slightly smaller head, smaller ventral fins, shorter ventral—anal interspace, more stout build, and different colour pattern.

Clarence Galaxias are greenish black dorsally, with bold, dark and contrasting bars or wavy lines on the sides coalescing on the back. The unmarked ventral surfaces are a light silvery fawn.

DISTRIBUTION Currently only known from Clar-



ence Lagoon, its tributaries and the upper reaches of the Clarence River, Tasmania. This river is a tributary of the Nile River, which in turn runs into the Der-

went River, which flows through Hobart. HABITAT Clarence Galaxias have been taken from still waters in Clarence Lagoon and flowing waters entering and leaving the lagoon. The preferred habitat is not known.

NOTES No major migrations are known in this species, although it has been little studied. The Clarence Galaxias presumably feeds on smaller animals, although it has not been observed feeding.

Most Australian species of galaxiids occur in cooler parts of the mainland and in particular Tasmania, where at least 16 of 22 recognised species



Clarence Galaxias Galaxias johnstoni Wayne Fulton

occur, twelve of them endemic. Some galaxiids are known to occur to the north of Perth in Western Australia and in south-east Queensland, although the diversity of galaxiid species from these warmer areas is not great.

Besides occurring in Australia, galaxiids are also found in New Zealand, New Caledonia, South America and South Africa, a distribution often explained as being a result of continental drift. The theory is that the common ancestor lived on the supercontinent Gondwana before it broke up into the current continental formation. Another possibility is that the ancestor of modern galaxiids was a seadwelling fish, with a wide range over the southern oceans, which later evolved into freshwater forms.

The largest species of galaxiid known is one from New Zealand, which reputedly reaches 580 mm in length and weights of nearly a kilogram. The smallest species has an adult length of about 25 mm. CAUSES OF ENDANGERED STATUS Restricted distribution and the threat posed by introduced fish such as trout and English perch, which apparently eliminate galaxias.

NUMBER LEFT Probably fewer than a thousand adult fish.

PRINCIPAL ACTION REQUIRED Further biological research, the maintenance of habitat quality and the removal of introduced exotic fish.

## **SWAMP GALAXIAS**

Galaxias parvus Frankenberg 1968

SIZE 65 mm (largest known about 90 mm) IDENTIFICATION Distinguished from other *Galaxias* by the distinctly rounded tail fin. The only other *Galaxias* species with this attribute is *Galaxias* cleaveri, which is distinguished from *G. parvus* by its lowland distribution in Tasmania and by having 56–60 vertebrae and two long pyloric caecae. *Galaxias* parvus has 44–49 vertebrae and no pyloric caecae and is only found at high altitudes, in the area near Lake Pedder.

Dorsally the colour is greyish to yellowish brown, becoming grey-green on the lower sides and whitish ventrally. The back and sides have many small, irregular, dark grey-brown spots and blotches. Some specimens, particularly smaller ones, may have a salmon pink to gold coloration on the ventral surface in front of the pelvic fins.

This is a relatively stocky species and differs from other *Galaxias* by the presence of three pores that run in series from below the eye to the anterior

DISTRIBUTION Known only from the headwaters



of the Gordon and Huon rivers, in the uplands of south-western Tasmania, including Lake Pedder, all from a relatively small common divide. HABITAT Although

juveniles have been collected in Lake Pedder, the preferred habitat appears to be swamps, still pools and backwaters. Most specimens are caught by sweeping a dip net through vegetation at the margins of pools.

NOTES Different and isolated populations of this species appear to show variations in the number of vertebrae and the fin rays. For example, Lake Pedder specimens have fewer fin rays and vertebrae than do specimens in the upper Huon River, indicating evo-

lutionary diversions between these populations.

Females collected in February and March showed different stages of ovary development, some being immature, while others were markedly developed, though not completely mature. Juveniles are abundant around the edges of Lake Pedder in early January and it appears that spawning occurs after the winter rains when surface water is plentiful. The whole life cycle is spent in fresh water.

STATUS Possibly endangered. A number of researchers now regard this species as not being at risk.

CAUSES OF CURRENT STATUS The restricted range of the species, the risk posed by the potential introduction of species such as trout, redfin and other piscovorous fish, and the alteration of habitat by the impoundment of large amounts of water, which would adversely affect this species.

NUMBER LEFT Many thousands.

PRINCIPAL ACTION REQUIRED Further bio-

PRINCIPAL ACTION REQUIRED Further biological research and population surveys.



The Swamp Galaxias is only known from the headwaters of the Gordon and Huon rivers in the uplands of southwestern Tasmania. The introduction of trout, redfin and other piscovorous fish would threaten its existence, as would the disturbance of its habitat.

Wayne Fulton

### LAKE PEDDER GALAXIAS

Galaxias pedderensis Frankenberg 1968

SIZE 75 mm (largest known about 110 mm) IDENTIFICATION The Lake Pedder Galaxias is distinguished from similar species by the following characteristics: tail fin notched to forked; four pores in series from below the eye to the anterior nostril; gill rakers short and stout; anal fin originates below the middle of the dorsal fin or further back; pyloric caecae absent or only one present (in rare cases two); head longish, flattened above and tapering to a slender snout; usually 12–13 pectoral fin rays.

This species is distinguished from the closely related Clarence Galaxias *Galaxias johnstoni* by the marginally larger head, larger ventral fins, larger ventral—anal interspace, lighter build and different colour pattern.

Although colour varies somewhat, it is often very bold, with contrasting brown and off-white bands on the back and sides, the pattern being very irregular and extending toward the head. The dark and light areas are of similar size. The belly is off-white, although the fin bases are usually dark.

DISTRIBUTION Known only from Lake Pedder,



Tasmania, and the water draining into the lake. HABITAT This species seems to have remained abundant in the lake since the water level was raised following con-

struction of a large dam across the outlet river.

Around the shores of the lake, it is mainly seen among rocks and boulders rather than in submerged vegetation. Lake Pedder Galaxias have also been caught in a stream flowing into the lake. This species and the Swamp Galaxias have been caught in a small pond near the shores of the lake. Both appear to tolerate the low-pH water in the lake.

NOTES Reproduction appears to take place during late winter or spring. At this time, fish are presumed

to migrate to the upper reaches of streams flowing into Lake Pedder and the upper Serpentine River. On one occasion a large number of mature females were found to have accumulated in a pool below a man-made waterfall, indicating an upstream migration when breeding.

Like the Swamp Galaxias, the Lake Pedder Galaxias only came to scientific attention in 1968, when the area came to the attention of conservationists who wanted to defend it against a proposed hydroelectric scheme and dam that would significantly alter the local environment.

Other species of *Galaxias* may also be endangered. These include *G. auratus* Johnston 1883, known only from Lake Sorrell, Lake Crescent and the Clyde River in the Tasmanian highlands; *G. tanycephalus* Fulton 1978, known only from Arthur's Lake in the Tasmanian highlands; *G. fuscus* from Victoria; and various species or subspecies within the *G. olidus* species complex on mainland Australia.

CAUSES OF ENDANGERED STATUS The restricted range of the Lake Pedder Galaxias, the unknown long-term effects of drastic habitat alteration due to the raising of the water level of the lake, and the risk of introduction of predatory fish. NUMBER LEFT Thousands.

PRINCIPAL ACTION REQUIRED Close monitoring of known populations of this species and further biological research.



Lake Pedder Galaxias Galaxias pedderensis Wayne Fulton

## LAKE EACHAM RAINBOWFISH

Melanotaenia eachamensis Allen & Cross 1982

SIZE 50 mm

IDENTIFICATION Rainbowfish are small freshwater fish found in many parts of Australia, particularly north of the Tropic of Capricorn, being found in most waterways of northern Australia.

The Lake Eacham Rainbowfish is similar in appearance and features to the closely related, highly variable and widely distributed Splendid Rainbowfish *Melanotaenia splendida*. The Lake Eacham Rainbowfish differs in its more slender build, the fact that its body depth in males is only about 30 per cent of the total length and several other features.

The Lake Eacham Rainbowfish may be distinguished from all other known Australian Rainbowfishes by the following traits: seven to sixteen cheek scales; nine to thirteen horizontal scale rows; the first dorsal fin origin roughly even with or before the anal fin origin. A distinct black band is absent, usually consisting of a series of narrower stripes on the sides, although the mid-lateral one may be expanded to form a diffuse dark band. A toothless groove usually separates an enlarged row of teeth at the front of the jaws and a dense band of smaller teeth is behind, although often hard to detect. The vomer has a few feeble teeth on the lateral section. DISTRIBUTION Known only from the waters of



Lake Eacham, on the Atherton Tableland, about 40 km south-west of Cairns, Queensland. HABITAT This lakedwelling fish can be found in clear, shallow

water along the shoreline. It is particularly abundant around docks, near submerged logs and branches and among aquatic weeds. The water temperature ranges from 23 to 27 degrees Celsius and has a pH of 7. The average depth of the whole lake is about 149 metres.

NOTES In the 1970s and early 1980s this fish was very numerous and easy to collect using almost any sort of net. The fish is now so rare in Lake Eacham that it may be extinct in the wild, although recent unconfirmed sightings have been noted.

These hardy fish feed extensively on small insects and insect larvae along with smaller amounts of microscopic crustaceans and algae. The fish are in turn eaten by larger fish and birds. These fish are sometimes called 'Sunfish' due to their habit of congregating in open sunlight.

Courtship is initiated by the male fish and consists of rapid chasing interspersed with stationary displays where the fins are fully extended. During courtship and spawning, the overall coloration is greatly intensified, especially that of the fins, particularly in males.

The breeding period is only about ten days and only a few relatively large eggs are laid each day, usually in the morning. Fertilised eggs are 1–2 mm in diameter. These are attached to aquatic plants by thin thread-like filaments. The eggs hatch five to twelve days later.

The Lake Eacham Rainbowfish is presumed to spawn at all times of the year, in common with other related species. However, spawning activity does appear to peak during the northern wet season.

The young fish (fry) grow rapidly and presumably feed on microscopic food. Sexual maturity occurs within twelve months, and in some cases within a few months. Growth rates of young vary greatly, even among young from the same batch of eggs.

Wild Lake Eacham Rainbowfish are presumed to have a normal life span of one to four years. Captives, which are very hardy, tend to outlive their wild counterparts. They also appear to grow faster and larger than wild fish. In captivity it is possible to hybridise the Lake Eacham Rainbowfish with other members of the genus *Melanotaenia*.



Recently Dr Walter Ivanstoff of Macquarie University completed an electrophoresis examination of all captive populations of the Lake Eacham Rainbowfish and some Splendid Rainbowfish *M. splendida*. He was unable to electrophoretically separate any of these fish, which indicates a similarity between these fish and raises further questions about the classification of these and other rainbowfish.

Before 1978 only the Lake Eacham Rainbowfish, the Fly-speckled Hardyhead *Craterocephalus* sp. and the Northern Trout-gudgeon *Mogurnda mogurnda* inhabited the lake. A 1987 survey of Lake Eacham revealed five species of fish, including four introduced species, the Mouth Almighty *Glossamia aprion*, the Archer Fish *Toxotes chatareus*, the Bony Bream *Nematolosa erebi* and the Banded Grunter *Amniataba percoides*. Rainbowfish and Trout-gudgeons were apparently eliminated from the lake, presumably as a

Known only from the waters of Lake Eacham on the Atherton Tableland in Queensland, the Lake Eacham Rainbowfish may even be extinct in the wild. Once very numerous, it was easily caught, and this vulnerability to predation has led to its near-extinction.

Jean-Paul Ferrero/AUSCAPE International

result of competition with these other fish.

STATUS Endangered, possibly extinct in the wild.
Captive populations are secure.

CAUSES OF CURRENT STATUS The restricted range of this fish makes it vulnerable to predation and elimination by introduced fish species.

NUMBER LEFT Probably none in the wild. At least a thousand in captivity.

PRINCIPAL ACTION REQUIRED Rigid protection of Lake Eacham, and the removal of intro-

duced fish species if at all possible.

## CLARENCE RIVER COD

Maccullochella ikei sp. nov.

SIZE 40–50 cm (maximum about 80 cm), commonly about 1–2 kg. Largest authenticated specimen was 49.5 kg.

IDENTIFICATION Very similar in appearance to the Murray Cod *Maccullochella peeli* (see description of Trout Cod), from which it is distinguished by having much longer filaments on the pelvic fin tips. For many years this species was treated as an eastern form of the Murray Cod, known from the Murray—Darling system.

DISTRIBUTION Occurs in the Clarence River sys-



tem. It is, however, restricted to areas of relatively undisturbed habitat, including parts of the Nymboida, Little Nymboida, Boyd and Mann rivers and the

Dandarah and Washpool creeks.

HABITAT The preferred habitat is clear, rocky, relatively fast flowing streams. By day the cod is often found sheltering under logs and snags, tending to be most active in its wanderings during summer and at night.

NOTES Reports from the turn of the century indicate large numbers of cod in the Clarence, Richmond, Brisbane and Mary river systems of coastal northern New South Wales and south-east Queensland. Cod from the Mary and Brisbane river systems were so plentiful that they were used as pig feed by local farmers.

The last documented report of cod from the Brisbane River system was in the 1940s, when several were taken from the Stanley River. The last authenticated capture of cod from the Richmond River system was in 1971. It is believed that cod in both river systems are now extinct. Cod in the Mary River system are now restricted to areas of undisturbed habitat in several small tributaries.

Cod from all four systems are similar and in the past have been usually regarded as one species. Recent investigations have cast doubt on that assumption. But all remaining indigenous cod from any of the abovenamed river systems must be treated as endangered. The decline of cod in these rivers has resulted from a variety of human and human-initiated activities, although the relative importance of each factor is not known.

The fish is omnivorous, with almost any type of flesh being taken. Although shrimps, mussels, smaller fish, and crayfish are most often taken, frogs, small reptiles and even birds are known to have been taken. Wood-boring grubs, worms and centipedes are also relished by this species.

The growth rate reflects availability of food, and sexual maturity occurs when the fish attain about 1.5–2 kg in weight. The growth rate is slower than that of the well-known Murray Cod *Maccullochella peeli*, however. Except at the spawning period, it is difficult to distinguish between the sexes, but the female, when 'ripe' before spawning, has a more rotund abdomen and the vent becomes noticeably swollen.

Spawning behaviour is similar to that of the Trout and Murray cods.

The Clarence River Cod has been shown to hybridise with the Murray Cod under controlled captive conditions. This may also occur among wild fish if they are given the opportunity. Murray Cod fry are currently available from inland commercial fish hatcheries and are being sold to north coast farmers for stocking farm dams. If these fish are liberated in the Clarence River system they may hybridise with Clarence River Cod, leading to their ultimate extinction.

CAUSES OF ENDANGERED STATUS Overfishing has probably not been the principal cause of the decline. The reasons for the decline include hab-



itat alteration and degradation, competition with and predation by introduced fishes, disease and the everpresent threat of hybridisation with Murray Cod. NUMBER LEFT Probably thousands.

PRINCIPAL ACTION REQUIRED Correction of all the abovementioned problems and captive breeding of all types of cod still found in the river systems of the east coast.

Farmers in coastal northern New South Wales and south-east Queensland used to catch the Clarence River Cod (bottom) in great numbers and use it as pig feed. Habitat disturbance, competition with and predation by introduced fish, disease and the everpresent threat of hybridisation with the Murray Cod (top) are the causes of its current endangerment.

## TROUT COD

Maccullochella macquariensis (Cuvier 1829)

SIZE  $40-50~{\rm cm}$  (maximum about  $70~{\rm cm}$ ) commonly about  $1~{\rm kg}$ . Never exceeds  $16~{\rm kg}$ .

IDENTIFICATION Also commonly called the Blue-nosed Cod, this is one of two freshwater cod species known from the Murray—Darling basin. Until very recently this species was confused with the larger and more common Murray Cod *Maccullochella peeli*, and the two are presented as synonymous in most texts.

The Trout Cod is distinguished from the Murray Cod by its overhanging upper jaw, straight head slope, longer snout, grey colour and speckled pattern. The Murray Cod has jaws of equal length, a concave head slope, shorter snout, a green colour and mottled pattern. Both species have numerous other external and internal differences.

DISTRIBUTION This species originally occurred



throughout the upper reaches of the Murray River and its tributaries, and also parts of the Darling River system, including the upper Macquarie River.

Now this species is restricted to a number of isolated populations, including in the Seven Creeks River system, Lake Sambell, where it was apparently introduced, the Mitta Mitta River, the Upper Murray River at Tintaldra, and the Murray River just below Yarrawonga, all in Victoria. A single specimen was taken recently from the Murrumbidgee River near Tharwa (ACT), while an apparently introduced population has been recorded from the Cataract Dam area of the Nepean River system in coastal New South Wales.

HABITAT Usually a river-dwelling species, this fish is found in both still and fast flowing water. By day it is often found sheltering under logs and snags, tending to be most active in summer and at night.

NOTES At the turn of the century, the Murray Cod Maccullochella peeli was by far the most important freshwater food fish in Australia. Large numbers of Murray Cod were fished from the Murray—Darling system, with a consistent percentage of the catch apparently consisting of Trout Cod Maccullochella macquariensis. Both species were introduced into other areas with varying degrees of success. Although many introductions at first seemed successful, the population tended to eventually die out.

The fish is omnivorous, with almost any type of flesh being taken. Although shrimps, mussels, smaller fish, and crayfish are most often taken, frogs, small reptiles and even birds are known to have been taken. Wood-boring grubs, worms and centipedes are also relished by this species.

The growth rate reflects availability of food, and sexual maturity occurs when the fish attain about 1.5–2 kg in weight. Except at the spawning period, it is difficult to distinguish between the sexes, but the female, when 'ripe' before spawning, has a more rotund abdomen and the vent becomes noticeably swollen.

Spawning usually occurs in September and October, although occasionally it occurs as late as November. This is usually in response to the water temperature rising to above 20° Celsius. A large female can produce up to 20 000 eggs, of which very few survive. The sticky eggs are a pale amber in colour when extruded and are about 3 mm in diameter.

Spawning takes place when waters flood over normally dry banks, with eggs being deposited by the female in a depression about a metre in diameter and 30 cm deep, or a submerged hollow river gum log. The male immediately fertilises these eggs, which hatch about two weeks later. The female guards the eggs prior to hatching.

Flood mitigation programmes and the construction of dams along the river systems where these fish



occur have dramatically reduced the number of young fish being produced, and the population has crashed in most areas.

CAUSES OF ENDANGERED STATUS Numbers of this species have plummeted in recent years. This is probably due to the effects of competing introduced species, and habitat alteration through human activity, including flood mitigation activity. Heavy fishing, though no doubt detrimental, probably is not the principal cause of the decline.

NUMBER LEFT Thousands.

PRINCIPAL ACTION REQUIRED Removal of competing pest species from some areas where the Trout Cod occurs; protection of habitat and seasonal changes to habitat through planned management;

Until very recently the Trout Cod was often confused with the larger and more common Murray Cod. Both species were important freshwater food fishes and were introduced into other river systems than the Murray–Darling system, where they naturally occur. Flood mitigation programmes, dam construction and competition from introduced fish species are probably the principal causes of the fish's decline.

G. E. Schmida/ANT Photo Library

prohibition of fishing in protected areas until numbers increase to an adequate degree; further biological research, and perhaps the setting up of breeding farms for this fish. All of these measures are now being undertaken.

## LONG-NOSED TREE FROG

Litoria longirostris Tyler & Davies 1977

SIZE 20-25 mm

IDENTIFICATION Like most tree frogs, the Longnosed Tree Frog has large finger and toe pads, which act like suction cups, enabling it to be an efficient climber. *Litoria* species can be readily distinguished from members of the other Australian genus *Nyctimystes* by their horizontal pupil and the absence of venation of the lower eyelids.

This distinctive species may be confused with the Dwarf Rocket Frog *L. dorsalis*, of tropical northern Australia, from which it differs in its larger adult size and oval disks, or *L. meiriana*, of the north of the Northern Territory and Western Australia, from which it is distinguished by its reduced toe webbing.

The Long-nosed Tree Frog is brown in colour dorsally with obscure and irregular darker flecks and blotches. The creamy white belly is finely peppered with dark blackish-brown on the throat. A few specimens have concentrations of stippling on the chin, chest and flanks. Its call is not known.

DISTRIBUTION McIlwraith Range, on the eastern



side of Cape York,
Queensland.
HABITAT Undisturbed,
'closed' rainforests are
the only known habitat.
NOTES Like all Australian tree frogs of the

genus *Litoria*, this species lays eggs in water. The eggs develop quickly and hatch to produce free-living aquatic tadpoles.

This small, agile frog is active both by day and at night. It is usually found in association with small creeks. Diet consists of soft-bodied arthropods.

Mating is by amplexus; the male mounts the female and holds on to her as she hops, swims or walks about. The male holds on to the female's body

with his forearms and will only separate after mating, unless disturbed by a predator. If fleeing from a predator by swimming, tree-frogs in amplexus move their hindlimbs in synchronisation.

As frogs lack a copulatory organ, the eggs are fertilised as they are laid.

CAUSES OF ENDANGERED STATUS The restricted rainforest habitat of this frog is under potential threat of destruction and alteration. NUMBER LEFT Thousands.

PRINCIPAL ACTION REQUIRED Preservation of all known habitat, further biological research.



The rainforest habitat of the small, agile Long-nosed Tree Frog is under threat from loggers, hushfires and other forms of habitat alteration. Few specimens have been seen in the wild since the species was first discovered. Further biological research is needed.

Queensland Museum

## THORNTON PEAK TREE FROG

Litoria lorica Davies & McDonald 1979

SIZE 35 mm

IDENTIFICATION Distinguished from other Litoria species by the following characteristics. Uniform grey or grey-brown above; white belly with dark brown peppering on the throat; skin with fine tubercles, with larger ones over the eyes and ears; lower surfaces granular except for the smooth throat; prominent but not extensive vomerine teeth behind the choanae; pectoral fold usually absent. Pads on all limbs well developed; toes almost fully webbed; fingers basal webbing only, with the second finger longer than the first. There is a small inner, but no outer metatarsal tubercle. The tympanum is small and indistinct. The frog's call is not known.

DISTRIBUTION Known only from Thornton Peak,



just north of the Daintree River in far North Queensland. **HABITAT Specimens** have been found on granite boulders in notophyll

zone near turbulent, fast flowing water. The area is in undisturbed, relatively inaccessible rainforest. NOTES In common with a number of North Queensland Litoria species, the Thornton Peak Tree Frog has evolved to suit a habitat and ecological niche that has become geographically restricted as the climate of the region has become generally drier.

It is probable that the maximum potential range of this species is no more than 20 km to the north and west of Thornton Peak, and is separated from adjacent mountainous regions by the Daintree and Bloomfield river valleys.

The life cycle of this frog is not known, but it is presumed to breed during the northern wet season, from about late December to March. Eggs are probably laid in the fast flowing streams, with the tadpoles metamorphosing into frogs within a few

months, while the streams remain fairly full.

Up to another fifty Australian species of tree frog await description. More than a hundred tree frogs are known from Australia already, with most species occurring in the north-east and east. It is feared that Cane Toads may have eliminated undescribed species. CAUSES OF ENDANGERED STATUS Increased human impact in the limited area where this frog occurs. Residential development near Thornton Peak could aid the invasion of Cane Toads.

NUMBER LEFT Thousands.

PRINCIPAL ACTION REQUIRED Preservation of all known habitat, further biological research, and the elimination of Cane Toads.



The Thornton Peak Tree Frog is known only from Thornton Peak near the Daintree River in far North Queensland, and is under threat from nearby residential development, which may aid the invasion of the Cane

Queensland Museum

## SANDHILL FROG

Arenophryne rotunda Tyler 1976

SIZE 32-36 mm

IDENTIFICATION Also called the Round Frog, this small, globular frog has short limbs and is similar in appearance to frogs of the widespread genus *Pseudophryne*, from which it differs in possessing maxillary teeth, a larger pectoral girdle, reduced digits on the limbs, colourless and translucent skin on the snout tip and in the absence of large areas of dark pigment on the belly, although there are some small, isolated clusters of dark stippling. The skin around the body forms a loose sac, extending to the elbow and knee.

Dorsally the Sandhill Frog is dull cream with brown stippling, particularly on the sides. Its call is not known.

DISTRIBUTION Known from Shark Bay, Western



Australia, and sites along the coast and nearby areas south for at least 250 km.

HABITAT Sand dunes with little, if any, surface water.

NOTES This nocturnal frog feeds principally on ants, which are the most abundant insect life on the dunes. The frogs burrow into the sand at dawn and re-emerge at night; although the sand at the surface is bone dry, it is moist at a depth of about 10 cm. The fresh water at this level is relatively pure and free of dissolved salts, typically having less than ten parts per million. Due to the large size of the grains of sand, and their relatively low surface tension, the frogs are able to absorb water whenever they are in contact with moist sand.

To collect Sandhill Frogs it is possible to follow tracks made as they waddle through the sand and where the tracks terminate the frog will be found. A small crater forms where the frog has buried itself.

Most desert frogs bury themselves using a backwards shuffling motion, principally using the scooping actions of the hindfeet. Sandhill Frogs, on the other hand, burrow head first. They simply drop their heads and dive into the sand, descending at a 45-degree angle, with their posterior and hind legs projecting into the air for a few seconds. As the Sandhill Frog goes deeper it uses its hindfeet to push itself further into the sand.

Studies at Shark Bay reveal that forty Sandhill Frogs travel from 8.8 to 27.6 m in a single night, with an average of 14.8 m travelled.

For the purpose of reproduction, males and females form pairs between July and November. They burrow together and remain below the surface for at least five months. As the sand dries, the frogs descend to moist layers up to a metre in depth.

Mating occurs underground and the female lays six to eleven creamy white eggs in circular capsules. The eggs, which have a diameter of about 5.5 mm, hatch after about ten weeks, with fully formed frogs emerging.

A population survey in optimal habitat at Shark Bay revealed about 277 Sandhill Frogs per hectare, with a biomass of 530 grams per hectare. STATUS Listed as endangered, but this status has now been questioned by some researchers, who have found large numbers in widely scattered localities. CAUSES OF CURRENT STATUS Restricted range of this species to a maximum potential area of 5300 square kilometres. To date, human impact on this species has been hard to assess.

NUMBER LEFT Possibly millions.

PRINCIPAL ACTION REQUIRED Most of the places where this frog occurs are within conservation zones or proposed conservation zones. More field-work needs to be done to reveal the true extent of populations.



The Sandhill Frog is known only from Shark Bay and nearby areas in Western Australia, where it lives in sand dunes. It burrows into the sand at dawn, re-emerging at night to feed principally on ants. It is able to absorb moisture through its skin when it burrows into moist sand.

Above. G. Harold/Australian Museum Right. T. Preen/Australian Museum



## MOUNT BAW BAW FROG

Philoria frosti Spencer 1901

SIZE Males 45 mm. Females 50 mm IDENTIFICATION In common with other frogs of the genus *Philoria*, the Mount Baw Baw Frog has the following characteristics: moderate to stout build; maxillary teeth present with vomerine teeth also present behind the choanae; a large and oval-shaped tongue; first finger not opposed to the second; feet not webbed; horizontal eye pupil; indistinct or hidden tympanum; terminal phalanges—the tips of the digits are only marginally dilated.

Dorsally the colour is brownish, with irregular whitish patches. Ventral surfaces are cream with heavy brown mottling. The back has numerous small warts, and there are enlarged swellings behind the eyes (parotid glands).

- In a breeding condition the male's throat is heavily pigmented, while the female is differentiated by having spatulate fingers.

Where this frog occurs, only two other frog species are known, the Common Froglet *Crinia signifera*, and the Whistling Tree Frog *Litoria verreauxi alpina*, which are both very different in form.

The Mount Baw Baw Frog's call is an unusual and variable series of moans and grunts. It has also been recorded as a short 'clunk' repeated in sequences of up to thirty calls.

DISTRIBUTION Known only from Mount Baw



Baw and immediately adjacent parts of the same range, at elevations above 1500 metres. HABITAT Its preferred habitat is among moss and boulders, in boggy

areas near creeks, and in sphagnum bogs. It is rarely, if ever, found outside this habitat.

NOTES The Mount Baw Baw Frog is related to similar species that occur in cold upland areas of New South Wales and south-east Queensland. All species

are probably relicts of forms that were more widespread during the most recent ice age, when they also may have occurred in lowland areas. As temperatures rose, their ranges decreased, leading to isolation of populations and subsequent speciation.

Male Mount Baw Baw Frogs call from November to January whilst situated in well concealed positions. About 100 large 4-mm opaque eggs are laid in a nest of loose foam in shallow water under a rock or log. The tadpoles hatch but remain with the eggs, feeding on the yolk and at no stage capturing food of their own. The tadpoles are unpigmented and lack labial teeth, although they do have horny jaws. Young frogs emerge from the foam nest after about four to six weeks.

CAUSES OF ENDANGERED STATUS Ski resort development in the area where this frog occurs, and further proposed development in the same area. In the long term, climate change caused by the 'greenhouse effect' poses a serious threat.

NUMBER LEFT Thousands.

PRINCIPAL ACTION REQUIRED Careful planning of all future development where this species occurs, and close monitoring of these populations. The World Wildlife Fund Australia has just spent about \$43 000 on a study of this species.



Mount Baw Baw Frog Philoria frosti M. G. Swan/Australian Museum

## GASTRIC BROODING FROG

Rheobatrachus silus Liem 1973

SIZE Males 33–41 mm. Females 44–54 mm IDENTIFICATION This squat, pug-nosed frog, with its dull colour and obscure pattern, can be distinguished from other frog genera by the following characteristics: tongue completely attached to the floor of the mouth; tympanum hidden; fang-like maxillary teeth more than 1 mm in length present; vomerine teeth absent; toes fully webbed; terminal disks present and fingers long and flattened. The Gastric Brooding Frog is distinguished from the Eungella Gastric Brooding Frog Rheobatrachus vitellinus by its smaller adult size, its lack of brilliant yellow patches and dark brown markings on the belly and its more southerly distribution.

The dark dorsal surface is rough and warty. Ventrally the frog is a pale cream, with the ventral surfaces of the hind limbs orange-ish in colour. The snout is blunt, and the eyes, which are set close together, are very large and protruding. Its call is unknown

DISTRIBUTION Only recorded from the Blackall



and Conondale ranges in south-east Queensland. HABITAT This aquatic frog is found along rocky mountain streams in undisturbed wet sclerophyll forest.

NOTES During the day it hides under submerged rocks, while at night it sits on rocks or clings to them while partially submerged. If disturbed, it submerges itself and hides on the bottom of the creek, typically under rocks.

The reproductive behaviour of this species is very unusual. Females lay large-yolked eggs, which measure up to 5.1 mm in diameter. These eggs characterise species which lack the need to feed during larval development. Mating occurs from November to January, when the male fertilises these eggs.



Gastric Brooding Frog Rheobatrachus silus H. Ehmann/Australian Museum

Although it has never been observed, it is presumed that the eggs are fertilised by the male before being swallowed by the female. Whether the eggs are laid in the water or on land is not known. As the number of eggs in ripe females (about forty) always exceeds that which develop in the stomach (21–26), it must be assumed that the female either fails to swallow all eggs, or (though this is less likely) digests the first ones swallowed.

The tadpoles, which are at first unpigmented, develop in the stomach of the female, gaining pigment later. They have hooked tails and are effectively unable to swim in free water. Disturbed females may regurgitate partially developed tadpoles.

As the tadpoles develop into young frogs, the stomach of the female becomes increasingly distended and the lungs may partially collapse to allow for the extra space taken up by the mass of developing young. When the young have become small frogs, they are gradually regurgitated over the space of about a week; the female typically comes to the water surface to allow one or more young to leave the mouth from the buccal cavity.

Although when the eggs are first ingested into the stomach of the female, her digestive secretions are apparently normal, a jelly surrounding each egg acts to turn off these secretions, thus protecting the eggs and allowing them to develop in a safe environment. The key ingredient secreted by the eggs and larvae, which protects them from digestive enzymes, is a substance known as prostaglandin E2. To keep the young in the stomach, the lower digestive system is apparently paralysed by the prostaglandin E2 secretions after the entry of eggs into the stomach.

As yet it is not known how developing young excrete waste from the stomach, or how they obtain oxygen from within the stomach.

The creeks where this species was originally found have suffered from silting as a result of clear-felling trees in the catchment areas. This could have led to the elimination of Gastric Brooding Frogs, although some researchers believe that the decline of this frog is due to another factor. No frogs have been caught in the wild since 1979.

STATUS Endangered, possibly extinct.

CAUSES OF CURRENT STATUS Gross habitat destruction from logging activity and gold prospectors, leading to silting of creeks.

NUMBER LEFT Not known.

PRINCIPAL ACTION REQUIRED Location of remaining wild populations and the immediate protection and management of their habitat. This includes the entire catchment areas for the creeks in which they occur.

Logging and gold prospecting in the Blackall and Conondale ranges in south-east Queensland are causing the silting of creeks where the Gastric Brooding Frog occurs. Its habitat requires immediate protection and careful management if it is to survive.

Michael Tyler



## **EUNGELLA GASTRIC BROODING FROG**

Rheobatrachus vitellinus Mahoney et al. 1984

SIZE Males 52–62 mm. Females 62–78 mm IDENTIFICATION The Eungella Gastric Brooding Frog is distinguished from the Gastric Brooding Frog *Rheobatrachus silus* by the following characteristics. The belly has extensive brilliant yellow patches and dark brown markings, rather than being a pale cream colour; the adult size is larger, and both species occur in widely separated parts of Queensland. See the entry for the Gastric Brooding Frog *Rheobatrachus silus* for more description. The Eungella Gastric Brooding Frog's call is not known. DISTRIBUTION Restricted to Eungella National



Park, some 60 km northnorth-west of Mackay, Queensland.

HABITAT Restricted to boulder-strewn, fast flowing creeks in rainforest. The water must be

clear and relatively cool. The frogs tend to hide among rocks in the current or backwaters.

NOTES This very slimy frog is essentially similar in form and habits to the Gastric Brooding Frog.

A notable difference is that in the Gastric Brooding Frog portions of the stomach wall of the female carrying babies undergo a massive and radical change, dilating and becoming thin and transparent, not unlike a plastic bag. By contrast, the stomach wall of the Eungella Gastric Brooding Frog does not change at all throughout the gestation of young.

Specimens of either species of Gastric Brooding
Frog are urgently required for further research into
how these frogs are able to suppress production of
gastric acids. It is known that eggs and tadpoles of
this species secrete a substance called prostaglandin
E2, which apparently inhibits hydrochloric acid production in the stomach. This prostaglandin is
already used in the treatment of humans with gastric
ulcers.

That both species occur in widely separated remnant rainforests indicates a much wider range for the ancestors of these two species. As rainforests have contracted, so have the ranges of the Gastric Brooding Frogs. Further clearing of habitat and silting of creeks since European settlement has hastened both species on the road to extinction.

The reason for the delay in both *Rheobatrachus* species being scientifically described probably stems in part from their dull appearance.

CAUSES OF ENDANGERED STATUS The range of the Eungella Gastric Brooding Frog is restricted to a relict area of rainforest, and this frog is highly sensitive to any form of habitat alteration. None have been seen in the wild since August 1986. NUMBER LEFT Not known.

PRINCIPAL ACTION REQUIRED Strict habitat protection throughout the water catchment area where this frog occurs.



Eungella Gastric Brooding Frog Rheobatrachus vitellinus Frithfoto

## MOUNT GLORIOUS TORRENT FROG

Taudactylus diurnis Straughan & Lee 1966

SIZE Males 27 mm. Females 30 mm IDENTIFICATION Frogs of the genus *Taudactylus* are lightly built, agile, ground-coloured frogs. These smallish frogs are distinguished from related common and widespread *Crinia* species by their possession of T-shaped terminal phalanges of the toes and fingers, and the distal expansion of the digits into disks, rarely discernible in the field.

The Mount Glorious Torrent Frog is usually identified on the basis of its inhabiting a distinctive mountain stream environment, and its limited distribution. However, diagnostic features that separate this species from other *Taudactylus* are the lack of a dorso-lateral skin fold; the relatively normal rounded snout with the nostril roughly equidistant from the mouth and the tip of the snout; the head width of less than 0.38 times the snout—vent length; fingers lacking subarticular tubercles; finger disks noticeably wider than the penultimate phalanx; the colour being olive green–grey to almost black above, with indistinct irregular darker markings, and the ventral surfaces of the thighs greyish-cream, heavily spotted with dark grey.

It is distinguished from the closely related Eungella Torrent Frog *Taudactylus eungellensis* by its smaller adult size and more southerly distribution.

The tadpoles of *Taudactylus* frogs are different from those of all other Australian frogs. They are dark brown, with a globose body and narrow fins. The unique characteristic is the umbrella-shaped oral disc completely surrounded by papillae. Mount Glorious Torrent Frog tadpoles also lack the rows of teeth found in all other *Taudactylus* tadpoles except those of the Eungella Torrent Frog.

For many years the lack of vocal sacs in adult males led researchers to believe that this frog had no call. However, in 1973 Liem and Hosmer recorded that this species emits very soft, infrequent chuckling sounds. To the human ear, this is a soft 'eek-

eek', occasionally with sharper notes. The call is most commonly heard during male-to-male aggressive encounters. Due to the background noise of running water in its natural habitat, this species is rarely heard calling in the wild.

DISTRIBUTION Known from a few localities in



south-east Queensland, including Mount Glorious, in the D'Aguilar Range, and the Conondale and Blackhall ranges further north.

HABITAT Found in and

around shady, permanent, flowing streams and nearby pools in rainforest, at elevations between 400 and 600 metres.

NOTES The Mount Glorious Torrent Frog is usually only diurnal. It clings with its toe disks to rock walls or to rocks in creeks, and when disturbed will jump into the water and remain motionless on the bottom for up to fifteen minutes before re-surfacing.

The breeding season is from November to April, and tadpoles are found at any time of year. 30–50 large eggs (2–2.5 mm in diameter) are laid in gelatinous clumps under submerged rocks. The bottom-dwelling tadpoles scrape food from the creek bottom with their umbrella-shaped lip.

The Mount Glorious Torrent Frog survives in a habitat dominated by a large cannibalistic frog of the genus *Mixophyes*, and competes with the Tusked Frog *Adelotus brevis* and two or three types of tree frog, all of whose tadpoles are raised in the same streams.

The Mount Glorious Torrent Frog is presumed to feed on various arthropods, spiders and other soft-bodied animals.

Frogs of the genus *Taudactylus* are all restricted to rainforest creek habitats, which were probably more continuous along the Queensland coast within the last



40 000 years. Habitat change resulting from deliberate Aboriginal burning of habitat has resulted in the long-term contraction of range. Continued removal of rainforest since European settlement has no doubt accelerated the decline of these species, which are now apparently restricted to relict rainforests.

STATUS Endangered, possibly extinct.

CAUSES OF CURRENT STATUS Not certain, but habitat destruction by clear-felling of trees and silting up of creeks has possibly removed this species from some areas. Cane Toads have recently invaded some areas where this frog was formerly recorded as occurring. In spite of intensive searching for speci-

The Mount Glorious Torrent Frog is under threat from habitat destruction and the invasion of the Cane Toad. This frog may even be extinct; it is essential that any remaining populations be located and their habitat properly managed.

R. W. G. Jenkins/Australian Museum

mens in the late 1980s, none were found. NUMBER LEFT Not known.

PRINCIPAL ACTION REQUIRED Location of remaining populations, and active management of their habitat, including all catchment areas. This entails keeping Cane Toads out of these areas.

#### **EUNGELLA TORRENT FROG**

Taudactylus eungellensis Liem & Hosmer 1973

SIZE Males 26 mm. Females 32 mm IDENTIFICATION Distinguished from the closely related Mount Glorious Torrent Frog *T. diurnis* by its larger adult size, distribution and coloration.

The dorsal surface of the Eungella Torrent Frog is light, with distinct irregular dark markings. Ventral surfaces of the thighs are cream or yellow, sometimes with dark spots on the antereo- and postero-distal parts of the thighs. Tubercles on each side of the anal opening are usually more pronounced in this species than in the Mount Glorious Torrent Frog.

The call of this species is not known. Published records, supposedly of the call of this species, have probably been of the call of the closely related and more recently described Liem's Torrent Frog *T. liemi*, found in the same areas.

DISTRIBUTION Ranges to the north and west of



Mackay, Queensland, from Clarke Range in the north to Finch Hatton Gorge and Crediton in the south.

HABITAT Occurs along small, shady, permanent

creeks in virgin rainforest and wet sclerophyll forests at elevation between 500 and 900 metres.

NOTES This species occurs in wetter habitat than is typical of the area. The isolated rainforest pockets in the vicinity of Eungella are remnants of what was formerly more widespread; and the Aboriginal meaning for the word Eungella is 'land of the cloud', indicating the relative moisture of the area.

The Eungella Torrent Frog is abundant where it occurs. It is active day and night.

Males actively seek females in summer, commencing in November, peaking in December and ending in May. The 30–50 eggs, measuring 2.2–2.6

mm in diameter, are deposited in a single mass under submerged rocks around December.

Most tadpoles metamorphose around April and May. The tadpoles of this species are essentially the same as those of the Mount Glorious Torrent Frog, from which they may be differentiated by the prominent X-shaped marking on the dorsal side of the body, the distinct papillary ridges on the lower labium and other oral features that comprise degenerated labial tooth rows.

Tyler reported unusual mating behaviour in this species. A male frog, perched on a rock in the middle of a creek, gave every impression of trying to attract attention to itself, first by a series of tiny hops, then by a sequence of arm and leg waving in an elaborate gymnastic display. A female, sitting a metre away on another rock, was immobile. After a short period, the male jumped into the water and swam to where the female was sitting. He went up to her and began to stroke her head and body. Eventually this activity ceased and the pair dived into the water and swam off together.

Such elaborate mating behaviour may be a result of this species lacking a vocal sac, and having to communicate for mating purposes by alternative means. It has been speculated that high background noise levels in this frog's habitat rendered voice communication ineffective.

CAUSES OF ENDANGERED STATUS Long-term decline in habitat, combined with the threat posed by introduced Cane Toads and possible damage to the creek habitat inhabited by the frog.

NUMBER LEFT Thousands.

PRINCIPLE ACTION REQUIRED Active conservation and management of habitat, including all catchment areas; the exclusion of Cane Toads from these areas is crucial.

#### LIEM'S TORRENT FROG

Taudactylus liemi Ingram 1980

SIZE 25 mm

IDENTIFICATION To identify frogs of the genus *Taudactylus*, see the description of the Mount Glorious Torrent Frog *Taudactylus diurnis* on pages 72–3. The Liem's Torrent Frog (see picture on page 76) is distinguished from other *Taudactylus* species by the following characteristics: dorso-lateral skin fold absent; head and snout rounded and normal in appearance, with the nostril roughly equidistant from the mouth and the tip of the snout; head width less than 0.38 times the snout–vent length; fingers lacking subarticular tubercles, disks on the fingers and toes only marginally wider than the penultimate phalanx. These small disks distinguish Liem's Torrent Frog from the Eungella Torrent Frog.

This frog is grey-brown on the dorsal surfaces, with a darker brown to black triangular patch with the base between the eyes and the apex pointing backwards, occasionally coalescing with a broad,



Cane Toads and long-term habitat decline have reduced the overall population of the Eungella Torrent Frog. Active conservation and management of its habitat are required for its survival.

Margaret Davies/Frithfoto

darker, lyre-shaped vertebral zone. Various other head markings are present. The ventral surfaces tend to be cream, with brown peppering on the legs.

In common with *Taudactylus* species found in rainforests near Cairns and northwards, this species has well-developed vocal sacs. The call has been recorded as a high-pitched metallic tinkering noise, sounding like a little hammer tapping on metal, repeated four or five times in quick succession. DISTRIBUTION Known from two sites near Eun-



gella, west of Mackay, Queensland, namely Mount William in the north and Crediton to the south.

HABITAT Rocky streams and their envi-

rons in undisturbed montane rainforest.

NOTES This secretive frog is active day and night.

Males are most often heard calling in December,
although they have also been heard calling in large
numbers in July, indicating breeding activity at that
time of year. Males call from under rocks on land,
along the edges of rocky streams.

At Crediton, in April 1975, some Liem's Torrent Frogs were caught inside rolled-up ends of palm fronds *Archontophoenix* sp. in an area lacking running streams. Some of these specimens were gravid females. The moist micro-environment of the trunk ends of these palm fronds acted as a catchment for water during rain, and may have some significance for the potential reproduction of this species.

Females produce 34–51 large eggs measuring 1.7–2.5 mm. The appearance and habits of this frog's tadpoles are unrecorded.

Within its habitat, the Liem's Torrent Frog has to compete with several other frog species for food and breeding sites, including the Tusked Frog Adelotus brevis, Eungella Torrent Frog Taudactylus eungellensis,

Great Barred Frog Mixophyes fasciolatus, Red-eyed Green Tree Frog Litoria chloris and Lesueur's Tree Frog L. lesueurii. Natural predators include various venomous snakes, tree snakes, birds and some small carnivorous mammals.

CAUSES OF ENDANGERED STATUS Restricted range, and the vulnerability of this species to any habitat alteration. Also probably vulnerable to displacement by Cane Toads.

NUMBER LEFT Thousands.

PRINCIPAL ACTION REQUIRED Active conservation and management of remaining habitat,

including catchment areas. Close monitoring of the remaining known populations and exclusion of Cane Toads from these areas.

The Liem's Torrent Frog, from Eungella, west of Mackay in Queensland, is very sensitive to habitat alteration. It has to compete with several other frog species for food and breeding sites, and is preyed upon by various snakes, birds and some small mammals. If the Cane Toad is allowed to invade its range, the Liem's Torrent Frog will almost certainly face extinction.

Margaret Davies/Frithfoto



# KROOMBIT CREEK TORRENT FROG

Taudactylus pleione Czechura 1986

SIZE 24-28.5 mm

IDENTIFICATION To identify frogs of the genus *Tandactylus*, see the description of the Mount Glorious Torrent Frog *Tandactylus diurnis*. The Kroombit Creek Torrent Frog is the only *Tandactylus* species known to occur in the Kroombit Tops area, near Gladstone, Queensland.

It is distinguished from the Mount Glorious Torrent Frog *T. diurnus* and Eungella Torrent Frog *T. eungellensis* by the very small disks on its fingers and toes, and from Liem's Torrent Frog *T. liemi* by its rounded rather than acuminate head shape when viewed from above, and other characteristics. The frog *Taudactylus rheophilus* from further north is distinguished from this species by its more robust build, the presence of a continuous dark lateral band running from the eye to the groin and a vertical rather than a rounded snout shape. Other *Taudactylus* from the rainforest areas of far North



The known range of the Kroombit Creek Torrent Frog is extremely restricted. Recent searches for the frog have failed to discover any specimens, and it may be extinct. The principal cause of its decline is not yet known.

Queensland Museum

Queensland are distinguished by a variety of characteristics, but are unlikely to be confused with this species due to their geographical separation of more than a thousand kilometres.

This frog has been observed calling in December and February in its natural habitat. The call consists of a series of rapidly repeated metallic 'tinks', lasting 2–4 seconds, given at 3–10-second intervals. Each series of 'tinks' typically consists of 8–10 notes, but may be more or less in number. The interval between notes slows towards the end of a series, particularly when a long series of 'tinks' is given. Captives in plastic bags have made a short 'click' sound not unlike that of *Pseudophryne major*, another frog species.

DISTRIBUTION Known from the headwaters of



Kroombit Creek, Kroombit Tops, south-east Queensland, a single collection locality.

HABITAT Taken from rocky streams with permanent running water in

an area of undisturbed relict montane rainforest. NOTES The only available information on this frog is that recorded by Czechura in his description of the species.

During periods of low activity specimens were found sheltering deep within rock crevices, under boulders or within rock piles in the vicinity of permanent pools or running water. The presence of these frogs is often only indicated by occasional calling by males.

Although these frogs are active during the spring and summer, when rainfall is heaviest, most activity appears to be around February, when gravid females have been caught. Calling by males may take place during day or night, but peaks in intensity during the early evening.

Calling males appear to maintain a minimum distance of about 1.5 metres between each other. Active frogs may be found amongst ground cover along watercourses where ephemeral pools and soaks form.

Although basking or obvious diurnal behaviour has not been observed in this frog, further observations may reveal this occurring. Other frogs known from the same immediate area, and presumably competing for resources, include a tree frog *Litoria barringtonensis*, the Tusked Frog *Adelotus brevis* and the Great Barred Frog *Mixophyes fasciolatus*.

Recent searches for this frog have failed, and it may be extinct. However, it may still exist in numbers in the wild and therefore should not be prematurely labelled as such.

STATUS Endangered, possibly extinct.

CAUSES OF CURRENT STATUS Restricted range, and the vulnerability of this species to any habitat alteration. Also the frog is probably vulnerable to displacement by Cane Toads. The principal cause of decline of this and other frogs in recent years still is not known.

NUMBER LEFT Probably thousands.

PRINCIPAL ACTION REQUIRED Active conservation and management of remaining habitat, including catchment areas. Close monitoring of the remaining known populations and exclusion of feral pests from these areas.



#### **ELEGANT MICROHYLID**

Cophixalus concinnus Tyler 1979

SIZE Males 18–22 mm. Females 23–27 mm IDENTIFICATION Microhylid frogs are most diverse in tropical parts of the world, with the few species found in tropical Australia being derived from New Guinea stock and from the sub-family Genyophrininae. Australian microhylids of the genus *Cophixalus* are characterised by several features. These include: the presence of a firmisternal pectoral girdle lacking clavicles and procoracoid cartilages; small to medium-sized finger disks, with lateral grooves; an obscure tympanum usually covered by skin; intercalary cartilage absent; dilated sacral diapophyses; unwebbed toes and no dorso-lateral skin folds.

Although called microhylids, these frogs are not closely related to hylids, the true tree frogs. Both groups have 'suckers' on the feet, which are derived differently, the true tree frogs not having lateral grooves on their suckers.

Until recently, only about five species of *Cophix-alus* were known from Australia, but in 1985 Zweifel described six new species, and at least four more undescribed species are known. Separation and identification of microhylid species is often difficult.

The Elegant Microhylid is distinguished from other Australian *Cophixalus* by the facts that the disk of the third finger is broader than that of the fourth toe, and the well-developed disks are rounded in shape, rather than being truncated distally.

This squat, moderate-limbed frog is a uniform grey-brown colour above, occasionally with obscure

The Elegant Microhylid lives in a remote area of montane rainforest. Its habitat is at risk from introduced plants and animals and human development nearby. The Elegant Microhylid is threatened with extinction by the introduction of the Cane Toad, as are most native frogs. M. Trenerry/Australian Museum

paler patches. There is sometimes a pale spot in the groin. The ventral surfaces are white, yellow or orange, variegated and with dark brown stippling.

The collector of the specimens described the call of one of the males as 'a short rattle'.

DISTRIBUTION Currently known only from



Thornton Peak, a large massif just north of the Daintree River in far North Queensland. HABITAT Known only from an isolated area of montane rainforest. Few

specimens are known to science at this stage. Most specimens are caught at night on low vegetation. A collector recorded one specimen resting in a hollow branch, with another being caught resting on a fallen palm frond covering a mat of ferns.

NOTES Like all Australian microhylids, this species is essentially insectivorous. It lays its eggs on land, where development takes place. Fully formed frogs hatch from the eggs.

Natural predators include snakes and lizards, as well as birds of prey, such as kingfishers. This species escaped scientific attention until recently because of the remoteness of its habitat, and its small, innocuous nature.

The scientific name *concinnus* is a Latin word meaning 'elegant, beautiful or fine', and refers to the lateral and ventral markings found on this frog. CAUSES OF ENDANGERED STATUS Restricted known habitat is at risk from introduced plants and animals as well as proposed development. Cane Toads pose a very serious long-term threat. NUMBER LEFT Thousands.

PRINCIPAL ACTION REQUIRED Further survey work to ascertain the numbers and whereabouts of remaining populations, with active conservation of areas where this species occurs.

## COOKTOWN MICROHYLID

Cophixalus exiguus Zweifel & Parker 1969

SIZE 18 mm

IDENTIFICATION This microhylid is the smallest in Australia. It is distinguished from other Australian microhylids by the following characteristics. The disk of the third finger is only as broad as or narrower than that of the fourth toe; the tibia-length to snout—vent ratio is at least 0.37; the eye-naris to internarial-distance ratio is at least 0.73; the disks are wider than the penultimate phalanges.

The variable dorsal colour is usually pale brown with a dark V-marking between the eyes. There is also a dark H- or W-shaped mark in the shoulder region and faint ocelli near the groin. A mid-dorsal stripe is sometimes present. Ventrally the frog is a translucent yellowish brown with a deep red blotch in the groin.

DISTRIBUTION To date this frog has only been



recorded from an area a few kilometres south of Cooktown in far North Queensland. The site is Mount Hartley, at an elevation of between 550 and 680 metres.

HABITAT All specimens collected to date have come from primary rainforest, where the type specimens were collected beneath logs, stones and other ground cover during the day.

NOTES Where this species occurs, it seems to occur in reasonable numbers. Its cryptic habits make it

rarely seen, however, and its call is unknown.

The diet consists principally of arthropods, which it catches among ground litter and low vegetation.

Prior to the contraction of rainforests following European settlement, the Cooktown Microhylid was possibly more widespread in northern Queensland. Like all Australian microhylids, extant populations appear to be relicts of populations that invaded the north of Australia from New Guinea, when there was suitable habitat between the two land masses. As Australia became drier, the microhylids here apparently became restricted to the small pockets of suitable habitat that remained, including the small area of rainforests where this species is known to occur.

Tree snakes *Dendrelaphis punctulatus*, Slaty-grey Snakes *Stegonotus cucullatus* and other frog-eating reptiles presumably prey on the Cooktown Microhylid. CAUSES OF ENDANGERED STATUS Small area of known habitat under threat from possible vegetation changes resulting from fires and introduced plants establishing themselves in the area. Cane Toads may eliminate this species if they establish themselves in the locality where the Cooktown Microhylid occurs.

NUMBER LEFT Thousands.

PRINCIPAL ACTION REQUIRED Habitat management and protection as well as the elimination of Cane Toads. More biological research into this species is required.

# BELLENDEN KER RANGE MICROHYLID

Cophixalus neglectus Zweifel 1962

SIZE 25mm

IDENTIFICATION Distinguished from other Australian microhylids by the following characteristics: disk of third finger only as broad as or narrower than that of the fourth toe; tibia-length to snout-vent ratio less than 0.33; eye-naris to internarial-distance ratio less than 0.73; disks only slightly or not at all wider than penultimate phalanges.

This is a stout, short-legged species. The colour is usually a uniform light brown or grey dorsally, occasionally with obscure darker flecks on the back and a narrow black bar below an indistinct fold over the ear. The ventral surface is pale and smooth. The disks on the fingers and toes are very small.

This species is most likely to be confused with the Elegant Microhylid *Cophixalus concinnus*, from which it can be distinguished by the smaller limbs and toe pads. Its call is not known.

DISTRIBUTION Known only from the Bellenden



Ker Range, south of Cairns in Queensland. HABITAT To date all specimens have come from primary rainforest, being found beneath ground cover by day,

and foraging on leaves and vegetation at night.

NOTES Specimens are sometimes found sheltering
under cover in close proximity to small creeks. This
species does not need free water to reproduce because

larval development takes place within the eggs, which are laid on land. However, near small creeks there is an excellent supply of arthropod food and ground cover, both sought after by this species.

The Bellenden Ker Range Microhylid is numerous where it occurs, but much of its potential habitat has been cleared or altered in recent years. Although Cane Toads have invaded the adjacent coastal plains in large numbers, the toads seem to have had some difficulty invading the preferred rainforest habitat of this species. However, the fact that the preferred and known habitat of the Bellenden Ker Range Microhylid is totally surrounded by predatory toads does not enhance the future prospects of this frog. Like a number of other North Queensland frogs that have had their ranges reduced by the impact of toads, this frog will remain under threat until the toads are eliminated.

The only known natural predators are reptiles, birds and mammals, although which of these accounts for the greatest mortality among the frogs is not known.

CAUSES OF ENDANGERED STATUS Loss of potential habitat both before and since European settlement, as well as the threat posed by the Cane Toad.

NUMBER LEFT Thousands.

PRINCIPAL ACTION REQUIRED Remaining habitat must be maintained in its current state, and in the long term Cane Toads should be eliminated.

# **ROCK-DWELLING MICROHYLID**

Cophixalus saxatilis Zweifel & Parker 1977

SIZE 29-35 mm

IDENTIFICATION Distinguished from other Australian microhylids by the following characteristics. The disk of the third finger broader than that of toe four; finger and toe disks truncated distally; minimum tibia-length to snout—vent length ratio 0.43.

This is almost certainly the largest Australian species of *Cophixalus*. Dorsally the colour is brownish with irregular darker markings, which typically include a transverse bar between the eyes, a W-shaped mark between the forelimbs and sometimes faint ocellate markings above the groin. Ventral surfaces are a creamy-white, peppered with dark brown or black, with concentrations of this on the chin and distal parts of the limbs. Its call is not known.

DISTRIBUTION Only known from Black Moun-



tain, south-south-west of Cooktown, Queensland. HABITAT Specimens have been found in the warm and humid cavities below and between the large tumbled boulders

that characterise the area.

NOTES The scientific name *saxatilis* indicates the rock-dwelling habits of this species. The factors that led to the Rock-dwelling Microhylid becoming restricted to this habitat are not known, although its slightly larger size relative to other Australian microhylids is probably some form of adaptation to the rocky environment in which this frog lives.

Specimens are caught at night when foraging for insect food in the rock piles. Due to their small size and relatively short hop, they are not difficult to catch.

That the call of this species is not known is a common feature of many microhylids. Tyler reports that some species have calls that sound more like the call of an insect or bird, so that calling males are easily overlooked by frog researchers.

Natural predators of this species would include small carnivorous mammals and snakes, both of which are abundant in the Black Mountain area. CAUSE OF ENDANGERED STATUS Restricted habitat, which may suffer in the long term from the invasion of introduced Cane Toads.

NUMBER LEFT Thousands.

PRINCIPAL ACTION REQUIRED Elimination of Cane Toads from North Queensland. All known habitat lies entirely within a conservation zone.



All the known habitat of the Rock-dwelling Microbylid lies within a conservation zone on Black Mountain, near Cooktown in Queensland. Specimens live in warm, humid cavities among the tumbled boulders that characterise the area.

G. A. & M. M. Hoye/Australian Museum

# WESTERN SWAMP TORTOISE

Pseudemydura umbrina Seibenrock 1901

SIZE 14 cm; shell length 12.5 cm

IDENTIFICATION The only short-necked tortoise in south-western Australia. It is also the only shortnecked tortoise in Australia where the ventral intergular shield contacts and partly separates the pectoral shields. This is Australia's smallest tortoise.

HABITAT Occurs in one or two small swamps near



Bullsbrook, on the northern outskirts of Perth in Western Australia.

NOTES This species was in sharp decline prior to white settlement.

although urban development near its habitat, and introduced animals, such as cats and foxes, which feed on tortoises and eggs, have certainly accelerated this species' decline.

The Western Swamp Tortoise inhabits waterholes that dry up for six months at a time during the hotter summer months. Most other tortoises could not tolerate the conditions to which this species has adapted.

Three to five eggs are laid in spring and hatch some six months later. If the swamps remain dry, the young may not survive, and recent dry years have made recruitment of young tortoises minimal.

During dry seasons, tortoises aestivate, reemerging when their swamps refill.

In the wild, these tortoises feed on tadpoles, small crustaceans and aquatic insects. Young tortoises take anywhere between eight and fifteen years to reach sexual maturity, depending on the availability of food and genetic factors

Although it was originally described in 1901 and first collected in 1839, this tortoise was unknown until rediscovered in 1954. At the time of its rediscovery the total world population was estimated at a few thousand individuals. At the time of writing,

fewer than a hundred specimens are believed to exist. The remaining known habitat and wild population of the species are now protected in the Ellen Brook (53 ha) and Twin Swamps (142 ha) reserves.

Perth Zoo, the only institution that has kept a number of specimens for any prolonged period, has found captive breeding relatively easy. However, the zoo has had problems with specimens being killed in hailstorms. No large-scale breeding programme for this species has been initiated. Due to changed environmental conditions, both before white settlement and since, it is now obvious that this species is currently unable to survive in the wild state.

CAUSES OF ENDANGERED STATUS Increased predation by species such as foxes and cats, coupled with the low fecundity of this tortoise.

NUMBER LEFT About 20 in captivity, 30 in the wild.

PRINCIPAL ACTION REQUIRED Large-scale captive breeding programme, probably involving the removal of all remaining specimens from the wild.



Foxes, cats, a low fecundity rate and a restricted range have all combined to endanger the existence of the Western Swamp Tortoise. It occurs in the Twin Swamps Nature Reserve on the northern outskirts of Perth.

H. Ehmann/Australian Museum

## LEATHERY TURTLE

Dermochelys coriacea (Vandelli 1761)

SIZE 2.4 m; shell length 2.1 m; 500 kg IDENTIFICATION Could hardly be confused with any other turtle. Adults are very large and usually dark brown, grey or black dorsally, occasionally with lighter marbling dots, blotches or spots. Seven prominent ridges run longitudinally across the carapace. Unlike other marine turtles, the limbs lack claws.

DISTRIBUTION Global. Found in both the Atlan-



tic and Indian—Pacific
Oceans in all tropical and
nearby temperate waters.
HABITAT Being a truly
pelagic species, its habitat consists of open
oceans, near-coastal and

coastal waters.

NOTES Although it nests on beaches in tropical areas, the Leathery Turtle is commonly found in temperate waters, where it feeds on various aquatic life, particularly jellyfish. Most sightings of this species in Australia are along the heavily populated eastern seaboard, where adults are seen basking on the water surface of large bays and open estuaries. This basking enables the turtles to raise their body temperature above that of the surrounding water so that they can survive more easily in these colder waters. The turtles apparently feed on the Bell Jellyblubbers Catostylus mosaicus and Portuguese Man o' War Physalia utriculus, which are found in these waters in large numbers. The turtle's oesophagus is lined with backward projecting spines, which aid in the swallowing of the soft, slippery jellyfish. Some dead turtles have been washed up on beaches, apparently having choked to death after eating plastic bags they mistook for jellyfish.

The front flippers of this species are proportionately larger than those of other sea turtles, the rear flippers being used principally as rudders.

Mating occurs in late spring and early summer, when the turtles aggregate in the tropical waters near nesting beaches. Shortly afterward the female comes ashore to lay her eggs in a specially dug nest above the high tide mark. The female typically emerges under cover of darkness and on the high tide, and crawls with great difficulty to the nesting site. A large hole, about a metre deep and slightly bottle-shaped, is scooped in the sand before the 90 or so billiard-ball-sized eggs are laid.

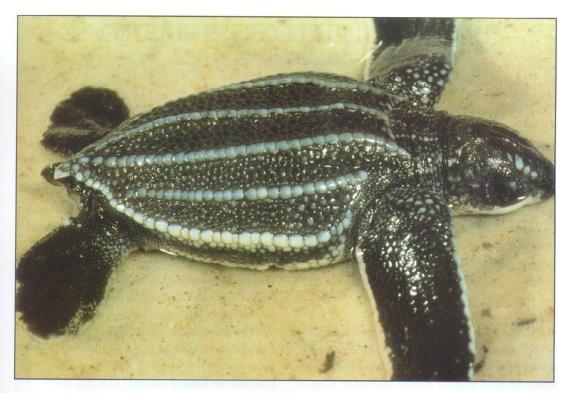
Before returning to the sea, the female covers the nest with sand and then feebly attempts to camouflage the nest by spinning the underside of her shell around the nest and adjacent area, as well as throwing sand over it with her flippers. Incubation lasts for 60–73 days, depending on sand temperature (the higher the temperature, the shorter the incubation), and most eggs usually hatch without problems.

Females typically nest several times in a season, with intervals of about ten days between successive layings. However, a given female will not nest every year.

Hatchlings measure 6 cm and weigh less than 50 grams. They usually emerge from their nests at night, when the sand has cooled down, and head instinctively for the sea, which they recognise by the light reflecting off it. Young turtles will follow torches or other man-made lights when these are present, instead of going to the sea.

Despite the great fecundity of adult turtles, few young survive to adulthood. Hazards include monitor lizards, which prey on eggs and young turtles on land, and sharks, seabirds, crabs and other marine life, which can attack when the turtles finally make it to the sea.

Globally there are about 20 000 adults; however, these turtles are most vulnerable where they nest, the principal threat being human egg-gathering.



Although some specimens have been found nesting in Northern Australia, no major rookeries for this turtle are known there. The main rookeries are in French Guiana, near the Marowijne River; at Trenggannu in East Malaysia and in Costa Rica. About 1000 females nest at each rookery each season. Nesting also occurs in Trinidad, Surinam, Sri Lanka, Fiji and on the coast of Natal.

Most countries now protect this species and the beaches tend to be manned by conservationists and fauna officials. However, poachers still take a serious toll, and numbers continue to decline.

CAUSES OF ENDANGERED STATUS Uncontrolled gathering of eggs by humans (for food); introduced feral predators, accidental death in fishing nets, and, more recently, choking to death on plastic bags.

NUMBER LEFT About 20 000.

PRINCIPAL ACTION REQUIRED Cessation of human egg removal at all nesting beaches; protection of laid eggs from predators, possibly involving artificial incubation at 'turtle farms'.



The principal threat to the Leathery Turtle is the gathering of eggs from beach nesting sites. Numerous predators in the wild, introduced feral predators, fishing nets and plastic bags—which the turtles choke on, having mistakenly eaten them—pose other hazards to this marine turtle.

Top. Queensland Museum Above. M. Rauzon/Australian Museum

#### PINK-TAILED LEGLESS LIZARD

Aprasia parapulchella Kluge 1974

SIZE 140 mm; tail 60 mm

IDENTIFICATION Legless lizards are distinguished from snakes by several characteristics, including their broad, fleshy tongues, narrow belly (ventral) scales and the ability to shed their tails. They also have small, scaly rudiments of hind limbs.

Aprasia species are distinguished from other legless lizards (Pygopodidae), by their small size and worm-like nature, as well as by other characteristics, including the following: head covered with enlarged symmetrical shields, smooth ventral scales, no preanal pores (tiny holes above the vent) or parietal scales (located on the head).

This species is differentiated from other *Aprasia* by the following characteristics: external ear opening absent; prefrontal scale not in contact with subocular labial; colour of head not sharply contrasting with that of the body; nasal and first supralabials completely fused to form a single scale, three pre-anal scales; usually two pre-ocular scales; and no lateral head pattern. The Pink-tailed Legless Lizard is the only *Aprasia* species known in its range.

DISTRIBUTION The Pink-tailed Legless Lizard is



known only from Coppins Crossing, Australian Capital Territory, where it is common, and a few specimens have been located near Tarcutta, Bathurst and Coot-

amundra, all in New South Wales.

HABITAT Only known from grazing country with weathered granite slabs and scattered trees, in proximity to water. Not known from any 'virgin' habitats. NOTES Specimens are usually caught under rocks in tunnels of a small black ant (*Iridomyrmex* sp.), on which the lizard feeds. The elongated form of this lizard facilitates access into the galleries of ant nests, where feeding takes place. The Pink-tailed Legless

Lizard is fossorial in its habits, but is not found under well-embedded rocks.

Like other pygopodids this species can vocalise, emitting a wheezing squeak. It can also use its tongue to wipe clean the clear spectacle covering its eye.

Several specimens have been known to share the same site, and specimens are commonly found with old sloughed skins, indicating long-term residence of a single site.

Two large, elongated eggs are produced around December. Specimens are not being maintained in captive breeding colonies. The principal area known for this species, Coppins Crossing, is under threat from the increasing urban sprawl of Canberra, and further fieldwork might reveal populations in other areas.

CAUSES OF ENDANGERED STATUS Not known, but possibly related to the drastic habitat modification that has occurred over the last two hundred years over the range of this species.

NUMBER LEFT Fewer than a thousand (at Coppins Crossing, ACT). No other extant populations are known, although they probably exist, and isolated accounts of this species from several suitable localities are recorded.

PRINCIPAL ACTION REQUIRED Field research to ascertain whether there are other populations of this species. In the interim, steps should be taken to ensure preservation of the Coppins Crossing population.



Pink-tailed Legless Lizard Aprasia parapulchella

#### BRONZE-BACKED LEGLESS LIZARD

Ophidiocephalus taeniatus Lucas & Frost 1897

SIZE 250 mm; tail 130 mm

IDENTIFICATION See picture on page 89. To distinguish this species from a snake, see Pink-tailed Legless Lizard *Aprasia parapulchella*. Distinguished from other pygopodids by the following characteristics: head covered by large, symmetrical shields including the parietal scales; anterior nasal scales in contact; 16 mid-body rows of smooth scales; pre-anal pores absent; external ear-opening small and concealed by overlying temporal scales; fewer than eight scales in a line across the top of the head, joining the angle of the mouth on each side.

DISTRIBUTION Known from a few widely scat-



tered localities in the Finke River and Lake Eyre drainage basins, in the southern Northern Territory and the north of South Australia. HABITAT Specimens

have been found in essentially ungrazed areas of relatively thick vegetation with loose, sandy soil overlaid with leaf litter and plant debris over deep cracking sandy loams. These areas are always well drained and usually in the vicinity of well-defined creek channels.

NOTES Described from a single specimen in 1897. Only one specimen was known to science until it was rediscovered in 1978.

This 'sand-swimming' lizard typically lives in loose leaf litter, in the region between the litter and the soil substrate. Its principal diet is insects, and research has shown Nymph Roaches (*Calolampra* sp.), lepidopteran larvae and termites to be most frequently eaten. Captive specimens have been maintained on a similar diet.

Bronze-backs will drink free water when it is available in the form of dew on leaves or surface rainwater. The activity periods of this lizard are not known, but it moves about under the substrate by day as it regulates its body temperature.

When shedding its skin, this lizard sloughs it in one piece. Unlike most pygopodids, which slough by manoeuvring through obstacles on the ground surface, the Bronze-back does so below the leaf litter, using chunks of soil to remove the skin.

For reasons that are not entirely clear, in some areas of apparently ideal habitat within the assumed range the Bronze-back is absent. This could be due to earlier habitat disturbance and elimination of this species from these areas. Where populations of this lizard occur, the population density averages one lizard per 5 square metres.

To protect itself from predation the Bronze-back is of similar colour to the soils and leaf litter where it occurs. Furthermore, when caught and placed on a hard surface from which it cannot escape by burrowing, it writhes the end of its tail. The tail writhing attracts attention to the tail, which will be shed if attacked. Most adults of this species appear to have regenerated tails.

Mating occurs around September, with two eggs produced in early summer. The eggs do not hatch until February or later.

CAUSES OF ENDANGERED STATUS Overgrazing by cattle farmers, and introduced species such as rabbits and goats have led to the destruction of most habitat suitable for this species, reducing its present range to a series of pockets within its presumed former range.

NUMBER LEFT Between 10 000 and 100 000. PRINCIPAL ACTION REQUIRED Further fieldwork and a proper mapping of remaining populations and their locations. Steps should be taken to ensure preservation of the remaining habitat areas where this lizard is still present, probably by excluding all grazing stock or by declaring the areas wildlife refuges.

#### LANCELIN ISLAND STRIPED SKINK

Ctenotus lancelini Ford 1969

SIZE 180 mm; tail 100 mm

IDENTIFICATION The Lancelin Island Skink is a member of Australia's largest skink genus, *Ctenotus*. It can be distinguished from another closely related species, *C. labillardieri*, by its larger adult size (25 per cent longer), paler brown dorsal colour, speckled back and yellow legs spotted and streaked with brownish black. *C. labillardieri* occurs on the nearby Western Australian mainland.

DISTRIBUTION Known only from Lancelin Island,



a nine-hectare island off the lower west coast of Western Australia. HABITAT Typically found on limestone rock outcrops on the northern and southern extremities

of the island.

NOTES This small diurnal lizard, like all members of the genus *Ctenotus*, is very active and fast moving. A ground-dwelling species, it excavates shallow tunnels under slabs of limestone and other cover, where it rests when inactive. Several individuals may share the same site.

When pursued, the Lancelin Island Skink will dive under loose sand in a bid to escape. As with all skinks, the tail is readily shed if it is grabbed by a predator. Regenerated tails are always distinguishable from the originals.

The Lancelin Island Skink is active at relatively high temperatures and is an opportunistic feeder on insects and other small soft-bodied animals. This species has presumably evolved from the same stock as mainland dwelling *Ctenotus labil-lardieri*, and is an excellent example of how speciation on islands occurs.

Although it is an egg-layer, almost nothing is known of the ecology of the Lancelin Island Skink. CAUSES OF ENDANGERED STATUS The risk of species being introduced onto the island, which could wipe out the only known population of this lizard.

NUMBER LEFT Fewer than 1000.
PRINCIPAL ACTION REQUIRED Strict protection of Lancelin Island, and the maintenance of habitat by the prohibition of the introduction of exotic plants and animals.

Right above. Cattle, rabbits and goats have eaten out most of the habitat suitable for the Bronze-backed Legless Lizard (see page 87), reducing its range to a series of pockets of relatively undisturbed vegetation. These should be preserved, and the whereabouts and extent of remaining populations established, as essential conservation

M. Peterson/Australian Museum

Right below. Known only from a nine-hectare island off the lower west coast of Western Australia, the Lancelin Island Striped Skink is in extreme danger of extinction should any foreign predatory species be introduced to its range.

R.E. Johnstone/West Australian Museum





# LINED BURROWING SKINK

Lerista lineata Bell 1833

SIZE 100 mm; tail 50 mm

IDENTIFICATION This very small, slender skink is one of more than sixty species from the genus Lerista that occur throughout Australia. However, in the general region that the Lined Burrowing Skink occurs, one is only likely to encounter six other Lerista species. L. lineata can be distinguished on the basis that it is the only species with two digits on the forelimbs and three on the hind limbs. The other Lerista species have different combinations of digits on limbs or no forelimbs at all.

DISTRIBUTION Lower west coast of Western Aus-



tralia, from about Mandurah northward to about Fremantle, and also on nearby Garden and Rottnest islands. HABITAT Pale sands supporting heathlands

and shrublands, with abundant leaf litter and ground debris. Known to inhabit suburban gardens. NOTES Skinks of the genus *Lerista* offer an excellent model for evolutionary study. They comprise the most complete limb reduction series in Australian

vertebrates. Species vary from having five-digit fore and hindlimbs (for example, *Lerista bougainvillii*), through varying degrees of limb reduction and numbers of digits, to complete limblessness (for example, *L. apoda*). The Lined Burrowing Skink is roughly in the middle of this sequence.

The Lined Burrowing Skink is mainly active in the evenings, when it forages on the ground surface in search of its insect prey. Predation by domestic cats is clearly a contributing factor to this species' decline in urban and near-urban areas.

During the day, the Lined Burrowing Skink is active under ground cover such as leaf litter. It may be located on cold days hiding under logs and other ground material. It is known to produce about four eggs in early summer that hatch within two months. CAUSES OF ENDANGERED STATUS Continuing urban development of Perth and nearby areas. NUMBER LEFT More than 10 000.

PRINCIPAL ACTION REQUIRED Preservation of adequate habitat in well-managed reserves, and detailed biological studies.

Lined Burrowing Skink Lerista lineata R.E. Johnstone/West Australian Musuem



#### PEDRA BRANCA SKINK

Pseudemoia palfreymani Rawlinson 1974

SIZE 190 mm; tail 120 mm

IDENTIFICATION. See picture on page 93. It is hardly necessary to resort to scale counts to distinguish this skink from other skinks: it is the only lizard found where it occurs.

DISTRIBUTION Restricted to Pedra Branca Rock,



a small wave-swept islet 26 km off the southern coast of Tasmania. Pedra Branca Rock can only be reached with some difficulty and then only in very favourable

weather conditions.

HABITAT The 2.5-hectare sandstone rock, which is less than 60 metres above sea level, is almost devoid of vegetation, and is a breeding colony for seabirds. Guano has been cemented into crevices and between boulders. The distribution of the Pedra Branca Skink is determined by the availability of shelter and, due to the somewhat territorial nature of this species with regards to shelter, numbers are restricted accordingly. Suitable habitat is restricted to six small areas with a combined area of 1360 square metres.

NOTES Information on this species is principally the result of a single study in March 1984. At the time the population of lizards on this island was reliably estimated to consist of 226 lizards, and was apparently fairly stable.

Diet appears to consist almost entirely of regurgitated fish, scavenged from the islet's co-habitants, gannets and albatrosses. Littoral crustaceans may also be eaten.

Although this species hibernates in the cooler months from about May, it will emerge from its burrow to bask on days when the ambient temperature exceeds 15° Celsius. It is common for basking lizards to cluster together, forming a dark, heatabsorbent mass of up to seventeen individuals as an efficient means of raising body temperatures in cool, windy conditions.

Regenerated tails are common in Pedra Branca Skinks and result either from predation by birds or from active combat between individuals. Lizards presumably fight to keep their burrows, although often two individuals, presumably one of each sex, will share a single burrow. One to three live young are produced during summer.

The closest relative of the Pedra Branca Skink is the Spencer's Skink, Pseudemoia spenceri, which is now restricted to colder, hilly regions of Victoria, the Australian Capital Territory and New South Wales. No close relative occurs in Tasmania. The Pedra Branca Skink presumably arrived here from Tasmania at the peak of glaciation, some eighteen to twenty thousand years ago, when Tasmania and the islet were joined, because of lower sea levels. The species presumably died out in Tasmania and continued to evolve on Pedra Branca Rock, being isolated for 15 000 years. It is now Australia's most southerly occurring wholly terrestrial vertebrate. CAUSES OF ENDANGERED STATUS Human influence has not yet placed this species at great risk. However, changes to climate that may result from the 'greenhouse effect', a rising sea level, elimination of nesting birds, and other possible alterations could pose a serious threat to this species. Its small, relatively inbred population make it particularly vulnerable. NUMBER LEFT 200-300.

PRINCIPAL ACTION REQUIRED Pedra Branca Rock is included in the South-west National Park. The population of skinks here should be closely monitored in the event of a change of circumstance.

#### ADELAIDE BLUETONGUE

Tiliqua adelaidensis (Peters 1863)

SIZE 150 mm; tail 60 mm

IDENTIFICATION A dwarf form of bluetongue lizard distinguished from other bluetongues by the following: tail shorter than the snout—vent length; no distinct cross-bands; more than thirty-two mid-body scale rows; anterior temporal scales more or less equal to others, not being longer than broad.

The two species most likely to be confused with the Adelaide Bluetongue are the Eastern Bluetongue, *Tiliqua scincoides*, which has temporal scales larger than others, being much longer than broad, and the Western Bluetongue *T. occipitalis*, which has broad, dark cross-bands on the body.

DISTRIBUTION Not known. Only eleven speci-



mens are known, all recorded from localities in South Australia, although the reliability of some locality data is uncertain.

HABITAT After

detailed morphological examination, this lizard was presumed to be an inhabitant of mallee woodland or scrub habitats.

NOTES Specimens of the Adelaide Bluetongue are recorded from different types of habitat, including outer suburban Adelaide, and it is believed that the localities in which the lizards were caught may not necessarily have been their point of origin. In other words, they 'stowed away' in timber or similar, and were caught after being transplanted.

The Adelaide Bluetongue was a diurnal ground dweller, feeding mainly on invertebrates, unlike other bluetongues, which tend to be more omnivorous.

Like all *Tiliqua*, the Adelaide Bluetongue was a live bearer, presumably giving birth to fewer than four young at a time.

The single specimen kept in captivity fed well but lost weight rapidly, presumably due to 'captivity

stress' or a parasite burden. After six weeks, and in an emaciated condition, it was killed, and was lodged with the South Australian Museum in early 1960.

In spite of several thousand hours spent by experienced herpetologists since 1960, specifically looking for this species, no Adelaide Bluetongues have been found. Some areas of suitable habitat near Adelaide, particularly east of the Mount Lofty Ranges, and on the mid and upper Yorke Peninsula, have yet to be searched.

STATUS Extinct (last live specimen caught in 1959). CAUSES OF CURRENT STATUS Not known. The Adelaide Bluetongue was probably in decline prior to the arrival of European settlers. Factors contributing to its decline may have included mice or other introduced animals, severe habitat destruction in the form of clearing and the removal of stones, or introduced toxic food species such as a plant or insect. NUMBER LEFT Presumably none.

PRINCIPAL ACTION REQUIRED Before the Adelaide Bluetongue is given the dubious honour of extinction, remaining potential habitat should be surveyed, and, if specimens are found, some should be removed from the wild and captive colonies established. Obviously the areas where Adelaide Bluetongues occur should also be protected and studied in detail.

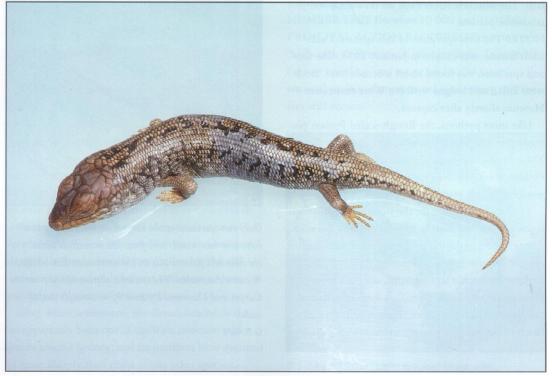
Right above. The Pedra Branca Skink (see page 91) is the only lizard found on Pedra Branca Rock, off the southern coast of Tasmania.

R. W. G. Jenkins/Australian Museum

Right below. Only eleven specimens of the Adelaide Bluetongue, a dwarf form of bluetongue, are known to science, the most recent having been collected in 1959. It was probably in decline before the arrival of European settlers, and is now probably extinct.

Glen Shea





#### **ROUGH-SCALED PYTHON**

Morelia carinata (Smith 1981)

SIZE 2000 mm; tail 244 mm

IDENTIFICATION The Rough-scaled Python is most closely related to the Carpet/Diamond Pythons *Morelia spilota*. These pythons are distinguished from other Australian pythons by their mainly small and irregular head shields. The Rough-scaled Python is distinguished from the Carpet/Diamond Pythons by its strongly keeled (as opposed to smooth) scales.

DISTRIBUTION Known only from two young



adult female specimens, taken from Mitchell River Falls, north-west Kimberleys, Western Australia.

HABITAT Both snakes were caught in patches of

monsoon vine forest in the immediate vicinity of the falls. The Mitchell River Falls are on a dissected sandstone plateau.

NOTES The first specimen of this species, a sub-adult female, was caught in January 1973. The second specimen was found about a decade later. Both were killed and lodged with the West Australian Museum shortly after capture.

Like most pythons, the Rough-scaled Python possesses pits within scales above and below the mouth. These heat-sensitive pits enable the Rough-scaled Python to actively seek warm-blooded prey, being sensitive to very minute temperature variations.

The breeding season for the Rough-scaled Python is not known, but mating probably occurs around spring, with egg-laying occurring around the beginning of summer (the wet season).

After the female lays her eggs, she coils around them to help incubate them — a form of maternal care common to all pythons. Python eggs typically hatch about sixty days later, depending on incuba-

tion temperature, although most python eggs are incubated at between 29 and 32 degrees Celsius.

Hatchlings take care of themselves immediately after birth.

CAUSES OF ENDANGERED STATUS Not known. Only two specimens, both dead, of this large and presumably highly visible species are known to science. NUMBER LEFT Possibly many thousands. PRINCIPAL ACTION REQUIRED Further survey work in the Mitchell River area to establish population levels of the Rough-scaled Python. A captive breeding programme should be set up immediately, and would be extremely easy to set up, with no shortage of herpetologists willing to volunteer their time and money, thereby ensuring the future of this species.



Only two specimens of the large Rough-scaled Python have ever been noted, both from the immediate vicinity of the Mitchell River Falls in the north-west Kimberleys, Western Australia. The species is distinguished from the Carpet and Diamond Pythons by its strongly keeled scales.

G.F. Gow

## **BROAD-HEADED SNAKE**

Hoplocephalus bungaroides (Schlegel 1837)

SIZE 60 cm; largest adults about 90 cm IDENTIFICATION Coloration essentially similar to the unrelated Diamond Python *Morelia spilota*, from which this species may be distinguished by its large symmetrical head shields, wider ventral scales, the absence of labial 'heat pits' found in most pythons, and smaller adult size (Diamond Pythons average 200cm).

DISTRIBUTION Restricted to sandstone forma-



tions within a 250-km radius of Sydney, to the north-west, west, south-west and south of the city.

HABITAT Only found in virgin bushland with

numerous large exfoliating slabs of sandstone and rock crevices. Also required are sufficient numbers of food lizards, usually Lesueur's Gecko *Oedura lesueurii*. NOTES This snake will become aggressive with the minimum of provocation. Although no deaths from this snake's bite have been recorded, some people bitten have become seriously ill and required the administering of Tiger Snake anti-venene.

The Broad-headed Snake's habit of sheltering beneath exfoliating sandstone slabs during spring and autumn makes it particularly vulnerable to habitat destruction from gardeners, who take these rocks for use in suburban rock gardens. Populations within national parks are still vulnerable to the predations of overzealous rock collectors. Amateur snake collectors could conceivably pose a threat to some populations. Isolated areas within national parks and elsewhere with suitable habitat still seem to have healthy populations of this species.

Since white settlement, the Broad-headed Snake has apparently been one of the least common snake species around Sydney, and its numbers have declined far more sharply than those of any other species.

Typically nocturnal, this snake becomes diurnal in the middle of winter, when only daytime is warm enough for it to be active.

Diet is principally lizards, although captive specimens thrive on mice.

Mating is in the cooler months with five to twelve (usually about six) live young being born in midsummer (January). Newborns measure 16 cm.

This species breeds readily in captivity. To breed most types of snake, breeders separate the sexes prior to planned mating. This does not appear to be necessary with this species, with long-term cage cohabitants regularly mating. Captive specimens have lived up to ten years.

CAUSES OF ENDANGERED STATUS. Mainly the urbanisation of its habitat, with the expansion of the Sydney metropolitan area, and the removal of its remaining 'bush-rock' habitat by gardeners.

NUMBER LEFT Between 10 000 and 100 000.

PRINCIPAL ACTION REQUIRED Cessation of 'bush-rock' collections in relevant areas. Large-scale captive breeding, and active protection (as in national parks), of unprotected areas where this species still occurs.



Broad-headed Snake Hoplocephalus bungaroides

#### WESTERN BLACK-STRIPED SNAKE

Neelaps calonotus (Dumeril, Bibron & Dumeril, 1854)

SIZE 250 mm; tail 30 mm

IDENTIFICATION The mildly venomous Western Black-striped Snake is only likely to be confused with the closely related species *Neelaps bimaculatus* or the Moon Snake, *Furina ornata*, both of which lack the dark vertebral stripe of this species (at least on the tail). The Western Black-striped Snake has fewer than 150 ventrals (broad belly scales), while the other species have more than 150.

DISTRIBUTION Lower west coast of Western Aus-



tralia, from Mandurah, south of Perth, along the coastal and near-coastal strip, north of Perth to Lancelin.

HABITAT The preferred habitat is coastal and

near-coastal dunes on pale sand, vegetated predominantly with heathlands, or eucalypt—banksia woodlands on sandy soils.

NOTES The Western Black-striped Snake is predominantly active at dusk and during the night, although its activity time varies somewhat with the seasons, tending to be more nocturnal in the warmer summer months. The activity patterns of this snake reflect those of its prey, *Aprasia* and small skinks, principally *Lerista praepedita*, the smallest burrowing skink occurring in the same area.

Although technically mildly venomous, the Western Black-striped Snake refuses to bite, even when handled, and it is doubtful whether it could manage to get its jaws around a human finger to bite it.

When harassed, the snake will raise its forebody with its head angled downward to display its brightly coloured nape band.

During the day specimens are found inhabiting

upper soil layers under leaf litter, the overhanging foliage of shrubs or tussocks and under logs and other ground debris.

When mating, the male snake 'mounts' the female and aligns his body so that it covers that of the female, and faces the same direction. Copulation occurs when the male inserts a hemipene (penis equivalent) into the female's vent, both positioned near the tail end of the body. Copulation in snakes typically lasts from one to four hours. Two to five eggs are produced.

CAUSES OF ENDANGERED STATUS Restricted distribution of this snake being centred on the rapidly growing Perth metropolitan area, and associated residential—industrial development of its habitat. NUMBER LEFT More than 10 000.

PRINCIPAL ACTION REQUIRED Conservation of suitable large areas of habitat, combined with maintenance of captive breeding colonies.



The mildly venomous Western Black-striped Snake inhabits the lower west coast of Western Australia. Its habitat is threatened with disturbance by the continuing expansion of the Perth metropolitan area.

M. Hanlon/Australian Museum

#### **RED GOSHAWK**

Erythrotriochis radiatus (Latham 1801)

SIZE Males 450 mm. Females 580 mm IDENTIFICATION Goshawks are long-tailed, broad-winged hawks with powerful talons and red or yellow eyes, commonly confused with falcons, sparrowhawks, buzzards and sometimes even sea-eagles. In the field they often flick their tails.

The Red Goshawk (see picture on page 99) is distinguished from the collared, grey and Australian goshawks by the following characteristics: massive yellow legs and feet, a black striped breast and heavily barred wings and tail. Juveniles of other raptors are frequently misidentified as this species.

Though females are similar in colour to males, some female specimens tend to have paler bellies. Immatures are similar to adults but paler above. Their underparts are cream to pale rufous and they have more distinctly barred wings and tail. The eye is brown-yellow, the cere is blue-grey, often with a green tinge, and the feet tend to be a dull yellow. CALL The call is a high-pitched, chattering 'Skeep-skeep'.

DISTRIBUTION Known from the coastal and adja-



cent parts of eastern and northern Australia, from the central coast of New South Wales to the Kimberleys, Western Australia. Occasionally reported elsewhere, but

most of these records are doubtful.

HABITAT In eastern Australia this bird is found in association with densely timbered forests and dense growth in gullies. In drier areas, including the tropical north, this bird inhabits forested river margins and nearby areas of tropical open woodland.

NOTES The Red Goshawk does not seem ever to have existed in large numbers in any area. It is usually seen singly or in pairs.

It is near the top of the food chain. Diet is mainly

other birds, and a preference is shown for waterbirds and cockatoos. As the Red Goshawk is a swift flier, prey is usually pursued directly and caught either in midair or on the ground. Prey is sometimes startled by flying close to the ground through trees. On other occasions the Red Goshawk may wait hidden in a tree and ambush a bird as it flies past. Other prey includes small mammals, snakes and lizards.

In northern Australia breeding is in the dry season, from April to November. Nesting is restricted to August—September in the east. The nest is usually constructed in the uppermost branches of a tall tree in a densely vegetated area near water. The nest is constructed of sticks, twigs and green leaves in a horizontal or vertical fork. Occasionally the Red Goshawk will nest in the abandoned nest of a crow or hawk.

One to three, but usually two eggs, measuring about 56 x 46 mm, are produced. These are slightly coarse, blue-white in colour and sometimes smeared and blotched with brown.

In common with a large number of raptors, the Red Goshawk has suffered strongly from the effects of modern pesticide residues in its food. Pesticides such as DDT and more modern variants are retained in the body by animals, and because they prey on pesticide-affected animals many birds contain harmful levels of residues. The shells of raptors' eggs may become too weak to withstand the weight of the parent sitting on them, and break.

CAUSES OF ENDANGERED STATUS Loss of habitat through human activities in southern part of range. Pesticide residues in birds prevent successful breeding activity in many areas.

NUMBER LEFT Thousands.

PRINCIPAL ACTION REQUIRED Protection of breeding sites and more selective use of pesticides by the agricultural industry, meaning a greater reliance on biological means of insect pest control.

### PEREGRINE FALCON

Falco peregrinus Tunstall 1771

SIZE Males 380 mm. Females 480 mm IDENTIFICATION Falcons are small, powerful raptors with long, pointed wings and notched bills.

The relatively large Peregrine Falcon is identified by its dark head and extensive dark cheeks. The only falcon likely to be confused with this species is the Little Falcon *F. longipennis*, which is distinguished by its smaller size, restricted black cheeks and more extensive pale half collar.

Males and females are similar in appearance, though the underside of the female is a richer chest-nut. Immatures are dark brown above, with rufous edges to most feathers and a dark brown head and cheeks. The underside is rufous-buff with dark brown streaks, except on the paler throat and chest. CALL Vocalisations include a hoarse, indrawn 'eeagh', or a loud, shrill, repetitive scream 'kek-kek-kek'. Males sometimes give a soft 'ke-kik'. DISTRIBUTION Cosmopolitan. Found in most parts



of Eurasia, the Americas, Africa and Australia, including Tasmania. In Australia this species is not common anywhere. A number of subspecies are recognised, including

two in Australia — *F. peregrinus macropus*, a large-footed variety found in most parts of Australia, including Tasmania, and *F. peregrinus submelanogenys*, a smaller race from southwestern Australia. HABITAT Ranges from rainforest to arid regions and from tropical to cool mountain areas. This bird is most commonly seen in grasslands and open woodlands, or soaring above cliffs in hilly and coastal areas. Though in most areas the Peregrine Falcon is usually seen singly or in pairs, up to five may soar together above steep cliffs in mountainous areas. NOTES The Peregrine Falcon has been known to swoop on its prey at speeds of up to 300 km/h. Diet

is mainly small to medium-sized birds and small mammals, including rabbits. The Peregrine Falcon has been known to attack birds larger than itself, including a Black Swan *Cygnus atratus*.

Prey is usually swooped on from above and caught with the talons. In some cases a bird may be stunned while in flight and then picked off the ground. The falcon will sometimes hang on to large birds and fall to the ground with them. Before swooping on larger birds, the Peregrine Falcon will sometimes tire them by harassing them in flight for some time before making the kill. If it has not been killed by the force of a midair impact, the prey is pecked to death and usually carried or dragged to a sheltered place before being eaten. Pairs of Peregrine Falcons sometimes hunt co-operatively.

The breeding season in Australia is from August to September. A nest is not built; eggs are laid in a scrape at the rear of large cliff crevices, in hollows in large trees and in the abandoned nests of other raptors or crows.

One to three, usually three, eggs, measuring  $51 \times 41$  mm, are laid. The eggs are creamish-buff, heavily blotched with red or red-brown. Incubation is shared by both parents. The chicks are clothed in creamy-white down, which develops into a complete covering of juvenile feathers within about three weeks. Chicks have a strong tendency to wander from the nest at an early age. Adult plumage is attained after 12 months.

CAUSE OF ENDANGERED STATUS Pesticide residues in food, preventing successful breeding of the bird throughout most of its range. (See previous entry.)

NUMBER LEFT More than 100 000 worldwide. PRINCIPAL ACTION REQUIRED More selective use of pesticides by the agricultural industry, meaning a greater reliance on biological means of insect pest control.



Above. The powerful Peregrine Falcon lives in a number of different types of habitat, from arid regions to rainforest. It mainly eats small to medium-sized birds—it is shown here bringing the remains of a galah to its chicks—as well as small mammals.

Jack and Lindsay Cupper/AUSCAPE International

Right. The Red Goshawk (see page 97) lives in coastal and near-coastal regions from the central coast of New South Wales north to the Kimberleys in Western Australia. Like the Peregrine Falcon, it is affected by residues of modern pesticides in its food.

Dr David Hollands



#### PLUMED FROGMOUTH

Podargus plumiferus Gould 1845

SIZE 350-420 mm

IDENTIFICATION Frogmouths are nocturnal birds with powerful beaks, long tails and cryptic coloration. Most have a brownish-red and greyish phase of base colour; females are more often brown.

The Plumed Frogmouth has orange eyes and heavily barred wings. The prominent pale eyebrow and exceptionally large plumes above the beak assist in differentiating this bird from Tawny Frogmouths. gus ocellatus as being of the same species.

The Marbled Frogmouth has orange eyes and heavily barred wings. The prominent pale eyebrow and exceptionally large plumes above the beak assist in differentiating this bird from Tawny Frogmouths.

Males are greyish, with black and white marbling. The female is a less heavily marbled rusty brown. CALL Voices recorded include a descending 'coopcoop-coop-gobble-gobble-gobble...', a toad-like 'dugger-dugger...', a soft repeated 'koo-er-loo, koo-er-loo'. The female has a harsher voice than the male. DISTRIBUTION The coastal and near-coastal area



bounded by the Conondale Range in south-east Queensland to the north and Grafton in New South Wales to the south. HABITAT Rainforests and other wet forests.

NOTES This nocturnal, sedentary rainforest dweller is usually found resting during the day. It typically rests on branches close to a treetrunk, often in pairs or family groups. When disturbed, this bird may raise its beak to increase its resemblance to a broken branch. If this tactic fails, the bird may turn and face its aggressor with mouth agape, eyes wide open and feathers fluffed up.

Diet varies with seasonal availability of food, but includes insects, spiders, small mammals and reptiles. Mammals and reptiles are swooped on, held in the beak and killed by side-to-side bashing, before being eaten.

Frogmouths are known to occasionally 'hibernate' in cooler weather and some specimens become very obese, nearly doubling their weight. The stored fat in some of these birds has been found to contain DDT and other pesticide residues.

Breeding is in October and November. The nest is a flimsy platform of twigs and occasionally vine pieces. It is placed in a tree, often high up. One to three pure white eggs measuring 40 x 29 mm are produced. CAUSES OF ENDANGERED STATUS Removal of most of this bird's rainforest habitat. Pesticide residues seem to be further eliminating these birds. NUMBER LEFT Probably thousands. PRINCIPAL ACTION REQUIRED Conservation

PRINCIPAL ACTION REQUIRED Conservation of areas where this bird occurs and the reduction in the use of harmful pesticides by farmers.



Plumed Frogmouth Podargus plumiferus Klaus Uhlenhut/ANT Photo Library

#### LESSER NODDY

Anous tenuirostris (Temminck 1823)

SIZE 330 mm; tail 105 mm

IDENTIFICATION Noddies and terns are longwinged, short-legged birds that look like slender gulls. Noddies are dark-backed terns with contrasting white caps. They are usually seen in flocks and breed in large colonies on islands.

The Lesser Noddy is dark brown with a pale grey forehead and crown shading to darker grey at the nape. There is a small arc of white above the eye, a larger one below and an interrupting black eye-ring. Males and females are alike, while immatures sometimes have a whiter cap.

The Lesser Noddy is most likely to be confused with the Common Noddy *Anous stolidus*, which is equally numerous where the Lesser Noddy occurs. However, the Common Noddy is larger, browner, has a shorter, thicker bill, a longer wedged tail, often divided in the centre, and paler underwing coverts. CALL Rattling alarm notes are uttered at individual nests. A purring call is heard throughout the breeding colony.

DISTRIBUTION The only breeding colonies are on



the Abrolhos Islands, Western Australia, and on the Seychelles Islands in the Indian Ocean. These birds range widely over the Indian Ocean, though they do not seem

to undertake major seasonal migrations. HABITAT Usually nests and breeds in mangroves. NOTES The Lesser Noddy nests in colonies numbering thousands of individuals. These birds regularly fly in lines from their mangrove nesting areas over lagoons and fringing beaches, to hunt beyond the surrounding coral reef in the open seas.

During the day, young birds are seen in huge 'nursery' flocks on beaches. They return to the mangroves late in the afternoon.

Food includes fish, plankton, molluscs and jellyfish taken from surface waters. The Lesser Noddy may dive through the crests of waves.

The breeding season is from August to December, but occasionally lasts longer. The nest is a large platform of leaves and seaweed, slightly hollow at the centre and cemented together with droppings. It is constructed on an elevated mangrove branch.

The single egg measures 45 x 30 mm. It is matt off-white, sparingly spotted and blotched with reddish-brown and purple-grey. Incubation takes about 35 days.

The Lesser Noddy will not move from its nest when incubating its egg or brooding the young, and may be physically lifted from it by a human. CAUSES OF ENDANGERED STATUS In common with many seabirds, toxic metal and pesticide residues in food are causing birds to produce thinshelled eggs, which fail to hatch. If the problem becomes worse, this species may be unable to reproduce and become extinct within a very short period. NUMBER LEFT About 30 000 pairs. PRINCIPAL ACTION REQUIRE Greater care should be taken by manufacturers and others in disposing of toxic wastes, and the use of toxic pesticides by agricultural industries should be reduced.



Lesser Noddy Anous tenuirostris R. Goodale/Australasian Ace Films

## PLAINS-WANDERER

Pedionomus torquatus Gould 1840

SIZE Males 165 mm. Females 175 mm IDENTIFICATION Though superficially similar to Button-quails (Family Turnicidae), especially in that females are the larger, brighter and dominant bird, the Plains-wanderer is not similar enough to be grouped in the same family. In common with the true quails (Family Phasianidae) this bird has a hind toe (unlike Button-Quails). It has a bustard-like plumage, and its head-shape, bill, egg and certain behavioural aspects resemble those of a plover (Family Charadriidae). As a result of these traits and various peculiar anatomical features, this bird has been placed in its own family, Pedionomidae.

The male is less brightly coloured than the female and its breast is more coarsely scalloped white and dark grey. The female has a black collar, which is heavily spotted white, and a narrow, bright chestnut breast-band.

Immatures are similar to the male, but the upper parts are more heavily scalloped in pale fawn. The underparts are spotted, not scalloped, in dark brown. CALL The female utters a mournful bovine 'moo'. When danger threatens chicks, the male utters a soft 'chuck', often repeatedly.

DISTRIBUTION Restricted to isolated pockets of



western New South
Wales, western Victoria
and nearby parts of
South Australia. Formerly occurred over
most parts of New South
Wales, Victoria and east-

ern South Australia with the range contracting most sharply within the past 90 years.

HABITAT Flat, open grassy plains, including grassy open woodlands.

NOTES At the time of settlement and as late as 1900 this bird was extremely common, and was found in its thousands in many areas. It was noted as being common around Adelaide from June to January, apparently disappearing at other times. Where the birds went was never ascertained. However, the species appeared to have all but vanished from most areas just twenty years later. Remaining populations appear to have a precarious future.

Various causes of the current status of this bird have been proposed. The Plains-wanderer is a very tame and vulnerable bird. It is reluctant to fly, even in the face of danger, and specimens may be caught during the day by hand. It is easily caught by dogs, so it must be assumed that foxes and cats would find it even easier. Its coloration probably camouflages it from birds of prey.

Though the Plains-wanderer is noted to stand on tiptoes with its head held high, it runs with a quail-like motion, crouched and with head held down and forward. When pursued, it can be identified by its distinctive dipping, fluttery flight and its habit of alighting on a raised vantage point such as a tree stump.

The Plains-wanderer moves according to food availability, with birds remaining in one area as long as food persists. Diet includes various seeds and arthropods.

Though usually solitary, these birds are commonly found in pairs or small groups during the breeding season, from June to January. Breeding activity peaks between September and December.

Females commonly mate with several males in a single nesting season.

The male broods the eggs and rears the young with minimal assistance from the female. The nest itself is a grass-lined scrape at the base of a shrub or tussock. The three or four pointed eggs measure about  $30 \times 23$  mm. They are pale green-buff, heavily blotched and freckled with brown olive and grey. Incubation takes about 23 days. Chicks have been observed feeding on termites shortly after hatching.

Captive Plains-wanderers that later successfully

bred thrived on a diet of millet, high-protein softbill mix, mealworms and termites.

CAUSES OF ENDANGERED STATUS The single most important factor contributing to the birds' decline is probably predation by feral cats and foxes. Other significant factors include competition by rabbits, house mice and grazing stock, as well as habitat alteration resulting from other human activities, including the introduction of non-native grasses. NUMBER LEFT About 2000.

PRINCIPAL ACTION REQUIRED Large reserves

are needed to protect these birds, though this should be backed up with large numbers being held and bred in captive colonies.

The female Plains-wanderer (shown here) is more brightly coloured than the male and has a black collar. The Plains-wanderer is easily caught by dogs, cats and foxes, and competes with rabbits, house mice and grazing stock for food. It has suffered from the introduction of non-native grasses into Australia.

Len Robinson



## LORD HOWE ISLAND WOODHEN

Tricholimnas sylvestris (Sclater 1869)

SIZE Males 420 mm. Females 390 mm IDENTIFICATION Hen-like in appearance. Mainly brown in colour, with light and dark barring across the wings. The powerful legs, the feet with long toes and the narrow, slightly curved bill are grey with a brownish tinge. Adults have bright red eyes. The two sexes are similar in appearance, but males tend to be larger. Immatures and juveniles have brown or orange-red eyes.

CALL Several known. Low-frequency contact calls are often made when foraging. Territorial calling is loud and prolonged and there are a number of different alarm calls.

DISTRIBUTION Various parts of Lord Howe



Island, including Mount Gower, Mount Lidgbird, Little Slope, Erskine Valley, Boat Harbour and the Goat House area. HABITAT Most remaining woodhens live in

steep, damp, closed scrub forests, dominated by palms, ferns and other wet forest plants, or in other thickly vegetated habitats, where the ground is covered with a thick layer of plant litter.

NOTES Eight species of birds have already been exterminated on Lord Howe Island in the past 150 years. The Lord Howe Island Woodhen came perilously close to becoming the ninth.

Once commonly found on all parts of the island, this rail soon became restricted to the less accessible slopes of Mounts Gower and Lidgbird at the southern end of the island. The population crash resulted from predation by humans, introduced dogs, cats, rats and pigs, and litter disturbance by pigs.

By the late 1970s, after a ten-year study by John Disney and Peter Fullagar, it was concluded that the woodhen population had stabilised at fewer than thirty individuals and was unlikely to increase

beyond that level, so it was decided to commence a captive breeding programme to help conserve the woodhen.

Under the supervision of Glenn Fraser, this programme was extremely successful. Six males and three females were removed from the wild and placed in a special compound in Stevens Reserve. The birds were carefully tended and fed a combination of artificial and natural food.

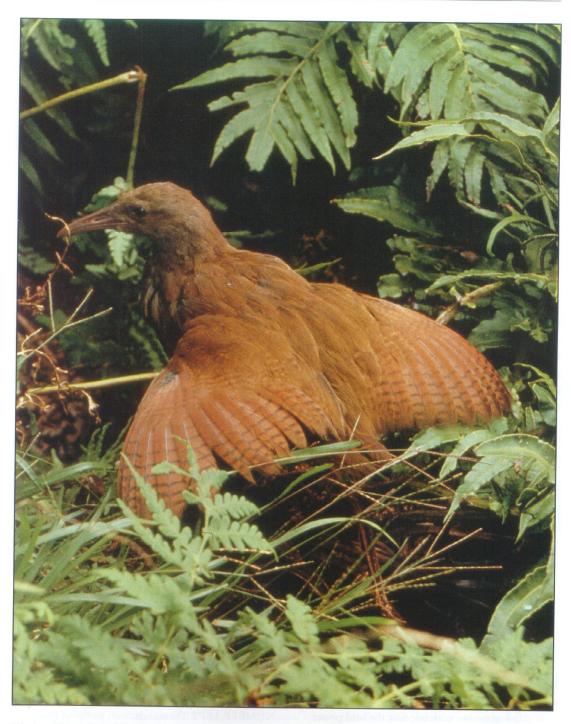
In the wild, woodhens typically produce just one clutch of eggs a year, which will be replaced if lost. The captive hens were laying five or six clutches per year in the improved conditions. The first eggs were hatched on 19 August 1980, and 92 were hatched over the following three years. At three months, chicks were released into various suitable parts of the island, where they continue to survive and breed. A programme to eradicate feral pigs has enhanced the survival prospects of wild woodhens.

Woodhens feed on a variety of insects, worms and other invertebrates, found by scratching over the forest floor. They scratch sideways with their curved bills, removing the ground debris that covers their food. Occasionally dead chicks and the eggs of other ground-nesting birds are taken.

Lord Howe Island Woodhens form mated pairs for life, and most breeding is from spring to summer. In a well-concealed nest of moss and sticks, two to four eggs are laid. These are cream, with irregular red-dish-brown mottling. The eggs take about 21 days to hatch, and the chicks grow rapidly.

The territorial adults later force their young to leave their area. The death of an adult allows a younger woodhen to occupy the territory. The territory is held all year for breeding and feeding. CAUSES OF ENDANGERED STATUS See Notes. NUMBER LEFT Several hundred.

PRINCIPAL ACTION REQUIRED A continuation



The Lord Howe Island Woodhen is the subject of an extremely successful captive breeding programme, with captive hens laying five or six clutches per year in captivity—they would typically produce only one clutch a year.

Ian Hutton/Australian Museum

# BLACK-BREASTED BUTTON-QUAIL

Turnix melanogaster (Gould 1837)

SIZE Males 150–160 mm. Females 170–180 mm IDENTIFICATION Button-quails are distinguished from true quails by their lack of hind toes, larger head, polyandrous behaviour (females mate with several males in a single breeding season), and the male being smaller than the female.

The Black-breasted Button-quail is one of the largest species, and is readily distinguished by its black or whitish, profusely barred chest. The male is brownish, with a whitish breast with black and chestnut barring. The female has a black head and breast with white spots and bars, mainly on the sides of the breast. Immatures resemble the male, but have dark eyes and grey legs.

CALL The female utters a rapidly repeated 'boom' to advertise her territory to males. A male with young utters a soft clucking sound.

DISTRIBUTION Coast and ranges of eastern



Queensland, from about Shoalwater Bay south to north-eastern New South Wales.

HABITAT Usually found at the edges of rainforest in situations

such as small grassy clearings, beneath tangled vines with thick overhead cover or underneath large clumps of lantana. Often found in proximity to false tobacco.

NOTES Because of the nature of its preferred habitat, this seldom-seen bird is sometimes more numerous in a given area than was initially thought.

To obtain seeds, invertebrates and other plant food, this strong, stocky bird uses its powerful legs and feet to scratch the ground litter.

While it scratches with one foot the bird pivots on the other foot, so that it rotates in a half-circle. Then it shifts feet and by rotating on the other foot creates a characteristic saucer-shaped depression.

These scrapes are often the only clue to the presence of this bird.

The territorial female refuses to allow other females into her area and entices other males with her repeated booming call, which also helps exclude other females. Any males that enter the female's territory will be mated with.

Breeding occurs in all but the coldest months of the year, but peaks between October and March. Both sexes build the nest, which is a shallow depression in the ground usually at the base of a shrub or tussock, and is lined with grass and leaves, but seldom covered over. The three to four rounded—oval eggs measure about 27 x 20 mm. They are glossy with a dirty white background, finely speckled with light brown and moderately covered with large blotches of dark brown, black or grey.

The male incubates the eggs alone for the sixteen or so days until hatching, and also rears the young. Females sometimes wander with males and young. The young grow rapidly and are sexually mature at about six months.

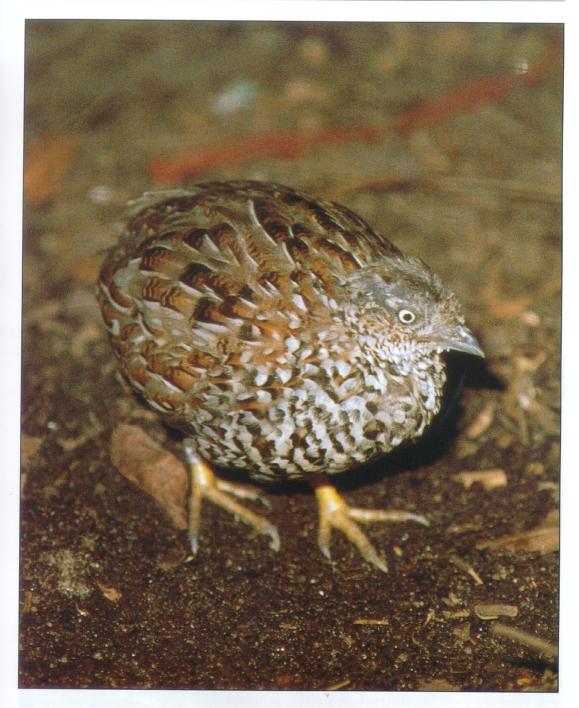
This bird normally runs at high speed when disturbed. It is reluctant to fly, and has difficulty doing

The Madagascar Button-quail *T. nigricollis* and the Philippines Ocellated Button-quail *T. ocellata* have similar appearance, habitat preferences and behaviour to the Black-breasted Button-quail, displaying an interesting case of convergent evolution of widely separated species.

CAUSES OF ENDANGERED STATUS Clearing of rainforest habitat for agriculture or timber-getting, bushfires and the effects of introduced predators such as foxes and cats.

NUMBER LEFT Thousands.

PRINCIPAL ACTION REQUIRED Further research into this bird and the maintenance of substantial captive breeding colonies, possibly in zoos.



Like many rainforest creatures, the Black-breasted Button-quail's future is under a cloud because of the continued logging of rainforest areas. Being reluctant to fly, it is easily caught by foxes and cats.

L. F. Schick/Australian Museum

#### CHRISTMAS ISLAND FRIGATEBIRD

Fregata andrewsi Latham 1790

SIZE Males 910 mm; tail 390 mm. Females 1000 mm; tail 420 mm

IDENTIFICATION Frigatebirds are large, longwinged, forked-tailed seabirds characterised by weak feet. They are usually observed soaring high in small groups on motionless wings. Courting males inflate a large red sac on the throat. Young frigatebirds have pale reddish to buff heads.

The Christmas Island Frigatebird is differentiated from the similar Lesser Frigatebird *F. ariel* and Greater Frigatebird *F. minor* by its white belly, though females of the other two species have a white chest.

Male Christmas Island Frigatebirds, which are distinctly smaller than the females, are essentially black, with black axillaries, paler upper wing coverts and a white belly. The females have a white breast, axillaries and belly. The throat is black and there is a narrow white collar.

Juveniles and immatures of this species are difficult to distinguish from Lesser Frigatebirds except for their larger size. They tend to be dark brown instead of black, which changes on maturity.

CALL Several calls have been recorded. Near the nest these include clapping, rattling and yodelling calls.

DISTRIBUTION The only known breeding site is



Christmas Island. Most birds breed along the narrow shore terrace of the north-eastern extremity of the island, where the human population is centred, par-

ticularly between Smith and Northeast Points. This bird frequents the sea and islands of Malaysia, Indonesia, Northern Australia and other nearby parts of the Indian Ocean.

HABITAT Breeding habitat is a treed part of Christmas Island, where the birds build nests. Feeding occurs in seas around Christmas Island and elsewhere. NOTES Like all frigatebirds, the Christmas Island Frigatebird is truly adapted to an airborne existence. Birds are often seen soaring effortlessly for hours over coastal waters. They rarely land on the ground, though they will roost in trees.

It has been reported that this bird even drinks while airborne, swooping over freshwater pools and scooping up water in the lower bill. As an adaptation for long periods of flying and gliding, this bird has a very large wingspan in proportion to its body size, usually more than double the body length.

The name 'frigatebird' derives from the piratic nature of its feeding. To obtain food, these birds often intercept other seabirds returning to the island after feeding and force them to regurgitate their meal, which is typically squid or flying fish. The regurgitated food is either caught by the frigatebird as it falls, or picked up from the water surface before it sinks. Occasionally frigatebirds will fish for themselves from surface shoals of fish while still in flight, or even scavenge food from inland parts of Christmas Island.

The breeding season is long, lasting nine or ten months, with courtship commencing at the end of January. The male inflates his bright red throat pouch and the female caresses it. The nest is built during March, often from material stolen from other birds' nests, and is usually placed high up in the forking branch of a tall tree. The nesting tree is usually situated on the outer margins of the shore terrace, where there is wind and a clear drop to assist take-off.

Birds typically nest in colonies of three to ten pairs. The single white egg measuring 68 x 48 mm is produced in late April, May or June. The eggs hatch in June and July, with the first chicks starting to fly in October.

CAUSES OF ENDANGERED STATUS Islanders have reduced numbers of this bird to critically low levels by poaching birds and eggs for food from readily accessible nesting trees. The use of these birds as

a food source by the islanders has been going on for some time, but increased human population and poaching, combined with decreasing bird numbers, has caused the current problem.

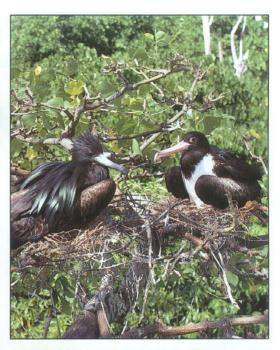
NUMBER LEFT Fewer than 2000 pairs.
PRINCIPAL ACTION REQUIRED Enforcement of protection legislation and restriction of further human urban development that would lead to the felling of nesting or roosting trees, which may cause a substantial decline in frigatebird numbers.

Right. Christmas Island, an Australian territory in the Indian Ocean, is the only known breeding site of the Christmas Island Frigatebird.

Graham Robertson/AUSCAPE International

Below. Christmas Island Frigatebirds rarely land on the ground, and will soar effortlessly over coastal waters for hours, usually in small groups.

J. Hicks/Australian Museum





### ABBOTT'S BOOBY

Sula abbotti Ridgeway 1893

SIZE 710 mm; 1600 g

IDENTIFICATION Gannets and boobies are large, distinctive seabirds with cigar-shaped bodies, long, narrow wings, stout, conical bills and long, wedge-shaped tails. Those of temperate seas are usually called gannets, while tropical species are usually called boobies.

No other Australasian gannet or booby has the same colour or pattern as the Abbott's Booby. This bird is mainly snow-white in colour, with dark black-brown on the upper wing surface. The back is patterned with bold black blotches of different shapes and sizes, but there is always a black patch on the flanks. Though the sexes are similar in colour, they are differentiated by beak colour, the male's being grey and the female's pinkish.

Immatures are similar to adults. Chicks are covered in pure white, soft down.

CALL Birds make several croaking and rumbling sounds at the nest, including a harsh 'ko-ark'.

DISTRIBUTION Nests on Christmas Island in the



Indian Ocean. Feeds in nearby parts of the Indian Ocean. This bird formerly also bred on Assumption Island in the Indian Ocean, but that colony became

extinct around 1936. The disappearance from that island principally resulted from persecution by labourers working the guano deposits there. HABITAT Abbott's Boobies nest high in tall jungle trees in undisturbed parts of the island's central inland plateau. They are commonly seen fishing over coastal and open seas.

NOTES The Abbott's Booby is a wide ranging seabird. It may travel several hundred kilometres in search of food during the breeding season, and only comes ashore to breed.

At sea these birds are often seen flying in steady, direct flight, sometimes at wave height but more often about 10 m above the sea, employing powerful, rapid, regular wingbeats, with occasional short glides. When several birds are together, they tend to fly in a single, ragged line formation.

When feeding these birds rise to 15 m or more above the sea and after locating fish hurtle in a headlong dive, with wings partly closed, into the sea to catch the fish. If diving from a lower level, these birds usually dive at a shallower angle.

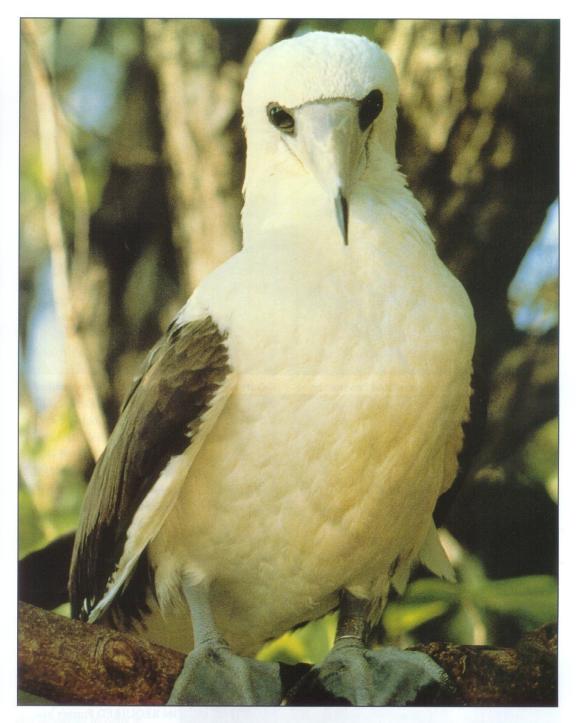
Diet is principally squid and flying fish.

Nests are usually near the tops of emergent trees of dense forest. The nest is usually situated on a broad limb at least 18 m above the ground. The large, cup-shaped nest is made of leafy twigs gathered by the male.

The female produces one whitish, chalk-covered egg measuring 60 x 40 mm between May and July. Incubation, which is carried out by both parents, lasts about 57 days. The hatchling is born dark-skinned and naked, taking about seven days to become covered in thick white down. Both parents rear and guard the chick, which remains dependent on the parents for about a year. Because the whole breeding cycle takes about 15–16 months, this bird breeds only every second year.

CAUSES OF ENDANGERED STATUS Phosphate mining is the major industry on Christmas Island, and most nesting areas for this bird lie on top of phosphate deposits that are earmarked to be mined. If the nesting sites are not mined but surrounding areas are, the desiccating effects of these surrounding areas on the breeding sites could still render the breeding sites unsuitable. These birds are unable to go anywhere else to breed.

NUMBER LEFT Fewer than 2000 pairs.
PRINCIPAL ACTION REQUIRED Habitat protection



A male Abbott's Booby. A native of Christmas Island, this bird is threatened by the possibility that phosphate mining will destroy its only breeding sites. Its extinction, should such mining go ahead, is a certainty.

J. Hicks/Australian Museum

## CHESTNUT-BREASTED WHITEFACE

Aphelocephala pectoralis (Gould 1871)

SIZE 100 mm; tail 40 mm

IDENTIFICATION Whitefaces were formerly known as 'Tom-tits' because of their resemblance to British tits, though they are not closely related. In fact, whitefaces are more closely related to thornbills and other small ground-feeding Australian warblers, with which they show similarities in feeding habits, coloration and flight. Whitefaces are readily identified by a white forchead, separated from the greyish crown by a narrow black line.

The Chestnut-breasted Whiteface is distinguished from the closely related Banded Whitface A. nigricincta by its lack of a well-defined, fine black breast-band. Occasionally Chestnut-breasted Whitefaces are confused with immature Banded Whitefaces, but even young specimens of the latter species show a distinct, fine black breast-band beneath the down feathers. The Southern Whiteface A. leucopsis has a completely white breast, rather than the broad chestnut band of the Chestnut-breasted Whiteface. The Chestnut-breasted Whiteface is the smallest of the three species.

Males and females are essentially similar in appearance. In immatures the crown, nape and face are brown with minute pale streaks. The wings are edged with white. The breast is dull fawn with dark feather-tips. The belly is white.

CALL Twittering noises, in the form of a weak chatter, mostly uttered in flight. The song consists of plaintive whistles, softer than those of other whitefaces.

DISTRIBUTION The interior of South Australia,



from west of Oodnadatta, where it is found with both the Banded and Southern Whitefaces, south to Port Augusta. HABITAT This species inhabits elevated gibber tablelands. Low-lying sandy areas are avoided.

NOTES This bird is often seen hopping about on stony ground in search of seeds and insects, in the company of both Southern and Banded Whitefaces. The Chestnut-breasted Whiteface is more timid than the other two species, however, and flies some distance when disturbed.

This bird apparently occupies areas independent of the local availability of surface water, though the possibility of long-distance movements as a response to changing local conditions cannot be discounted.

The Chestnut-breasted Whiteface may not be as rare as has been thought and its apparent rarity may be a result of the lack of fieldwork in the remote areas where it occurs.

Only one nest of this species has been described to date. It was located in the centre of a *Kochia* bush 300 mm above the ground. It was a loosely constructed, untidy-looking sphere with a side entrance near the top, lacking an entrance tunnel, and was built of dead twigs and lined with Cinnamon Quail-thrush *Cinclosoma cinnamomeum* feathers and sheep's wool. The nest lacked the long spout or entrance that characterises nests of the Banded Whiteface, though it was otherwise similar.

Breeding has been reported in August and September, but this probably reflects rainfall and other seasonal and climatic factors. About three eggs are produced, measuring approximately 18 x 13 mm. The matt eggs are pale pink and covered with purple-grey markings, especially at the larger end. CAUSES OF ENDANGERED STATUS Not known.

NUMBER LEFT Probably thousands.
PRINCIPAL ACTION REQUIRED Further biological research backed up with maintenance of a self-supporting captive population.



Above. The Eastern Bristlebird (see page 114) has suffered from the extreme contraction of its range to a series of isolated pockets of dense, undisturbed scrub in coastal areas. Most of these pockets appear to be in reserves of some kind, but the predations of cats are also a problem for this species. Esther Beaton/AUSCAPE International

Right. The Chestnut-breasted Whiteface is a small bird that inhabits gibber tablelands in the interior of South Australia and feeds on seeds and insects. Further fieldwork needs to be done throughout its range to establish whether it is as rare as has been thought.

Graeme Chapman



### EASTERN BRISTLEBIRD

Dasyornis brachypterus (Latham 1801)

SIZE 205–220 mm; tail 125–140 mm IDENTIFICATION See picture on page 113. Bristlebirds of the genus *Dasyornis* are an aberrant group of warblers; closely related genera either in Australia or elsewhere are unknown. The name 'bristlebird' comes from the two or three pairs of strong recurved bristles that project laterally from the gape, though it is unlikely that these will be observed in the field. All three species are dull and brownish in colour. Their populations have all declined sharply since European settlement.

The Eastern Bristlebird has rich brown upper parts, a rufous-brown rump and a pale buff line above the eye. The underparts are grey-brown with a scaly appearance. The flanks are dark brown. The wings are short and rounded, the tail long and graduated. The eye is red-brown, the bill dark brown, and the legs are grey-brown.

Males and females are similar in appearance and immatures are also thought to be similar.

CALL The alarm call is a harsh, sharp 'zeip' and a soft 'zit'. The song is variable, loud and piercing, but is usually along the lines of 'it wood-weet sip' or 'ipper-tee-chee'.

DISTRIBUTION Formerly found more or less con-



tinuously along the east coast and nearby areas. Since settlement, the Eastern Bristlebird's range has become little more than a series of isolated pockets within its

former range. Known localities where the species still occurs include Cunningham's Gap in Queensland and Dorrigo Plateau, Barron Grounds, Kiama and Mallacoota in New South Wales.

HABITAT This bird only lives in dense, undisturbed scrub, thickets and heaths in coastal areas and occasionally in montane native grasslands.

NOTES The Eastern Bristlebird, in common with other bristlebirds, lives on the ground among thick undergrowth, where it scratches through ground litter for seeds, insects and other small invertebrates. It leads a sedentary and solitary existence.

When disturbed it flees at high speed, running along the ground with its tail partly cocked and sometimes fanned. This bird will take to the air if necessary, though rarely for more than a few metres.

In common with other bristlebirds, the Eastern Bristlebird constructs a dome-shaped nest near the ground in grass tussocks, clumps of sword grass or small dense shrubs. The nest is constructed of coarse dry grasses, lined with finer grass, and has a large side entrance.

Two eggs are produced, measuring about 26 x 19 mm. They are a dull pale-brown with purple-brown blotches becoming more numerous at the larger end. Incubation for eggs at one nest was recorded as taking three weeks. It is common for only one chick to develop.

During the breeding season, from August to January, bristlebirds are highly vulnerable, deserting their nests after the slightest disturbance, making observation of nesting habits a difficult task.

Though the first specimens were collected from the Sydney area shortly after settlement, the Eastern Bristlebird has not been seen close to Sydney since about 1921.

CAUSES OF ENDANGERED STATUS Elimination of most of this bird's suitable habitat, the remainder of which appears to be in national parks and other reserves. Introduced predators, particularly cats, seem to have played a significant role in further reducing numbers of this species.

NUMBER LEFT Thousands.

PRINCIPAL ACTION REQUIRED Further research into the current status and long-term viability of all remaining populations is essential.

### RUFOUS BRISTLEBIRD

Dasyornis broadbenti (McCoy 1867)

SIZE 270 mm; tail 150 mm

IDENTIFICATION The crown and face of this species are rufous, while the throat and breast are grey, with a dark brown scalloped pattern giving a speckled appearance. The back is grey-brown, the wings and tail being slightly darker. The rump is cinnamon. The brown flanks grade into the grey-brown belly. The eyes are red-brown. The bill and legs are dark brown. The Rufous Bristlebird is distinguished from other bristlebirds by its larger adult size.

Males and females are essentially similar. Immatures are believed to be similar to adults.

CALL Recorded calls include a loud alarm call 'twik', which is rapidly repeated. A softer 'zir' alarm call has also been noted. The song is 'cheep-cheep-chew-chew-ee-ee', and has a squeaking, grating quality. Pairs sing in a duet.

DISTRIBUTION Currently known from near



Anglesea, south-west of Geelong in Victoria, to Murray Mouth in South Australia, mainly in coastal and near-coastal areas, but extending into the Otway Ranges along

valleys. Recorded in some parts of south-western Western Australia, principally in coastal country from Cape Naturaliste to Cape Leeuwin. It may now be extinct in that state.

HABITAT Most specimens are found in heathlands with dense thickets of sedge and melaleuca, or in the dense understorey of coastal forests.

NOTES This is normally a very shy species, feeding on seeds, fruit and invertebrates.

Pairs of birds occupy small territories averaging 1–2 hectares and both have a role in nesting.

The breeding season is from September to December. The large, domed, oval-shaped nest is situated near the base of a clump of rushes or a dense shrub.

It measures about 200 mm in diameter and is loosely constructed of dry plant stems, root fibres and fine grasses, lined with fine rootlets. The large side entrance has a short tunnel.

The two eggs produced measure about 27 x 21 mm. They are a dull purplish-white with numerous purplish-brown spots and freckles. The larger end of the egg has a slate-grey tinge.

Sub-fossil and fossil remains indicate that the Rufous Bristlebird was widely distributed and common during the Tertiary and Pleistocene periods.

Areas of heath occupied by this bird take about eight to ten years to regenerate after a bushfire. Excessive burning of suitable habitat by Aborigines probably led to the contraction of this species' range prior to European settlement. Further burning has no doubt accelerated the decline of this bird. CAUSES OF ENDANGERED STATUS Habitat destruction, and the introduction of predators. NUMBER LEFT Thousands.

PRINCIPAL ACTION REQUIRED The long-term security of remaining populations must be assessed as a matter of priority. Management of this species will probably have to include greater control of fire in areas where it remains.



Rufous Bristlebird Dasyornis broadbenti L. Pedler/Australian Museum

## WESTERN BRISTLEBIRD

Dasyornis longirostris (Gould 1839)

SIZE 170 mm; tail 95 mm

IDENTIFICATION The Western Bristlebird is readily distinguished from the Rufous Bristlebird *D. broadbenti* by its longer beak and its smaller adult size. It is unlikely to be confused with the Eastern Bristlebird *D. brachypterus*, which occurs in eastern Australia. CALL The alarm notes are a harsh sharp 'zeip' and soft 'zit'. A shrill whistle may be given when disturbed. The song given by the male is a musical whistle along the lines of 'chip-pee-tee-peetle-pet'. The female responds with a sharp three-note whistle that sounds like 'quick-more-beer'. Calling by males is also to establish territory.

DISTRIBUTION The Western Bristlebird was once



distributed over a wide part of south-western Western Australia. Currently it is only known to occur in a reserve at Two Peoples Bay, east of Albany, and in the Fitz-

gerald River National Park, west of Esperance.

HABITAT Found in dense heaths at Two Peoples

Bay. At the Fitzgerald River National Park this bird



Western Bristlebird Dasyornis longirostris Graeme Chapman/AUSCAPE International

inhabits steep, damp, densely vegetated gullies with eucalypts, plentiful bullich, banksia, tea-trees and rushes with patches of dense undergrowth often covered in a tangle of creepers.

NOTES This very shy species has proven difficult to observe in the wild. This is partially due to the dense habitat it prefers and the fact that its song bouts are brief. Males often only call about six times in succession before ceasing calling. The female responds to the male's call less than 50 per cent of the time.

The diet of seeds and insects is collected on the ground, with most feeding taking place in the early morning and late afternoon. The bill shape of this species reflects the higher proportion of insects in its diet than in that of its relative, the Rufous Bristlebird. When feeding, this bird will forage on tracks and other open areas, and its tail is usually held horizontally, but is elevated when the bird is disturbed. If disturbed it will run rather than fly, and if forced to fly it rarely travels more than 10 m, typically skimming over heath or similar vegetation.

Breeding is from August to January. The nest, which is located near the ground concealed in a banksia or grass clump, is dome-shaped with a large side entrance measuring 150 x 130 mm. It is constructed of coarse, wiry grasses and lined with fine grass. Two eggs measuring about 23 x 18 mm are produced. They are a dull brownish-white, with purple-brown freckles and blotches, more numerous at the large end, which is also tinged purplish-grey. CAUSES OF ENDANGERED STATUS Large-scale habitat destruction for agricultural purposes, introduced predators such as cats and foxes and the increase in fires in remaining habitat areas. NUMBER LEFT No more than a few hundred. PRINCIPAL ACTION REQUIRED Active management of areas within national parks where this bird occurs. Captive breeding with a view to reintroducing the species into other suitable areas.

#### NOISY SCRUB BIRD

Atrichornis clamosus Gould 1843

SIZE 210 mm; tail 100 mm

IDENTIFICATION The male has brown upper parts with fine cross bars of dark brown. The white throat forms an inverted V above the black upper breast. The lower breast is full white, while the belly and flanks are buff-brown to reddish. The eye is dark brown, the upper jaw red-brown, the lower jaw pink-white. Legs are pink-brown.

The female is essentially similar to the male but lacks black on the breast. Immatures are similar to adults, but lack the barring on the upper parts. The throat and breast are chestnut, the belly and rump grey.

CALL Despite reports to the contrary, the Noisy Scrub Bird does not truly mimic other birds' songs. It does, however, have a substantial repertoire of sounds. Two alarm notes are a loud, harsh 'squeak' and a softer 'zit'. A three-note call is 'zip-da-dee'.

The territorial song by males is a sharp, penetrating whistle of ten to fifteen notes, with the notes in the last part closely spaced and almost staccato, commonly ending with a sharp cracking sound. A short, softer, more tuneful song is also common. DISTRIBUTION Only known from a fauna reserve



at Two Peoples Bay, east of Albany, Western Australia. From 1899 until 1961, when this bird was rediscovered at Two Peoples Bay, it was regarded as extinct.

HABITAT At Two Peoples Bay the Noisy Scrub Bird is most common on a hilly granite headland, where it is found in dense, tangled undergrowth, particularly in association with the bullich *Eucalyptus megacarpa*, which occurs in moist, shady, heavily vegetated gullies. Some birds, usually young males, are found in dense patches of eucalypts on heaths between the gullies.

NOTES This bird, with short rounded wings and a long tail, has no effective clavicle or 'wishbone', which are present as mere splints of bone. Because of this similarity to the more familiar Lyrebirds (genus Menura), some taxonomists place these two types of birds in a single family associated with the true songbirds. Lyrebirds are also capable of a wide variety of singing tunes, have a similar colour pattern, which tends to blend in with their thickly vegetated habitats, and have strong legs and small wings.

With its loud, persistent song, the males of this species are easy to locate. However, because it can remain hidden in vegetation, it is rarely seen. The females, which call less frequently, are harder to locate. When escaping from a predator or moving over an open area, this bird moves in a quick but jerky manner.

Males sing throughout the breeding season, from May to early September. Singing frequency increases rapidly at the start of the season, remaining high throughout the season until breeding activity ceases. The territorial males have a long song, but on the rare occasions when they confront one another at their territorial boundaries only a short song is produced.

Immature males set up territories in less than favourable habitat, while older males occupy more favourable and well-separated territories in the gullies, often with only one male occupying a short gully. Most of the male's time is spent in a restricted part of this territory, usually fewer than 10 000 square metres. The nesting area of the female is usually on the periphery of the male's territory and well separated from his preferred haunts.

The nest is a domed structure measuring about 200 mm x 150 mm x 18 mm high, usually concealed in rushes or a tangled shrub about 200 mm above the ground. A short platform leads to the side

entrance. The nest usually takes about three weeks to build.

The single, long, oval-shaped egg measures about 29 x 20 mm. It is pale buff, blotched with orange-brown, especially at the larger end. If it fails to hatch, the female may build a second nest and lay again.

Incubation is 36–38 days. The chick leaves the nest three or four weeks after hatching and stays with the mother for at least three weeks after fledging. The young is fed similar food to the adult's diet, which includes a wide variety of invertebrates found mainly on the ground. Food is caught by flushing insects from ground litter, which is turned over by a flick of the head.

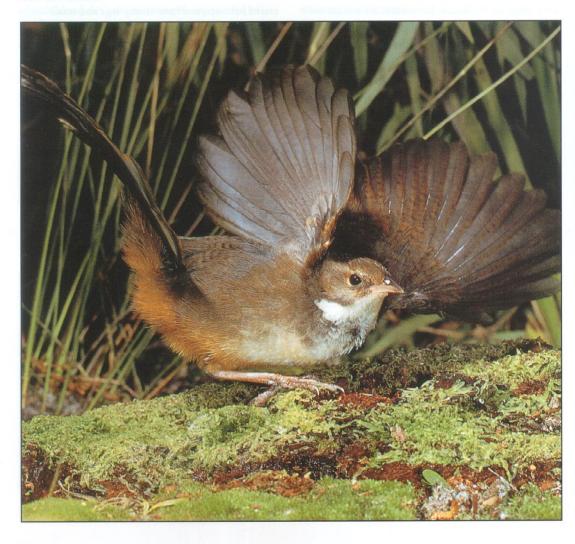
CAUSES OF ENDANGERED STATUS Elimination of habitat, including by excessive burning, destruction of vulnerable nests by fires, and predation by cats and foxes.

NUMBER LEFT Probably 500–600 birds.

PRINCIPAL ACTION REQUIRED Active management of the reserve at Two Peoples Bay.

A male Noisy Scrub Bird. Probably no more than a few hundred of these birds now exist, in a fauna reserve at Two Peoples Bay near Albany in Western Australia. They live amid dense, tangled undergrowth, and feed on insects flushed from ground litter.

A. G. Wells



### CARPENTARIAN GRASSWREN

Amytornis dorotheae Mathews 1914

SIZE Males 170–180 mm. Females 160–170 mm IDENTIFICATION The male has a mainly black forehead with thin white streaking. The crown is chestnut-brown with white streaking of longitudinal lines of shaft feathers. The dark face has a moustachelike stripe. Lores are chestnut and throat, chest and upper belly are white, grading to tawny on the lower belly and undertail coverts. Broad white streaks are on the flanks. The upper back is chestnut brown, with the lower back and rump grading to plain chestnut. The tail is dusky brown, with the feathers broadly marked with chestnut. The eye is brown, the bill dark grey with a paler base and the feet are grey.

Females are essentially similar to the males. However, their flanks and lower belly are deep chestnut, separated from the white breast by an incomplete band of lanceolate white feathers broadly edged with black.

Immatures are similar to adults, but have a duller upper surface with more indistinct streaks. The belly is paler tawny. Females lack a breast-band.

CALL The alarm call is a buzzing 'tzzzzt'. The contact call when flying is a soft, cricket-like ticking or clipping, given by both sexes. Males also have a distinct song, which may be sung at any time of year. The male utters loud, sweet, musical phrases.

DISTRIBUTION Restricted to an area along the



south-western head of the Gulf of Carpentaria, from Limmen Bight River in the Northern Territory east to China Wall Range and Nicholson River basin on the Oueensland border.

HABITAT This bird appears to be confined to craggy, spinifex-covered sandstone hills. It is never seen far from the protection of rocky ridges.

NOTES When startled, the Carpentarian Grasswren readily takes flight, flying on rapidly whirring wings for short distances over spinifex before diving into

cover. This bird will peer at intruders from beneath rocks or spinifex. When running over boulders and spinifex, it holds its head and tail low.

This sedentary species lives in groups and family parties typically numbering four or five birds. A territory about 200–300 m in diameter is maintained outside the normal breeding season.

Breeding is from October to late February. The nest, constructed in or near the top of a spinifex clump, is a bulky, oval-shaped dome with a side entrance near the top. It is constructed of closely interwoven dried spinifex stems with a few eucalyptus leaves, and lined with various soft dead leaves.

Two, sometimes three, eggs measuring about  $20.5 \times 16$  mm are laid. These vary in colour from white to pale pinkish-brown-red, with mauve or pinkish markings peppered over the surface.

Diet includes seeds and insects.

CAUSES OF ENDANGERED STATUS Restricted in range; vulnerable to predation by cats, foxes and competing birds.

NUMBER LEFT Thousands.

PRINCIPAL ACTION REQUIRED Further population surveys and biological research; mandatory habitat protection; long-term captive breeding.



Carpentarian Grasswren Amytornis dorotheae Graeme Chapman/AUSCAPE International

### EYREAN GRASSWREN

Amytornis goyderi (Gould 1875)

SIZE 140 mm

IDENTIFICATION The male Eyrean Grasswren is cinnamon-brown above with white streaks. Below, it is white with flanks of cinnamon. It has an indistinct black moustache. The tail and wings are dull brown. The iris is olive-brown, the legs are orange-brown with a violet tinge, and the bill is grey.

The female is distinguished from the male by the chestnut flanks. Immature birds are similar to adults but generally duller.

CALL A high 'seep-seep' or an upward inflected 'zzrt-zzrt'. The song is a series of rich, loud, staccato phrases, trills and silvery cadences. Songs and calls of adults are difficult to distinguish from one another, as they are usually uttered in loud, excited, jumbled bursts.

DISTRIBUTION Known from the southern Simpson



Desert and nearby areas, including the northern Lake Eyre region. To date all positively identified specimens are from South Australia.

HABITAT Seems to pre-

fer crests and slopes of sandhills with healthy tussocks of dune-binding canegrass *Zygochloa paradoxa*, which provides food, shelter and nesting. Occasionally this bird is found in association with the tall legume *Swainsona*.

NOTES Prior to August 1976, no specimens of this bird had been caught for 102 years. It remains generally scarce within its habitat but numbers appear to fluctuate on a yearly basis. In 1976, after a series of exceptionally wet years in central Australia, the Eyrean Grasswren was 'abundant' in the sandhills of the southern half of the Simpson Desert, at least in the area between Poepal's Corner and Eyre Creek.

Just one year later, after a significant drying out of the area, it was only with great difficulty that this species was located. Specimens of this bird were only found in a relict patch of greener canegrass.

It is assumed that when conditions are favourable, this bird is sedentary. However, it must migrate when conditions deteriorate. Specimens are found either solitary or in small groups.

The Eyrean Grasswren is very secretive, keeping to the dense canegrass cover and only rarely perching on the top of a tussock or shrub. Usually this bird is seen half-flying, half-bounding from one piece of cover to the next, keeping well ahead of the intruder. Distinctive tracks of paired footprints are sometimes left in the sand when this bird touches the ground at intervals of between 20 and 240 cm. Similar motion has been noted in other grasswrens.

Breeding has been recorded in August and September but may occur at other times. The nest is usually less than 50 cm above the ground, hidden in a canegrass clump. It is a deep cup or truncated sphere constructed of fine wiregrass blades and stems, often with canegrass rootlets or spider cocoons woven in. It is lined with fine grasses. The nest has a large opening on the leeward side.

The two eggs, which measure about 21 x 16 mm, are off-white, spotted and freckled with various shades of reddish-brown, purplish-grey or olive.

A pair of adults kept in Sydney lived for about four years. The diet includes the seeds of sandhill grasses, insects and their larvae.

CAUSES OF ENDANGERED STATUS Unknown. NUMBER LEFT In 1976 Shane Parker estimated the population of this species to be 'at least 112 000 individuals'. That figure is almost certainly a gross over-estimation, though population almost certainly numbers in the thousands.

PRINCIPAL ACTION REQUIRED Further biological research of this bird should be coupled with the maintenance of a permanent captive breeding stock.



Above. The Thick-billed Grasswren (see page 122) was once common throughout New South Wales, but is now extinct in most parts of that state. As it prefers not to venture into open areas, the clearing of land for settlement and the pastoral industry have had a heavy impact on its numbers.

Graeme Chapman/AUSCAPE International

Right. Eyrean Grasswrens rarely emerge from dense cover. They live among tussocks of canegrass in the southern Simpson Desert, becoming abundant in exceptionally wet years. Further research of this bird is needed.

A. D. & M. C. Trounson/Australian Museum



## THICK-BILLED GRASSWREN

Amytornis textilis (Quoy & Gaimard 1824)

SIZE 150-190 mm

IDENTIFICATION See picture on page 121. Male Thick-billed Grasswrens are usually dark amberbrown above and paler brown below, with white streaks. The centre of the belly is white. The eye is brown and legs are leaden-grey. The stout, black bill gives this bird its name.

The female is similar to the male, but has a chestnut patch on each side of the belly. Immatures are similar to adults but less distinctly marked.

At least two subspecies are currently recognised. However, there is little agreement by taxonomists on the true status of several regional forms of this and similar types of grasswren.

CALL The call is ventriloquial, a high-pitched squeak that is uttered when the bird is alarmed. The female has a reeling, sibilant trill. The song is a high-pitched, musical, silvery song with recurring phrases.



DISTRIBUTION Occurs in western and southwestern Australia, central Australia, including most of South Australia, and adjoining parts of New South Wales and

Queensland. Though formerly common in inland New South Wales, this bird appears to have become extinct in most if not all parts of that state. The range and overall population density of this bird have contracted markedly since European settlement. HABITAT Preferred habitat includes plains vegetated with saltbush, bluebush, nitrebush, canegrass Zygochloa paradoxa and similar vegetation. Along watercourses, flood debris is inhabited. NOTES This bird wanders in small troops of four to six birds, returning to accustomed haunts at the end of the day. When disturbed, it usually utters a squeak and bounces rapidly, half-running, half-flying to the next patch of cover or beyond. When

moving rapidly along the ground, the head is kept low with the tail held erect. This bird will perch on a raised area, such as a rock or on top of a bush, to survey the surrounding countryside.

On some occasions this bird is very hard to flush from cover. It has been known to remain crouched in a bush even when its hiding place is being pulled apart, fleeing only when actually exposed. The Thick-billed Grasswren has also been known to seek refuge in holes dug by rabbits.

It is usually sedentary in nature, but will undertake migrations during particularly bad seasons.

Its diet includes seeds, small berries, beetles and other arthropods. Feeding usually occurs under the cover of bushes or low vegetation.

Breeding occurs at any time of year and is governed by rainfall, though less breeding activity tends to occur in winter and at the height of summer.

The nest is usually semi-domed, but may be fully domed or cup-shaped. It is a loose construction of grasses, twigs and bark, lined with plant stalks or finer grasses, often finished with fine plant fibres, fur and feathers. The nest is usually built fairly close to the ground and concealed in saltbush, bluebush or a similar low plant.

Two or occasionally three eggs measuring about  $22 \times 16$  mm are produced. They are white to pale pink, speckled and blotched all over with redbrowns and greys.

CAUSES OF ENDANGERED STATUS Presumably the clearing of much suitable vegetation in inland Australia as a result of grazing livestock, rabbit plagues and other indirect effects of European settlement.

NUMBER LEFT Many thousands, scattered over a wide area.

PRINCIPAL ACTION REQUIRED Further biological research into this species is required, particularly into factors regulating populations.

# LILAC-CROWNED FAIRY-WREN

Malurus coronatus Gould 1857

SIZE 150 mm; tail 93 mm

IDENTIFICATION See picture on page 124. The male Lilac-crowned Fairy-wren is identified in breeding plumage by a lilac or purple crown with a black centre. The nape and face are black, the back and wings brown. The tail is blue and the throat and chest are white, shading to pale fawn on the flanks and belly. The eye is brown, the bill black and the legs are brown. Non-breeding males have a brown crown. The face is brown with some black before the eyes, and the eyebrow is white.

The female is essentially similar to the male, but lacks the distinctive crown. There is a patch of redbrown on each side of the face. The white around the eye extends to the bill. Immatures are similar in appearance to adult females.

CALL Several call notes are known. One is a highpitched reel, 'cheeper-cheeper', another a monotonous ticking or bubbling trill, while another is a loud, harsh rattle.

DISTRIBUTION The Kimberleys, across the trop-



ical Northern Territory to the south and western shores of the Gulf of Carpentaria. This bird is found in significantly fewer localities than it inhabited prior to the

commencement of grazing in northern Australia. HABITAT Preferred habitat is beside pandanus-fringed streams and rivers, though this bird is also found in low mangroves, canegrass brakes and similar habitats.

NOTES The Lilac-crowned Fairy-wren is the largest of the fairy-wrens and distinct from other Malurus

species in several ways.

A relatively bulky nest is built on or near the ground, usually well hidden in a clump of canegrass or similar dense waterside vegetation. The domed nest has a side entrance with an entry platform that extends some 80 mm from the nest. The nest is constructed of paperbark strips, grasses and leaves, lined with rootlets and other fine plant material.

The breeding season is usually from January to June, though males have been recorded as moulting into full breeding plumage in August, indicating some breeding activity at other times of year.

About three white eggs about 17 x 12 mm with dark brown speckling, especially at the larger end, are produced.

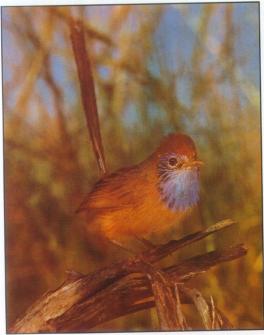
Where this species occurs it is usually locally common, being a highly gregarious species. Males tend to be shyer than females and are considerably harder to observe in the field. Females tend to lead parties or families of birds, rarely far from the water's edge, and utter a 'chirrip' call repeated by each bird. The tail is carried in a raised position, but not as far over the back as in most other *Malurus* species. The diet is principally insects, arthropods and other small invertebrates.

CAUSES OF ENDANGERED STATUS Habitat destruction caused by trampling water buffalo, pigs and livestock.

NUMBER LEFT Thousands.

PRINCIPAL ACTION REQUIRED Removal of all feral pigs and buffalo from relevant parts of northern Australia. Prevention of grazing by stock in the known habitat of this species. Captive breeding colonies would be an added safeguard for this bird.





Above. A pair of Lilac-crowned Fairy-wrens (see page 123) in pandanus, a preferred habitat of this bird. The cap on the male of the species gives the Lilac-crowned Fairy-wren its name. The wren lives in the Kimberleys, and in tropical areas as far east as the southern and western shores of the Gulf of Carpentaria. Grazing has been partly responsible for the bird's decline.

Graeme Chapman/AUSCAPE International

Left. A male Rusous-crowned Emu-wren; the female has grey cheeks and a greyish-fawn chin and throat. Burning and grazing of its spinifex habitat have affected populations of this bird.

M. & I. Morcombe

### RUFOUS-CROWNED EMU-WREN

Stipiturus ruficeps Campbell 1899

SIZE 145 mm; tail 80 mm

IDENTIFICATION Emu-wrens of the genus *Stipiturus* are distinguished from all other Australian birds by having only six feathers in their tails. These tails are substantially longer than the body of the bird, and are delicately filamented. The tail feathers lack barbicels (tiny, interlocking hooks) and have fewer barbs or barbules than normal. Because emu feathers also lack barbicels, early naturalists gave these birds the name 'Emu-wrens'. Both species are very similar and closely related.

The Rufous-crowned Emu-wren is distinguished from the Mallee Emu-wren (sometimes regarded as a race of the Rufous-Crowned Emu-wren) and the Southern Emu-wren by its unstreaked rufous crown, proportionately shorter tail and smaller adult size (making it one of the smallest birds in Australia) and its more northerly, arid-zone distribution.

Females are distinguished from males by their grey cheeks and greyish-fawn chin and throat.

Immatures are similar to adults but duller.

CALL The song is a high, faint, reeling trill. The bird also calls in a series of four or five rapidly delivered, intense, high notes at equal or slightly descending pitch. Many people cannot hear this high, faint call.

DISTRIBUTION Found throughout a wide area of



arid inland Australia, from western Queensland through the Northern Territory and South Australia to Western Australia. The full range of this species may not

yet be known, as it was only discovered in western Queensland, near Opalton, in 1969, before which the Rufous-crowned Emu-wren was not known from that state.

HABITAT Preferred habitat is spinifex country, particularly where the 'buck' variety grows. Usually there is also an overstorey of stunted mallee, melaleuca or acacia. On several occasions, however, this species has been found in low scrub on flat country, a long distance from the nearest spinifex.

NOTES Fleeing birds often fly headlong into a large hummock of spinifex, without being impaled on the numerous needle points. By removing the spinifex growth piecemeal (which is a difficult task) it is sometimes possible to capture a bird that has fled. It is rare to see a bird fly more than a few metres at a time, but it can move through large bunches of spinifex rapidly if necessary.

The breeding season is somewhat affected by rainfall conditions, but is usually between August and January. The nest is usually constructed within 300 mm of the ground at the centre of a spinifex clump or a small, dense bush. The well-hidden nest is oval in shape, and is constructed of twigs, bark strips, dry grass and leaves, bound together with spider's silk. It is lined with soft feathers and occasionally a few flowers. The entrance is usually at the side.

Two or three, usually three, 16 x 12 mm eggs are laid. They are white, freckled and spotted reddish-brown all over, but particularly heavily at the larger end.

Diet consists of insects and other invertebrates. CAUSES OF ENDANGERED STATUS Excessive burning and grazing of habitat is apparently reducing numbers of this species throughout its known range.

NUMBER LEFT Thousands.

PRINCIPAL ACTION REQUIRED Further population surveys and biological research to assess more clearly the habitat requirements of this bird. This should be followed by active management of remaining suitable habitat.

### HELMETED HONEYEATER

Lichenostomus cassidix Gould 1867

SIZE 210-230 mm

IDENTIFICATION This species resembles the closely related Yellow-tufted Honeyeater *Lichenostomus melanops*, from which it is distinguished by the prominent yellow crest or helmet on the forehead. It is also larger. Both species are brownish black on the back and yellow below. The face has a broad black mask and the lower cheeks and throat are yellow. Males and females are essentially similar in appearance. Immatures have greener yellow areas. CALL A series of harsh 'tchurrs', for contact and group displays. The alarm note is a more urgent, harsher 'tchurr'. The song is a sweet whistling. DISTRIBUTION Known only from the vicinity of



Yellingbo, in the Dandenong Ranges 45 km east of Melbourne.

HABITAT Associations of swamp gums, manna gums and tea-tree thickets alongside creeks,

where there is a broken canopy and a dense shrub understorey of leptospermum, melaleuca and hakea. NOTES This bird generally lives in small colonies, and is sedentary and gregarious in nature.

Diet includes insects, spiders and nectar, particularly scale insects. Most insects are caught in the canopy of lower trees and shrubs and occasionally beneath the bark of larger trees.

The breeding season usually extends from August to January, but in some years extends from June to March, allowing some birds to raise two broods in a year.

The cup-shaped nest is usually placed in a shrub or small tree 0.3 to 4 m above ground in a fork, vine tangle or where several stems interlace. It is constructed of bark strips and grass, bound with spiderwebs and cocoons. It is lined with fine strips of debris, animal fur and feathers.

Usually two, occasionally three, eggs measuring

about 23 x 17 mm are produced. They are smooth, dull flesh-buff to white, becoming darker at the large end, spotted and blotched with chestnut, purple-red and purple-grey mainly on the larger end, where a band occasionally forms.

Incubation lasts about two weeks. Though the female does most of the nest building, both parents brood the eggs and feed the young. Other birds occasionally assist at the nest. For several days after hatching nestlings are fed solely on nectar. Insects are introduced into the diet later.

CAUSES OF ENDANGERED STATUS Not certain. Presumably habitat clearing, excessive burning and human recreational pursuits.

NUMBER LEFT About 200 individuals.

PRINCIPAL ACTION REQUIRED Potential predators, including feral cats, foxes and introduced birds, should be kept out of the Yellingbo State Fauna Park, which also needs fire protection. A captive breeding programme with a view to reintroducing the bird to other areas is operating.



There are only about 200 individual Helmeted Honeyeaters in existence. The Honeyeater's habitat within the Yellingho State Fauna Park near Melbourne should be fire-protected and kept free of feral cats, foxes and introduced hirds

Len Robinson

### **BLACK-EARED MINER**

Manorina melanotis (Wilson 1911)

SIZE Males 245–260 mm. Females 235–250 mm IDENTIFICATION The Black-eared Miner is one of a group of species commonly known as the 'Large-wattled Honeyeaters'. These birds have a distinct wattle of coloured skin behind or over the eye and adults are more than 200 mm in length.

The only miners of similar colour to the Black-eared Miner are the Noisy Miner *M. melanocephala*, distinguished by its black crown, and the Yellow-throated Miner *M. flavigula*, distinguished by its smaller black wattle near the eye and its more yellowish colour.

Both sexes are similar in colour. Immatures are similar to adults.

CALL All calls are harsh and grating sounds. The territorial flight call is 'teu-teu-teu-teu'. A nasal, miaowing alarm call is given to ground predators. A whistled 'ti-ti-ti' is given to airborne predators. Before dawn this bird may sing in a chorus of whistled notes. Like all flock-dwelling birds, Black-eared Miners vocalise frequently.

DISTRIBUTION Restricted to the region within a



few hundred kilometres of where New South Wales, Victoria and South Australia meet. HABITAT Patches of trees and scrubs in woodland habitat.

NOTES The diet of the Black-eared Miner is mainly insects, mostly pecked off leaves in the woodland canopy. They also find food in tree flowers, and the bark of trees, and on the ground.

Black-eared Miners will unite to mob predators and are particularly noisy when ganging up on snakes and goannas.

These birds, when breeding, are often found in large colonies, where several females nest simultaneously. Males visit the females in turn, and after the eggs hatch may feed the young of several females. The

females may advertise their presence by a stereotyped flight display, in which the head is held up and back.

The breeding season commences in September or October. The nest is cup-shaped and constructed of twigs and grasses. It is lined with wool or animal hair, and cobwebs are used to bind the nest to the branches. The nest is usually located in the fork of a sapling or near the outer branches of a tree.

Two or three, occasionally four eggs measuring 26 x 19 mm are produced. They are red-buff in colour and thickly dotted with small red-brown spots, particularly at the larger end.

CAUSES OF ENDANGERED STATUS Habitat destruction through land clearance, direct competition and possibly hybridisation with the Yellow-throated Miner or Noisy Miner.

NUMBER LEFT Thousands.

PRINCIPAL ACTION REQUIRED Further research into wild populations of this species and the establishment of 'pure breeding' captive colonies.



The Black-eared Miner is now restricted to a small area of woodland around where New South Wales, Victoria and South Australia meet. As a species it may possibly be threatened by hybridisation with the Yellow-throated Miner or the Noisy Miner. This bird is feeding a chick at its twig-and-grass nest.

J. Purnell

### REGENT HONEYEATER

Xanthomyza phrygia (Shaw 1794)

SIZE 210 mm

IDENTIFICATION The Regent Honeyeater has a distinctive bare, warty face, yellow edges to the feathers on the back and black and white scallops on the back and breast.

Both sexes are similar in appearance. Immatures resemble adults but are duller, with browner wings and tail and a yellow bill. Adults have a black bill. CALL The call is a metallic, bell-like 'chink-chink-chink'. The song is a 'cloop-cloop-cloop' or a musical 'quipper-quip'.

DISTRIBUTION Coast, nearby ranges and slopes of



south-eastern Australia from Rockhampton in Queensland to the Victorian—South Australian border area and Kangaroo Island, South Australia. HABITAT Preferred

habitat is woodland and open forest. This includes disturbed areas.



The nomadic Regent Honeyeater feeds in flocks of up to 100 birds in flowering and fruiting trees. Its numbers have always appeared to fluctuate widely, but a sudden decline in recent years has as yet gone unexplained.

Graeme Chapman

NOTES The Regent Honeyeater is highly nomadic. Flocks numbering up to a hundred birds follow the flowering of trees such as eucalypts and banksias. These birds are sometimes reduced in number to a few isolated pairs in districts where they were formerly numerous. Occasionally large flocks of these birds may appear in areas where they were previously unreported. Numbers have shown a general decline in recent years.

Cultivated fruit, including figs, plums and grapes, is eaten in addition to the nectar and insects that typically constitute this bird's diet. When flocks are large, the damage to crops can be substantial.

When fleeing, this bird flies swiftly, with the bright yellow patches on the wings and tail being clearly visible.

The breeding season is from August to January. The nest is usually situated in a thick, vertical fork, an upright forked branch, on a horizontal branch or in a mistletoe, 1–19 m above ground level. The nest is cup-shaped, constructed of bark strips held together with spiderwebs and lined with dry grass and bark shreds. The inside of the nest measures roughly 65 x 50 mm.

Usually two eggs are laid, measuring about  $24 \times 18$  mm. Their colour is red-buff, becoming darker towards the larger end, with small purple-red and underlying violet-grey markings, which usually form a cap at the larger end.

CAUSE OF ENDANGERED STATUS Within its range, the Regent Honeyeater has never been as numerous or common as most other honeyeaters. In recent years, for uncertain reasons, numbers seem to have declined sharply.

NUMBER LEFT Thousands.

PRINCIPAL ACTION REQUIRED The holding of large numbers of this bird in captivity as a safeguard against disaster striking wild populations, while further biological research is carried out.

#### NORFOLK ISLAND GREY-HEADED THRUSH

Turdus poliocephalus Latham 1801

SIZE 220–225 mm; tail 80–85 mm IDENTIFICATION Birds usually identified as *Turdus poliocephalus* are found throughout a wide area, including most islands north of Australia. Their distribution includes rainforest and dense forest parts of New Guinea, the Solomon Islands, Indonesia, Malaysia, the Philippines, Taiwan, Samoa and Christmas and Norfolk islands. About fifty geographically separated subspecies are recognised. Due to the uncertainty of this species' taxonomic status, the Norfolk Island Grey-headed Thrush *T. poliocephalus* is treated here as a species in its own right, though such may not be the case.

The Norfolk Island Grey-headed Thrush is recognised by its grey head and body. The forehead, lores and crown are greyish brown, paler on the nape. The chin, throat and the sides of the face are brownish buff. The body is brownish black, while the wings and tail are blackish brown.

Both sexes are similar in colour. Immatures are similar, but the head is darker and dully streaked, while the underparts and flanks have a reddish tinge. CALL The call is a single 'tchook', often repeated. The song consists of a series of short warbles. DISTRIBUTION The Norfolk Island Grey-headed



Thrush is now restricted to central forest areas of the island

HABITAT Rainforests and dense wet forests are preferred.

NOTES This mainly ter-

restrial bird feeds principally on invertebrates such as insects, worms and molluscs, as well as seeds and fruit.

It usually found singly, in pairs or occasionally in family groups. These birds are usually found foraging unobtrusively on the ground in dense cover.

The breeding season is from September to Decem-

ber and from April to May, though related island thrushes elsewhere have different breeding seasons. The nest is bowl-shaped and made of grass, leaves, bark and moss, lined with leaves and grass. It is usually placed within 2–5 m of the ground in the fork of a tree or shrub, or in a tangle of vegetation.

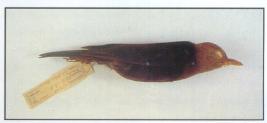
The two to four eggs measure about 30 x 21 mm. They are pale green or greenish blue, with red and grey splotches. The female alone incubates the eggs, which hatch in a little under three weeks. Fledging takes a similar period.

The nests, being close to the ground, are highly vulnerable to the predations of introduced cats and rats, both of which will climb low heights to catch young birds.

CAUSES OF ENDANGERED STATUS The European Blackbird *T. merula* and Song Thrush *T. philomelus* have been released onto Norfolk Island and appear to be displacing the endemic variety, which also has to defend itself from new predators such as rats and cats.

NUMBER LEFT Fewer than ten individuals.

PRINCIPAL ACTION REQUIRED A captive breeding programme to ensure the long-term security of the Norfolk Island Grey-headed Thrush is essential if any remaining specimens are found.



The Norfolk Island Grey-headed Thrush is possibly extinct; in recent years no specimens have been sighted. It has possibly been entirely displaced by the European Blackbird and Song Thrush.

American Museum/Australian Museum

## FORTY-SPOTTED PARDALOTE

Pardalotus quadragintus Gould 1838

SIZE 100 mm

IDENTIFICATION Pardalotes are spotted birds of pudgy build, with short tails, strong legs and stout, blunt bills adapted for taking scale insects from leaves.

The Forty-spotted Pardalote is distinguished from other Australian pardalotes by its plain crown, without spots or stripes and a dark eye in a lemon-yellow face, which lacks a white eyebrow or a dark mark between the eye and the bill. It actually has more than forty spots, but few people actually bother to count them. This bird is most likely to be confused with juvenile Spotted Pardalotes *Pardalotus punctatus*, which are more brownish than greenish and also have a red rump.

Both sexes look similar. Immatures are similar to adults, but the face and undertail coverts are a paler yellow.

CALL The normal call is a repeated soft, nasal 'whee-wit' or 'whee-oot', with the first note louder. Breeding males have a loud, nasal territorial 'twint'. When at the nest, both sexes utter a soft 'whi' contact call. DISTRIBUTION Restricted to six or seven relict



populations on peninsulas and islands in the east and south-east of Tasmania. Probably extinct on King Island in the Bass Strait. This bird formerly occurred over a

wide area of Tasmania, but since the 1920s the range has declined sharply to the point of near extinction. Remaining populations appear stable however, and are possibly on the increase.

HABITAT Dry sclerophyll forests in coastal and near-coastal areas seem to be the only habitat occupied.

NOTES The call of the Forty-spotted Pardalote differs from that of other pardalotes in Tasmania, and the presence of this bird is often only detected by its call. It is often hard to see, because of its small size, dull colour and tendency to feed 10 m or higher in the outer or top branches of eucalypts.

Where Forty-spotted Pardalotes occur, their favoured feeding tree is the white gum *Eucalyptus viminalis*. Diet is principally small beetles, wasps, flies and spiders from the stems and leaves. Other food sometimes taken includes millipedes, weevils, leaf bugs, termites and scale insects. Despite having a slightly hooked bill, adapted for feeding on scale insects, the Forty-spotted Pardalote does not feed as extensively on these insects as do other related pardalotes.

During winter, foraging groups of Forty-spotted Pardalotes form, often in company with mixed flocks of honeyeaters, fantails, thornbills and robins, and engage in spirited calling, wing fluttering and posturing, followed by play chasing, sometimes involving more than ten birds.

When food is plentiful these birds appear to be sedentary, often being found in the same tree all year, though migrations of up to 30 km within a year occur, possibly resulting from local food shortages.

Breeding partners sometimes maintain pair bonds for some time throughout the year, even when feeding in groups, though cases where birds swap partners before and during nesting are also known.

The breeding season is from September to January, with groups of birds nesting close together. They typically occupy adjacent tree hollows or hollow tree trunks. The nest is dome or cup-shaped, depending on the size and shape of the nest cavity, and is typically constructed of stringybark fibre and lined with fine *Poa* grass, mammal hair and feathers.

Three to five lustrous white eggs measuring about  $17 \times 13$  mm are produced. Both parents incubate the eggs and feed the young. Incubation takes about 16

days and the young fledge about 25 days later. CAUSES OF ENDANGERED STATUS This bird has apparently been relatively uncommon since European settlement. Competition from the more successful Spotted Pardalote *P. punctatus*, which has more recently colonised Tasmania and appears better able to utilise resources, could well be the the cause of the sharp decline in Forty-spotted Pardalote numbers since the 1920s.

NUMBER LEFT About 1500 breeding pairs.
PRINCIPAL ACTION REQUIRED Protection of habitat where this bird occurs and the maintenance of a substantial captive breeding population.

Below. The gregarious Gouldian Finch (see page 132) inhabits tropical Australia, nesting exclusively in hollow tree branches and hollows in termite mounds. The cause of its recent decline is not known. It is easily bred in captivity, although it remains endangered in the wild.

J.M. Labat/AUSCAPE International



Above. The Forty-spotted Pardalote is now restricted to a few relict populations on peninsulas and islands in the east and south-east of Tasmania. Once common in a large part of Tasmania, since the 1920s it has declined in the face of competition from the more efficient Spotted Pardalote.

Dave Watts/ANT Photo Library



## **GOULDIAN FINCH**

Erythrura gouldiae (Gould 1844)

SIZE 140 mm

IDENTIFICATION The Gouldian Finch (see picture on page 131) is not likely to be confused with any other Australian finch, due to its striking coloration. It has a green back, purple breast and yellow abdomen. Males have a darker purple breast than females. Juveniles are greyish to olive-green above and grey-brown below.

Several colour phases are known. 'Black-headed' birds outnumber 'red-headed' birds about three to one, while the 'golden-headed' phase is only seen very rarely.

CALL A sibilant 'ssit'. The song is an almost inaudible, high-pitched series of hisses and whines interspersed with clucking sounds.

DISTRIBUTION Tropical Australia and adjacent



drier grasslands, with the exception of the eastern side of Cape York,
Queensland.
HABITAT Preferred habitat appears to be open grassy plains with

scattered tall trees near sources of permanent water, or similar open woodland habitat.

NOTES This highly gregarious grass finch is often seen in large flocks, though it tends to avoid human habitation and settled areas. Diet includes various grass seeds, including sorghum. The birds cling to the vertical stems of the seed spikes as they remove the seeds. At certain times of the year insects become the dominant part of the bird's diet. Gouldian Finches feed almost entirely on flying ants and termites at the beginning of the breeding season, which coincides with the commencement of the northern

wet season and the emergence of winged termites.

When drinking, these birds suck up water.

Unlike any other Australian finch, these birds seem to nest exclusively in hollow tree branches and hollows in termite mounds. The nest itself is typically a feeble structure, globular in shape and constructed of dry grasses. Occasionally the eggs are simply deposited in the hollow.

Often birds nest side by side and up to six pairs may nest in the branches of a single tree. Nesting is mainly between December and May. From four to eight pure white 17 x 13 mm eggs are laid. Both sexes share incubation and brooding. Two or three broods may be raised in a single season. Groups of young birds have been observed in 'creches' in wild populations.

Young birds mature rapidly and are able to breed before they have adult plumage. Young parents and offspring are occasionally seen in the same plumage. At the end of the dry season, as the grasslands dry up, these birds appear to move further north to greener areas.

#### CAUSES OF ENDANGERED STATUS Not

known. A recent study by Sonia Tideman and others has found that 66 per cent of dead Gouldians found are infested in the air sac and lungs with a parasitic mite which can cause symptoms similar to bronchitis and pneumonia. The degree to which this mite has contributed to the decline in these birds is not known yet.

NUMBER LEFT Many thousands. Numbers in the wild may be underestimated.

PRINCIPAL ACTION REQUIRED Further research into wild populations and continued large-scale captive breeding.

#### WESTERN WHIPBIRD

Psophodes nigrogularis Gould 1844

SIZE 210-255 mm

IDENTIFICATION Whipbirds are crested birds with stout, conical bills and long tails. They are not ornately coloured.

The Western Whipbird is distinguished from the closely related Eastern Whipbird *P. olivaceous* by its distinct black throat with white sides, grey breast and nearby parts of the belly. The Eastern Whipbird has a black breast mottled with white.

Other features of the Western Whipbird include its grey crest, olive-green back, wings and tail, red eye, black bill, and dark brown to slate-black legs.

Both sexes are similar in appearance. Immatures lack the white throat markings found in adults. CALL The call consists of harsh, grating scolds and chatters. The song is sung by both male and female in conjunction. It starts with a scratchy 'it's for teacher' from the male, followed by 'pick it up' from the female. When disturbed these birds are silent. DISTRIBUTION There appear to be several geo-



graphically isolated populations in the southern part of Australia. These include the mallee in north-western Victoria and south-eastern South Australia, Kangaroo

Island, southern Yorke Peninsula and Eyre Peninsula in South Australia, and mallee country between Albany and Ravensthorpe in Western Australia. At the time of the first European settlement, this bird was common over a wide area of south-western Western Australia, including dune scrub near Perth. HABITAT Dense mallee and heath scrub. NOTES The Western Whipbird lacks the whipcrack song of its eastern relative. Its sweet, repetitive song is most commonly heard during winter. These birds appear able to sing with a ventriloquial effect.

Despite the frequency with which this relatively

noisy bird is heard, it is rarely seen for more than a fleeting glimpse. This sedentary, strongly territorial bird spends most of its time on the ground or in low undergrowth, where it feeds on insects.

The breeding season is from July to November. The cup-shaped nest is constructed of fine twigs, strips of bark and dry grass, lined with finer grass. It is usually positioned in a dense bush such as spinifex or swordgrass, less than a metre above the ground.

Two eggs measuring about 27 x 19 mm are produced. They are pale blue and sparsely spotted with black. The eggs are incubated by both sexes and take about 19 days to hatch, with a nestling period of roughly 14 days. If approached by a human, the sitting bird is very reluctant to be flushed from the nest. CAUSES OF ENDANGERED STATUS The key causes probably include habitat destruction and predation by foxes and cats. These birds probably declined in range after the arrival of Aborigines and their burning of the countryside.

NUMBER LEFT Thousands.

PRINCIPAL ACTION REQUIRED Further research into the biology of this bird and rigid protection of remaining habitat.



Western Whithird Psophodes nigrogularis J. B. Paton/Australian Museum

## WHITE-BREASTED SILVEREYE

Zosterops albogularis Gould 1837

SIZE 140 mm

IDENTIFICATION Silvereyes are identified by the characteristic white ring around the eye. The White-breasted Silvereye is one of two silvereyes endemic to Norfolk Island, and is easily distinguished by its larger adult size, brownish green back, brown flanks and white chin and throat. The belly is predominantly cream-white. The eyes are brown, the bill is black and the legs are grey.

Males and females are essentially similar. Immatures are similar to adults.

CALL The call is a series of high-pitched notes. The song is a sweet, pleasant warble, but is seldom heard. DISTRIBUTION Restricted to Mount Pitt Reserve



and adjacent areas on Norfolk Island. At the turn of the century, this bird was common on all parts of Norfolk Island. HABITAT Though most of the remaining popula-

tion inhabits the upland rainforest of Mount Pitt, this is not necessarily the preferred habitat of this species, but more likely reflects a final refuge in the wake of habitat destruction and introduced competitors elsewhere.

NOTES The White-breasted Silvereye differs from other *Zosterops* in its generally solitary nature.

Diet is varied and includes caterpillars, other invertebrates, wild fruits and berries.

Breeding occurs from October to December. The nest is a cup-like structure about 80 mm in diameter, constructed of fine grasses, rootlets, cobwebs and similar material, lined with finer material such as animal hair. It is usually suspended from a forking branch or twig about 5 m above the ground. Two pale blue eggs with a little gloss, measuring about 17 x 13 mm, are produced. These take almost two weeks to incubate.

The wide ranging Grey-breasted Silvereye was first noticed on Norfolk Island in 1904 and appears to have increased in number and become a serious competitor with the White-breasted Silvereye. Groups of Grey-breasted Silvereyes have been observed driving single White-breasted Silvereyes away from trees which contain mutually sought-after food.

CAUSES OF ENDANGERED STATUS There are probably several reasons for the decline of the White-breasted Silvereye since the turn of the century, including the introduction of feral cats and rats, and clearance of much of its habitat. However, the impact of the Grey-breasted Silvereye *Z. lateralis* on this species may also be a major factor contributing to its decline.

NUMBER LEFT Fewer than fifty.

PRINCIPAL ACTION REQUIRED Exclusion of Grey-breasted Silvereyes from where the White-Breasted Silvereye remains, and the establishment of a viable and permanent captive population.



White-breasted Silvereye Zosterops albogularis. Lithograph from Gould's The Birds of Australia, Supplement 1869. Mitchell Library

### GOULD'S PETREL

Pterodroma leucoptera (Gould 1844)

SIZE 300 mm

IDENTIFICATION See picture on page 137. Petrels (including fulmars and shearwaters) are seabirds with nostrils fused into a tube on the top of the bill to improve breathing and salt excretion in the marine environment. The bill is covered in plates of consistent design and has a distinct forceps-like downdrooping tip. The long wings enable these birds to glide over long distances, expending minimal energy.

The Gould's Petrel is one of the gadfly petrels, possessing largely white underwings with a black diagonal stripe. These fast flying birds are characterised by the dark W patterns on their upperwings.

The Gould's Petrel has a black head, nape and semi-collar and a relatively broad black diagonal stripe on the underwing. Its tail tip is black. Both sexes look alike. Immatures are similar to adults. CALL When the bird is in flight over the colony the call is a thin, cicada-like 'tit-tit-tit'. On the ground and at nesting sites the call varies on a squeaky, high-pitched 'pee-pee-pee-peeoo' or a low, vibrating growl 'cr-r-r-roe'.

DISTRIBUTION The only known breeding colony



of the nominate subspecies is on Cabbage Tree Island, a 20-ha island at the entrance of Port Stephens, New South Wales. These birds range widely over

nearby seas, including southern Queensland, New South Wales, Victorian and Tasmanian coasts. Specimens from the Fiji breeding colony are sometimes seen over the Great Barrier Reef.

HABITAT The Gould's Petrel faces little competition from other marine birds on Cabbage Tree Island because it chooses to nest in the rocky areas not favoured by burrowing inhabitants of the island.

NOTES Under the cover of the palm forest, this bird

nests in rock piles, hollows in fallen trees and small holes in the ground. The nest itself is minimally furnished, usually with little more than a few chips of dead Cabbage Tree *Livistona australis* fronds. Nests tend to be clustered in small groups, usually in palm-dominated areas, and principally in two gullies on the western slope.

Unlike most other petrels, the Gould's Petrel does not dig burrows and avoids nesting on islands where predators such as lizards and gulls are common.

These birds usually fly into their nesting area well after dark and can be seen circling above the island, calling and performing the paired chases typical of most gadfly petrels. To reach their nest sites they tumble through the tree canopy, and move about the sloping ground with a fluttering flight. To get off the island before dawn these birds usually scramble up the trunks of trees before fluttering off through a gap in the canopy.

This bird is a summer breeder, with the Cabbage Tree Island colony occupied from October to April. A single white egg measuring roughly 50 x 37 mm is produced.

The diet appears to consist almost exclusively of cuttlefish, which are caught on or just below the sea surface. They are swallowed whole and the horny beaks of these cephalopods are presumably regurgitated later.

CAUSES OF ENDANGERED STATUS Not completely known. Apparently this has always been a relatively scarce species.

NUMBER LEFT Fewer than a thousand adults nest on Cabbage Tree Island each year; a similar number nest in Fiji. No others exist.

PRINCIPAL ACTION REQUIRED Strict protection of breeding grounds in existing reserves from any form of disruption, including rats or cats. Rabbits on Cabbage Tree Island, a legacy of myxomatosis experiments, should be eliminated.

## PROVIDENCE PETREL

Pterodroma solandri (Gould 1844)

SIZE 400 mm

IDENTIFICATION The Providence Petrel is one of the all-dark gadfly petrels sometimes confused with dark shearwaters. The Providence Petrel is distinguished from other Australian all-dark petrels by its whitish face and white patches on the underwings. Other all-dark petrels have either a grey or a brown face. Both sexes are alike. Immatures are similar to adults.

CALL Flying birds call a loud, rapidly uttered, screeching 'kir-rer-rer, kik-kik-kik-kik'. Birds on the ground in the breeding colony have a more trilling version, 'ker-er, kuk-kuk-kuk-...ker-er'.

DISTRIBUTION An uncommon visitor to the east



coast of Australia, this bird nests in large numbers on Lord Howe Island, the only known nesting site. The reporting of adults in the sea east of Japan in July,

which is when breeding at Lord Howe takes place, could indicate another as yet undetected breeding colony closer to Japan.

HABITAT On Lord Howe, most large breeding colonies of this bird are on the steep forested slopes of Mounts Lidgbird and Gower. Smaller lowland colonies are probably remnants of larger colonies present prior to European settlement.

NOTES Large numbers of these birds gather at their Lord Howe nesting grounds from February to November. This bird seems to show little fear of humans, and at the commencement of the breeding season may be attracted by loud and persistent shouting, or similar noise.

On clear winter afternoons masses of petrels gather above the breeding colony and are seen flying in courtship chases above the treetops, diving and wheeling in the sharp wind upcurrents around the

mountainside. This activity commences around March and continues until about August.

Though nests are often close together in a colony, nesting birds aggressively maintain a territorial space around their nesting burrow, keeping intruding birds out. The nest itself is in a chamber at the end of a burrow about a metre long. The burrow entrance is commonly surrounded by a crescent-shaped mound of excavated dirt. An occupied burrow usually, but not always, has its entrance blocked by a plug of dried leaves and palm fronds.

The nest is usually a substantial pile of shredded palm fronds and *Dracophyllum fitzgeraldii* leaves. The single, white, 65 x 48 mm egg is laid around mid-May and hatches in July. The daytime mating aerial activity and night-time calling at the colony decline sharply after this, with birds not thus employed leaving the area by late August.

Until November, when the chicks become fledged, the adults appear to spend much time at sea in search of food, usually returning to the nests only at night to feed the growing chicks. Adults sleep quietly on the ground for most of the night, then commence calling prior to departing before sunrise. Diet is principally cephalopods, small fish and crustaceans more than 100 mm long, swallowed whole.

The endangered Lord Howe Island Woodhen *Tricholimnas sylvestris* is one of a number of predators of the eggs of this petrel. Most eggs taken are those laid by young birds on bare ground early in the season, before a proper nesting site is constructed. CAUSES OF ENDANGERED STATUS Elimination of breeding colonies of this species from some areas and the continued threat posed by introduced animals on Lord Howe Island.

NUMBER LEFT Fewer than 20 000 pairs. PRINCIPAL ACTION REQUIRED Removal of pests from Lord Howe Island and continued statutory protection.



Gould's Petrels (see page 135) are fast-flying, wide-ranging birds whose only known breeding colonies are on Cabbage Tree Island at the entrance of Port Stephens in New South Wales, and in Fiji. Fewer than 2000 birds exist, and the reason for their scarcity is not yet known.

Peter Fullagar/AUSCAPE International



The Providence Petrel nests in large numbers on Lord Howe Island, and once also nested on Norfolk Island, where it was hunted to extinction by human settlers and the animals they introduced. The petrel lays its eggs on hare ground during the early part of the breeding season, before a proper nesting site of shredded palm fronds and leaves is constructed, and there are a number of predators on its eggs.

Peter Fullagar/Australian Museum

## **RED-FRONTED PARROT**

Cyanoramphus novaezelandiae (Sparrman 1787)

SIZE Male 310 mm; tail 160 mm. Female 280 mm; tail 155 cm

IDENTIFICATION Generally this is a bright green parrot with lighter, more yellowish plumage on the underparts. A large, bright red patch covers the forehead and crown with an interrupted band across the eye. There is also a distinct red patch on each side of the rump. Females are marginally smaller than males, their red patch beyond the eye is less extensive and they have a smaller, narrower bill. Immatures resemble adults, but have less extensive red head markings. CALL When in the air, a chattering 'ki-ki-ki'. Other calls when perching include a trisyllabic, piping whistle resembling 'tee-pee-wee' on an ascending scale, and a soft, mellow 'tu-tu-tu-tu'. When alarmed the call is a harsh chatter.

DISTRIBUTION Essentially a New Zealand species;



however, the Red-fronted Parrot is also known from Norfolk Island, where it is usually called the Norfolk Island Parrot, and recognised as a distinct subspecies

C. novaezelandiae cooki. Formerly two other subspecies C. n. subflavescens and C. n. erythrotis were known from Lord Howe and Macquarie Islands respectively. HABITAT On Norfolk Island, the dense forest dominated by Norfolk Island pines at Mount Pitt Reserve. This parrot will visit nearby gardens to feed on ripening fruits, including peaches and guavas. In New Zealand, this species is most commonly seen on offshore islands, the only remaining stronghold. On treeless nesting islands, it rests and nests beneath tussocks or in holes.

NOTES Formerly, when more common, the Redfronted Parrot was often seen in large flocks. Now it is usually seen in pairs or small flocks.

The breeding season, though variable, is usually

from August to March, peaking between October and February. Typically the nest is in a hollow limb or a hole in a tree. Three to nine (usually five) roughly elliptical eggs, measuring about 26 x 23 mm, are laid on decayed wood-dust lining the floor of the hollow. After about twenty days of incubation, which commences within a day or two of the first egg being laid, the eggs hatch. Though only the female broods, both parents look after the young, which leave the nest some thirty days after hatching. CAUSES OF ENDANGERED STATUS The population on Macquarie Island apparently became extinct after sealers introduced cats to the island. Norfolk Island birds apparently suffer from a disease that causes them to lose their feathers, from competition from the introduced and now common Crimson Rosella Platycercus elegans, from predation by introduced rats and cats, and from loss of habitat to urban development.

Probably the Norfolk Island subspecies will never be able to viably survive in the wild state again. NUMBER LEFT A recently published estimate was between 17 and 30 birds on Norfolk Island. The total population still numbers in the thousands. PRINCIPAL ACTION REQUIRED Continued and widespread captive breeding is most important.



Red-fronted Parrot Cyanoramphus novaezelandiae J. Hicks/Australian Museum

### NIGHT PARROT

Geopsittacus occidentalis Gould 1861

SIZE Males 240 mm; tail 115 mm.

Females 220 mm; tail 95 mm

IDENTIFICATION This is a generally mottled, yellowish-green parrot of dumpy build. Females are similar in colour to males, but also possess a yellowish-white wing-stripe. Immatures are thought to be dull and plain in colour, with some yellow on the throat and neck, but this is not certain.

CALL In flight, a short, sharp note is made several times in succession. When coming to water at night, the bird has been recorded emitting a low, disyllabic whistle; also, when travelling to and from water, a long-drawn-out, mournful whistle, which carried some distance. A distinct squeak, as if the bird had been hurt, has been recorded when this bird is flushed from cover, sometimes likened to the croak of a frog. A captive specimen last century uttered a faint whistle and a loud, harsh, disyllabic note. DISTRIBUTION Formerly recorded from arid areas



of all mainland states.

Most recent unconfirmed sightings of this species seem to have been from spinifex country in far western New South Wales. Only one live

Night Parrot has been collected this century, from arid Western Australia. Most of the 22 known museum specimens came from South Australia. HABITAT A distinct preference for spinifexdominated habitats is shown, though some Night Parrots have been recorded from other habitats. NOTES The Night Parrot is similar in many respects to the rarely seen Ground Parrot Pezoporus wallicus, found in some coastal areas of the southern half of Australia. Both mainly nocturnal ground-dwellers rarely, if ever, perch in trees, and they both have a stout build and a greenish mottled colour.

The Night Parrot apparently feeds on spinifex

seeds and green herbage. During the day it lies in a tunnel or cavity in a clump of spinifex, emerging at night to feed and drink. Nests are usually constructed in hollows in spinifex. The nest itself is usually a platform of sticks, placed among the stalks of grass in the centre of the bush, connected by a tunnel to the outside of the hummock. No nests on the ground, beneath vegetation, have been recorded.

About four eggs are believed to be laid.

Because of the large expanses of apparently undisturbed habitat in the recorded former range of this species, its nocturnal habits and dull, inornate colour, it is likely that the Night Parrot still exists in reasonable numbers somewhere and has managed to elude modern birdwatchers.

STATUS Endangered, possibly extinct.

CAUSES OF CURRENT STATUS Not known. Presumably some animal introduced by Europeans has led to a decline of this species, either as a result of habitat alteration or more likely predation. The only time this species was recorded as comparatively abundant was between 1875 and 1885.

NUMBER LEFT Not known; possibly none. PRINCIPAL ACTION REQUIRED Location of wild specimens, with the subsequent establishment of breeding colonies in captivity, and research into all aspects of this species' biology.



Night Parrot Geopsittacus occidentalis. Lithograph from Gould's The Birds of Australia, Supplement 1869. Mitchell Library

## **RED-FRONTED PARROT**

Cyanoramphus novaezelandiae (Sparrman 1787)

SIZE Male 310 mm; tail 160 mm. Female 280 mm; tail 155 cm

IDENTIFICATION Generally this is a bright green parrot with lighter, more yellowish plumage on the underparts. A large, bright red patch covers the forehead and crown with an interrupted band across the eye. There is also a distinct red patch on each side of the rump. Females are marginally smaller than males, their red patch beyond the eye is less extensive and they have a smaller, narrower bill. Immatures resemble adults, but have less extensive red head markings. CALL When in the air, a chattering 'ki-ki-ki-ki'. Other calls when perching include a trisyllabic, piping whistle resembling 'tee-pee-wee' on an ascending scale, and a soft, mellow 'tu-tu-tu-tu'. When alarmed the call is a harsh chatter.

DISTRIBUTION Essentially a New Zealand species;



however, the Red-fronted Parrot is also known from Norfolk Island, where it is usually called the Norfolk Island Parrot, and recognised as a distinct subspecies

C. novaezelandiae cooki. Formerly two other subspecies C. n. subflavescens and C. n. erythrotis were known from Lord Howe and Macquarie Islands respectively. HABITAT On Norfolk Island, the dense forest dominated by Norfolk Island pines at Mount Pitt Reserve. This parrot will visit nearby gardens to feed on ripening fruits, including peaches and guavas. In New Zealand, this species is most commonly seen on offshore islands, the only remaining stronghold. On treeless nesting islands, it rests and nests beneath tussocks or in holes.

NOTES Formerly, when more common, the Redfronted Parrot was often seen in large flocks. Now it is usually seen in pairs or small flocks.

The breeding season, though variable, is usually

from August to March, peaking between October and February. Typically the nest is in a hollow limb or a hole in a tree. Three to nine (usually five) roughly elliptical eggs, measuring about 26 x 23 mm, are laid on decayed wood-dust lining the floor of the hollow. After about twenty days of incubation, which commences within a day or two of the first egg being laid, the eggs hatch. Though only the female broods, both parents look after the young, which leave the nest some thirty days after hatching. CAUSES OF ENDANGERED STATUS The population on Macquarie Island apparently became extinct after sealers introduced cats to the island. Norfolk Island birds apparently suffer from a disease that causes them to lose their feathers, from competition from the introduced and now common Crimson Rosella Platycercus elegans, from predation by introduced rats and cats, and from loss of habitat to urban development.

Probably the Norfolk Island subspecies will never be able to viably survive in the wild state again. NUMBER LEFT A recently published estimate was between 17 and 30 birds on Norfolk Island. The total population still numbers in the thousands. PRINCIPAL ACTION REQUIRED Continued and widespread captive breeding is most important.



Red-fronted Parrot Cyanoramphus novaezelandiae J. Hicks/Australian Museum



A male Orange-bellied Parrot at a nest, with three 4-week-old chicks. Until the early years of the twentieth century, flocks of thousands of Orange-bellied Parrots were commonly sighted. Their decline since then has so far gone unexplained, and the location of their major breeding grounds has still not been established.

Dave Watts/ANT Photo Library

### SCARLET-CHESTED PARROT

Neophema splendida (Gould 1841)

SIZE Males 200 mm; tail 95 mm. Females 180 mm; tail 90 mm

IDENTIFICATION A blue-faced parrot with a scarlet breast in males, or with a yellow breast and bluish lores in the female. The female differs from the very similar female Turquoise Parrot *N. pulchella* in its more bluish lores, (rather than yellowish white), though the two species may be differentiated by their disjunct distributions.

Immature specimens are similar to, but duller than, the adult female. Young males have darker blue on the face.

DISTRIBUTION Found from western New South



Wales, through most parts of South Australia and inland southern Western Australia, where it occurs in scattered colonies. Vagrants have been found as far

afield as north-western Victoria.

HABITAT Dry inland areas. Found in places with patches of low scrub, open woodland, mallee and mulga. Sometimes observed a substantial distance from water.

CALL A soft twittering that lacks the penetration typical of other *Neophema* parrots' calls.

NOTES This nomadic parrot seems to have had substantial fluctuations in numbers in the wild. It feeds principally on the seeds of grasses and herbaceous plants, procured on or near the ground. When taking seeds from standing grasses this bird holds down the stalk by placing a foot on it.

Nesting, in August to December, is in a tree hollow, often with several pairs in neighbouring trees or hollows. Three to five (rarely, six) white eggs are laid on a layer of wood dust, with a few green leaves deposited in the hollow. Only a few strongly aromatic leaves are placed in the nest, presumably to provide a particular level of humidity or to discourage parasites, and not for nest building.

The eggs measure an average of 23 mm by 19 mm and hatch after twenty days' incubation by the female. She sits tightly on the eggs and is fed regularly by the male. Thirty days after hatching the young leave the nest, but they remain with the mother for some time. Full adult colours develop during the second year.

Fortunately, a large number of specimens of Scarlet-chested Parrots is maintained by aviculturists; this species breeds easily. It is, however, susceptible to the effects of cold weather. A blue form and another form with almost entirely red underparts are now held in captive populations. In captivity, the Scarlet-chested Parrot has been hybridised with the Turquoise Parrot *N. pulchella* and the Elegant Parrot *N. elegans*.

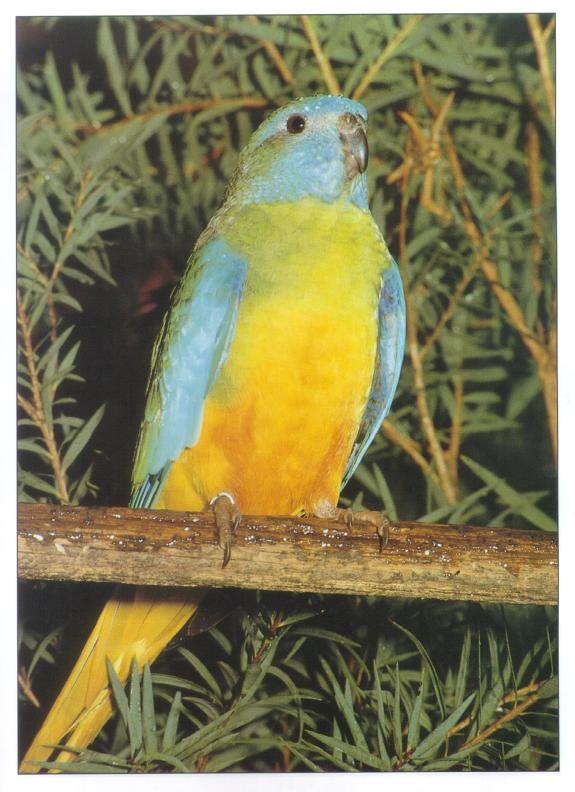
STATUS Endangered in the wild. Well-established captive populations.

CAUSES OF CURRENT STATUS Not known. Species seems to have been rare prior to European settlement.

NUMBER LEFT Thousands.

PRINCIPAL ACTION REQUIRED Maintenance of large numbers of breeding birds in captivity.

The Scarlet-chested Parrot (the picture shows an immature female) has always been scarce in the wild, though substantial numbers have now been bred in captivity. It prefers dry inland areas, and is found where there are patches of low scrub, open woodland, mallee and mulga.



### **GROUND PARROT**

Pezoporus wallicus (Kerr 1769)

SIZE 305 mm; tail 160 mm IDENTIFICATION The general colour of the Ground Parrot is green, mottled with black and yellow. The long legs are flesh-brown in colour. Males and females are similar in appearance, and both possess a pale yellow wing-stripe. Immatures are similar in appearance to the adults, but lack the red frontal band. The head, neck and breast are more heavily marked with black.

CALL Calling is usually at dusk and dawn for periods of up to forty minutes. Although several birds may call simultaneously, it is more common for one call to be followed by a response. The high-pitched call is a clear, measured series of notes, 'tee-tee-stit' or 'tee-tee-tee-stit', sometimes followed by an ascending series of notes with the last note drawn out. DISTRIBUTION Sporadically distributed along the



south-eastern Australian coast from Fraser Island to south-eastern South Australia, and coastal Tasmania. Also occurs in south-western Western Australia, where it is

known from around Cheyne Beach and Irwin's Inlet. Formerly more widely distributed in south-eastern and south-western Australia, including in the Flinders Ranges in South Australia, as far north as Geraldton on the Western Australian coast and in sand plain country in the south-west of that state. HABITAT Preferred habitat is low, sparse heathland, particularly along ridges in coastal and near-coastal areas, including some montane areas. Optimal areas are those regenerating after fire. About three years after burning the heath becomes ideal habitat and remains so for about another four years, unless burned again. Areas of dense vegetation protected from fire for some time appear to be unsuitable. Places that are damp and have matted

vegetation are avoided.

NOTES Due to the preference of this bird for coastal areas, it has suffered as a result of intense human activity in its original habitat: Brisbane, Sydney, Melbourne and Adelaide are all localities where this bird formerly occurred. The Ground Parrot's range is still contracting and is now only scattered localities within its former range. No known population of this species can be described as secure.

Largely nocturnal, this bird seems to be most active at dawn and dusk, when it is heard calling. If disturbed during the day when hiding in vegetation, it either runs away quickly using its relatively long legs, or flies above the vegetation for about 30 m before diving back into cover. When walking, this bird does not have the waddling gait typical of most other parrots.

Although not normally migratory, this species will fly over areas of unsuitable habitat, such as forest or water, to reach preferred areas of recently burned heathland.

Diet includes seeds of herbaceous plants and grasses and green shoots, including seeds of button grass *Gymnoschoenus sphaerocephalus*, *Anthistiria* sp. and other grasses, melaleuca fruits, acacia seeds, *Cladium junceum* (sedge) nuts, xanthorrhoea seeds, slender twine-rush *Leptocarpus tenax* seeds, and fruits of leafless briars *Rosa subiginosa*. When feeding, the Ground Parrot typically stands on grass stems, forcing the seed heads to the ground, where they are taken, or passes its beak along the stem and over the seed head, spilling the seeds on to the ground.

Breeding is from September to December. The nest is a well-concealed scrape in the soil, lined with chewed stalks and leaves, usually at the base of a tussock or dense bush. In swamps, the nest may be built on a raised platform in a tussock. Three to four white eggs measuring about 27.5 x 22.5 mm are laid, and take about 21 days to incubate. The chicks

are fed three times daily, remaining in the nest for about two weeks. After that, they hide in nearby vegetation and remain in proximity to the nest until able to fly.

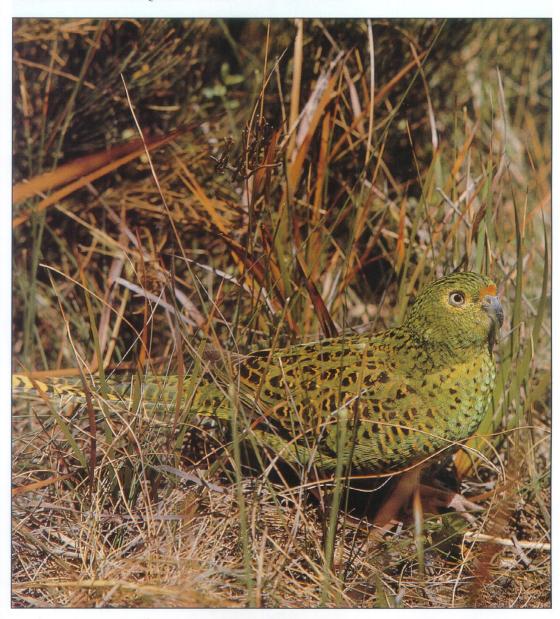
CAUSES OF ENDANGERED STATUS Loss of habitat combined with other factors that have not been completely determined.

NUMBER LEFT Between 10 000 and 50 000 birds. PRINCIPAL ACTION REQUIRED Further

research into this species, and continuing active management of reserves where the Ground Parrot is known to occur.

The Ground Parrot prefers coastal areas, so it has suffered greatly from loss of habitat with the development of Brishane, Sydney, Melbourne and Adelaide. Its range is still contracting, and no known population is secure.

Len Robinson



# ALEXANDRA'S PARROT

Polytelis alexandrae Gould 1863

SIZE 450 mm; tail 280 mm

IDENTIFICATION The male Alexandra's Parrot has the following coloration: nape and crown are light blue; forehead and sides of head pale bluish-grey; chin, throat and foreneck pinkish-red; breast and abdomen bluish-grey tinged green and yellow; lower flanks and thighs pinkish-red; the remainder of the flanks bluish; undertail-coverts olive-yellow; hind-neck, mantle, back and wings a pale olive-green; wing-coverts bright yellowish-green; secondaries and primary-coverts dull pale blue; primaries bluish-green narrowly edged with yellow; underwing-coverts green. Rump and upper tail-coverts are violet blue; central tail feathers are olive green stained with blue toward the tips, lateral feathers blue-grey margined with rose pink.

Females have shorter central tail feathers, duller, more greenish wing coverts, greyish-blue upper tail-coverts and rump, and a greyish-mauve crown.

Immatures resemble the adult female.

CALL Alexandra's Parrots have a loud, unmelodic call. The contact call, given in flight, is a prolonged rolling note, like that of a kingfisher. Cackling notes are also used. When flushed into trees and bushes, groups make a soft, twittering sound.

DISTRIBUTION Arid parts of central-western Aus-



tralia, roughly bounded by Fitzroy River and Coolgardie in Western Australia, Sturt Plains in the Northern Territory, far northern South Australia and the northern

Diamantina River in south-western Queensland. HABITAT Areas that have spinifex *Triodia* spp. Nesting specimens are usually found in areas of riverine eucalypts, though some nests have been found in *Casuarina* trees some distance from water. NOTES At irregular intervals, sometimes more than twenty years apart, a group of birds will appear at a

larger tree-lined watercourse. They remain to breed, and then with their young depart as abruptly as they arrived. A typical group consists of no more than 15 or 20 birds, though larger flocks have been seen.

Breeding colonies of several pairs form, and usually nest in the same tree or adjacent trees. Four to six white eggs measuring about 28 x 22 mm are laid in wood dust at the bottom of a hollow and take about 20 days to incubate. The female incubates the eggs and looks after the young for about five weeks after hatching, after which young, mother and other members of the group leave the nesting area. Young males acquire adult plumage in their second year.

In normal circumstances Alexandra's Parrots spend most of their time on or near the ground, searching for seeds of *Triodia* and other food. These birds also have been known to feed on acacia blossoms and mistletoe berries (*Loranthus* sp.).

When trying to hide from a predator the Alexandra's Parrot will perch on a branch and hold itself lengthwise in an unusual posture.

Typically this parrot flies close to the ground, but when migrating long distances it flies high. When flying low the wingbeats are irregular, so that the bird undulates slightly when flying. Prior to landing, it seems to pause momentarily in midair, then drop to the ground, fluttering its wings.

Though rare in the wild, large numbers of Alexandra's Parrots are held by aviculturists and are breeding in well-established collections, in Australia and in other countries.

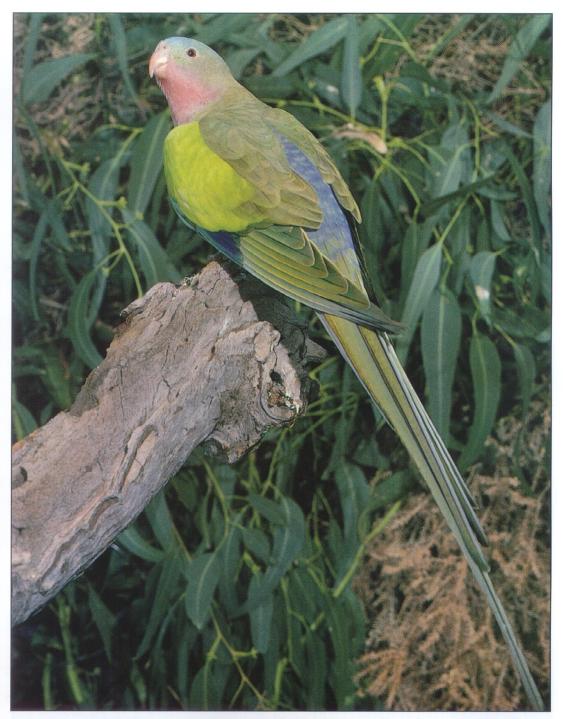
STATUS Endangered in the wild.

CAUSES OF CURRENT STATUS Unknown; this species has never been abundant in the wild.

NUMBER LEFT Thousands, including a large num.

NUMBER LEFT Thousands, including a large number in captivity.

PRINCIPAL ACTION REQUIRED Continued captive breeding should ensure the survival of this species. Studies of wild populations are required.



The Alexandra's Parrot has never been abundant in the wild, although a large number have been bred in captivity in Australia and overseas. This is a nomadic bird, and in the wild prefers arid parts of central—western Australia.

A. G. Wells

# GOLDEN-SHOULDERED PARROT

Psephotus chrysopterygius Gould 1857

SIZE 260 mm; tail 150 mm

IDENTIFICATION Of slim build and brightly coloured, this bird has dark brown eyes, grey-brown legs and a grey bill. The main distinguishing feature is the brilliant yellow-golden patch on each shoulder. Males lack the wing-stripe present in females, and are typically more brightly coloured.

Immatures resemble the adult female, but males have a darker and brighter wing-stripe under the tail-coverts and at the sides of the face.

Distinguished from the closely related Hooded Parrot *P. dissimilis* by the absence of sooty black on the forehead, which gives the Hooded Parrot its name.

The closely related Paradise Parrot *P. pulcherrimus* is differentiated by its scarlet rather than yellowgold wing-covert feathers.

CALL The contact call made in flight is a whistle-like 'fweep-fweep', repeated at least twice and sometimes drawn out to 'few-weep...few-weep'. Perched parrots repeat an abrupt 'weet' or 'fee-oo' sound. When the bird is distressed, the call is an abrupt 'cluk-cluk'.

DISTRIBUTION The centre of distribution for the



Golden-shouldered Parrot is a strip of dry savannah woodland 130 x 240 km around Musgrave on the Cape York Peninsula. Strays are commonly seen further south and along

the nearby coastal areas of Cape York and the Gulf of Carpentaria. Outside the breeding season, birds seem to migrate towards the western part of their range. HABITAT Nesting specimens are found in dry, semi-arid savannah woodland dotted with large termite mounds, in which they nest. These areas are near extensive flats. Specimens have been recorded inhabiting mangroves along the Watson River. NOTES These parrots are usually seen in pairs or

small parties feeding on the ground. Diet includes seeds, blossoms, leaf buds and the nectar of grevilleas. The parrots drink from waterholes and creeks at least once a day, most commonly in the morning or at dusk.

When fleeing, this shy bird has a strong, undulating flight. Wild specimens are very wary of humans.

Due to the relative rarity of this species, it has been targeted by bird trappers, dealers and smugglers. Nesting specimens are easily located nesting in the large spire-shaped or slab-sided 'magnetic', north-south-facing termite mounds. About a metre above ground level, the bird excavates a tunnel 5 cm in diameter and 45 cm long into the mound, with a nest chamber at the end. The four to six white, rounded eggs, measuring about 22 x 19 mm, take about twenty days to incubate. Young leave the nest about 35 days after hatching, and remain with the parents in a family group. The young birds moult at four months. Though offspring can breed the following year, males do not attain adult plumage for about 16 months.

Trappers often mark a nesting mound they have located with their initials scratched on the mound with a view to removing the chicks just prior to their leaving the nest. Sometimes the mother bird will desert a nest so marked.

Two broads may be raised in succession, one in May, at the onset of the dry season, with a second around July or August.

Nesting Golden-shouldered Parrots do not clean the nest chamber of droppings; instead, a symbiotic moth does the task. Larvae not only feed on the birds' droppings, but also assist in cleaning the birds' feet. The larvae spins itself a silken protection in the chamber and pupates. The emergent adult moths continue the cycle elsewhere.

Captive breeding colonies are now being maintained, and this parrot has been hybridised with the

Mulga Parrot *P. varius* and the Red-rumped Parrot *P. haematonotus*.

STATUS Endangered in the wild.

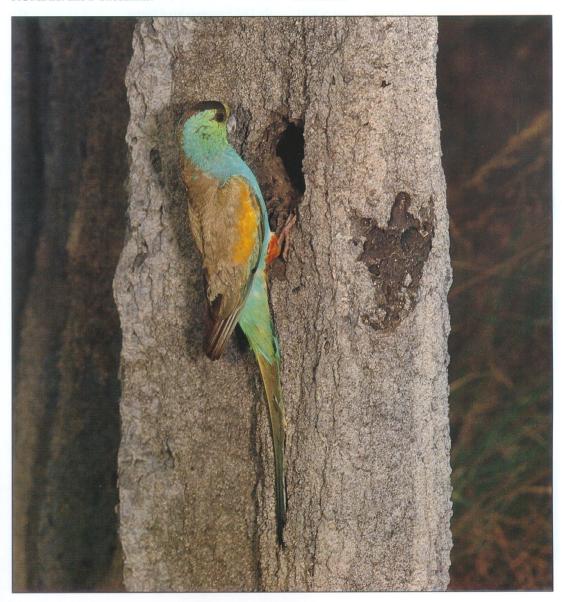
CAUSES OF CURRENT STATUS Extensive trapping of specimens by collectors and wildlife smugglers, combined with the relatively restricted range of this species. Also, the native grasses on whose seeds this species feeds are diminishing as introduced pasture grasses invade their habitat.

NUMBER LEFT Thousands.

PRINCIPAL ACTION REQUIRED Continued large-scale captive breeding, now being attempted in a bid to alleviate pressure on wild stocks. There is a strong possibility that releases into the wild from captive-bred stock could be carried out on a large scale.

A Golden-shouldered Parrot at a nest hole in a termite mound. This species may raise two broods in succession: one in May and a second in July or August.

Len Robinson



## HOODED PARROT

Psephotus dissimilis Collett 1898

SIZE 260 mm; tail 140 mm

IDENTIFICATION Essentially similar in appearance to the closely related Golden-shouldered Parrot *P. chrysopterygius*, from which it is differentiated by the sooty black on its forehead.

Immatures are similar in appearance to the adult female. Immature males usually have brighter blue cheeks.

CALL The contact call when in flight is a sharp, metallic-sounding 'chissik-chissik'. The bird also makes a variety of whistling notes.

DISTRIBUTION Distribution appears to be centred



around Pine Creek in the Northern Territory. Though the range includes drier parts of the north-eastern Northern Territory, including some offshore islands,

there appear to be fewer and fewer sightings outside the Pine Creek area.

HABITAT Most commonly seen in dry open woodland and grasslands, wherever termite mounds are prevalent. Nesting is often in proximity to eucalypt-



Hooded Parrot Psephotus dissimilis

lined watercourses and rocky ridges, which this species also frequents.

NOTES Though essentially similar to the Goldenshouldered Parrot, the Hooded Parrot is more likely to be seen in family parties and small flocks than is the Golden-shouldered Parrot.

When feeding, this bird is not timid, but approaches waterholes with great caution — probably a reflection of the many birds of prey that seek food around waterholes in that part of the country.

The breeding season extends from May to January, for the entire duration of the dry season, often with two broods raised each season. Two to four white, rounded eggs, about 20 x 18 mm, are laid in the nest in the side of a termite mound. No nesting material is used in the nest, the eggs being laid on a layer of crumbled earth or the floor of the chamber. Only the female broods.

The Black-throated Finch *Peophila cincta* often nests in abandoned termite-mound hollows.

Despite large numbers of Hooded Parrots now being maintained and bred in captivity, wild populations still appear to be under severe pressure from trappers.

The Hooded Parrot is more common in captivity than the Golden-shouldered Parrot. Both become fearless and aggressive after a while in captivity, though in the early stages captives may be difficult to keep, being delicate and requiring constant attention.

CAUSES OF ENDANGERED STATUS Native grasses that produce the seeds on which this bird feeds are being overrun by introduced varieties. Trappers taking specimens to sell to keepers in Australia and overseas have taken a heavy toll on this species. NUMBER LEFT Thousands.

PRINCIPAL ACTION REQUIRED Continued captive breeding of specimens, and the legal export overseas of captive-bred birds of this and other *Psephotus* parrots.

#### PARADISE PARROT

Psephotus pulcherrimus Gould 1845

SIZE 300 mm; tail 15 mm

IDENTIFICATION These slim parrots typically have an upright stance. The male has a bright red forehead capped with a black crown, while the back and wings are brown with a bright red patch on each wing. Scarlet feathers run from the centre of the abdomen to the underside of the tail. The rest of the body is emerald-green blended with turquoise.

Females are essentially a paler version of the male. The female is buff-yellow with brownish orange markings; her abdomen is pale blue. Her red wing patches are smaller and duller than those of the male.

Closely related to the Golden-shouldered Parrot *P. chrysopterygius* and Hooded Parrot *P. dissimilis*.

CALL A plaintive 'queeeek' or 'tit-sweet', of a sweeter nature than that of the average parrot.

DISTRIBUTION The Paradise Parrot was dis-



covered in the Darling Downs region in 1844. The last authenticated sightings of this bird were two pairs from the Burnett River region of coastal Oueensland, in

1921 and 1922. Recent unconfirmed sightings have been mainly from the New South Wales—Queensland border area. During the second half of last century, this species was locally common in an area from Brisbane to Rockhampton, when large numbers were trapped and sent to bird keepers in England. No live specimens have been since 1922.

HABITAT Nesting parrots were trapped in large numbers along river valleys, where they frequented open woodland and grassland scattered with termite mounds, which formed nesting sites.

NOTES The only photographs of this species were of a nesting male and female taken by cattleman C. H. Jerrard in 1921 as a result of a public appeal to find this species, initiated by naturalist Alex Chisholm.

Breeding takes place between September and March, which coincides with the seeding of native grasses. The female excavates a hole in a termite mound; the excavation terminates in a nesting chamber about 30 cm in diameter. The four or five rounded white eggs measure about 21 x 17.5 mm. Incubation lasts about three weeks, with only the female brooding.

Last century the Paradise Parrot was only occasionally bred in captivity, and no long-term breeding programmes took place.

STATUS Possibly extinct.

CAUSES OF CURRENT STATUS Large-scale trapping; the elimination of native grasses, whose seeds constitute an important part of this bird's diet; (introduced grasses have all but eliminated native species from many areas); introduced animals such as cats, cattle and foxes.

NUMBER LEFT Possibly none.

PRINCIPAL ACTION REQUIRED Captive populations should be established if specimens are found.



Paradise Parrot Psephotus pulcherrimus D. & M. Trounson/ANT Photo Library

#### BLUE WHALE

Balaenoptera musculus (Linnaeus 1758)

SIZE 30 metres; girth 15 metres; weight 130 tonnes. Females are slightly larger than males. IDENTIFICATION This is the largest animal ever to have lived, equalling three of the largest dinosaurs in size, or thirty elephants in weight. The body is bluish-grey with pale mottling, although often the underparts are yellowish due to the growth of diatoms. There are 80–100 furrows on the throat, and more than 700 plates of black baleen. The small dorsal fin is set well back and the tail flukes are about 6.5 metres wide in adults. The large pectoral fins are up to a seventh of the total body weight. There are two dorsal blow-holes.

DISTRIBUTION Most common in waters of the



southern hemisphere, but known from all oceans. Most are found in the southern Indian and Great Southern Oceans. HABITAT Open oceans. In summer it feeds in

Antarctic waters, migrating to its winter breeding grounds in temperate waters at the end of summer. NOTES The largest Blue Whale caught in Australian waters measured 33.27 metres. The heaviest was a female weighing more than 200 tonnes, killed in Walvis Bay, south-west Africa, in 1924.

Its most salient characteristics are the large folds of skin that run along the throat and chest, which enable the whale to open its mouth very wide to swallow huge quantities of water rich in krill (shrimp of the genus *Euphausia*). The teeth are modified into specially laminated bones with fringed borders framing the upper jaw and functioning as a sieve to trap food.

When swimming, the Blue Whale typically surfaces for air every ten to fifteen minutes. After breathing three to eight times, the whale dives deeply to recommence feeding. The tail breaks the

surface at the commencement of a deep dive.

Its powerful tail gives the Blue Whale a cruising speed of 8–21 km/h.

Only one young is produced after 10–11 months' gestation, every two years. The newborn calf weighs almost 3 tonnes and measures about 7.5 metres. Suckling lasts six or seven months with the young drinking up to 490 litres of high-fat (35 per cent) milk daily. About 90 kg of weight is gained daily, and the calf measures about 16 metres and weighs 26 tonnes at one year of age. The following year it is sexually mature at 24 metres for males and 25 metres for females.

This shy species is usually found in groups of two or three. Its rapid decline commenced in 1865 with the introduction of the explosive harpoon, and steampowered whaling ships. The decline accelerated with the introduction of large factory whaling ships, which could hoist a whale on board and process it within a few hours.

Prior to the commencement of mechanised whaling, total Blue Whale stocks were probably greater than 300 000. The decline was at its worst around 1930 when some 29 000 were killed. The only respite from the slaughter came during the two world wars, when humans had other preoccupations, and in recent years, when stocks became too low to be exploited commercially and public outcry led to the protection of the species.

CAUSES OF ENDANGERED STATUS Excessive commercial whaling has possibly put the number of whales left at a level too low to sustain this species. The very low reproductive rate will prevent Blue Whales reaching a secure population level for many years. NUMBER LEFT Fewer than 5000.

PRINCIPAL ACTION REQUIRED Cessation of all whaling activities. Research into the possibility of increasing the fecundity of the extant populations should also be undertaken.



A Blue Whale calf breaching. The Blue Whale typically surfaces for air every ten to fifteen minutes, and its warm breath condenses when it comes in contact with cooler polar air, sending a distinctive jet up to 6 metres high. The Blue Whale is the largest animal ever to have lived.

François Gohier/AUSCAPE International



A Humpback Whale (see page 154) breaching in Platypus Bay at Fraser Island, Queensland. The deep throat furrows are clearly visible here. The long pectoral fins are one-third of the total body length.

Ross Isaacs/AUSCAPE International

#### HUMPBACK WHALE

Megaptera novaeangliae (Borowski 1781)

SIZE 12–15 m; 30–40 tonnes (maximum 24 m and 64 tonnes)

IDENTIFICATION See picture on page 153. Distinctly more squat than other large whales, the Humpback has a black back and is very pale below with black markings. There are 14–30 deep throat furrows and more than 600 plates of dark grey baleen.

The long pectoral fins are one-third of the total body length and have scalloped anterior margins. Numerous tubercles and protuberances are found on these fins and the head. Between the relatively small dorsal fin and the tail is a series of low humps. DISTRIBUTION Northern and southern hemi-



sphere oceans; there are four northern and seven southern sub-populations respectively, which travel from polar feeding grounds along set routes to breed in the coastal

waters of tropical lands. There is little exchange between the northern hemisphere and southern hemisphere populations.

HABITAT This species migrates along the edges of continents and is an inhabitant of coastal and near-coastal waters.

NOTES The Humpback Whale lives in small slowmoving schools and will often leap from the water. Deep dives of up to thirty minutes are followed by a series of short, shallow dives; the explosive spout from the blowhole is neither as high nor as well defined as that of the Blue Whale.

The Humpback's diet consists of molluscs, crustaceans and small fish.

These are the most sonorous of the whales, producing 'songs' that consist of complete sequences of notes repeated almost exactly and lasting from six to forty minutes. Individual whales have unique songs, which are repeated almost without a break, the gap between finish and start being less than that between two notes.

When mating, the male and female swim side by side, knocking against each other with their long pectoral fins and leaping repeatedly. Favoured breeding grounds are in coastal waters, including bays, ports and large river mouths.

Gestation takes nearly twelve months with young measuring 4–5 metres at birth and suckling for five and a half months. Maturity is attained at 15–17 months.

Because of its relative speed and agility, the Humpback was formerly the most difficult whale to hunt. It was not until the twentieth century that numbers began to plummet. Originally there were about 111 000 worldwide, but by 1930 numbers had dropped to about 22 000 and by 1956 numbers had been reduced to fewer than 3000.

In recent years the northern Atlantic population has increased along the American seaboard, but populations remain static or in decline in all other waters. CAUSES OF ENDANGERED STATUS Excessive whaling activity.

NUMBER LEFT About 10 000.

PRINCIPAL ACTION REQUIRED There should be no further killing of Humpback Whales by humans for any commercial purpose. Close monitoring of remaining stocks should be carried out in in all areas.

#### SOUTHERN RIGHT WHALE

Eubalaena glacialis australis (Muller 1776)

SIZE 20 metres; 80 tonnes

IDENTIFICATION Generally blackish in colour, with a huge head and arched upper jaw, which makes up about a quarter of the total length. There are no throat furrows or dorsal fin. The pectoral fin is very broad. About 700 large black baleen plates are suspended from the upper jaw, each one about 3 metres long in adults.

On the snout is a peculiar patch of horny, roughened skin, called the bonnet. In the crevices of this skin lives an amphipod crustacean, the whale louse, which is often found in large numbers. Sea anemones and other crustaceans also adopt these whales as hosts. DISTRIBUTION Three geographical races of the



Right Whale are recognised: Eubalaena glacialis glacialis of the north Atlantic ocean, Eubalaena glacialis japonica of the northern Pacific and Eubalaena glacialis aus-

*tralis* of the southern oceans. All are severely depleted and endangered.

HABITAT In summer months the Australian subspecies *Eubalaena glacialis australis* is found in polar seas. At the end of summer it migrates along coastlines to warmer waters in order to breed.

NOTES The name Right Whale was given to this species by whalers last century. Its huge bulk and slow-moving nature compared to other whales made it easy prey for whalers in rowing boats, and it was therefore the 'right whale' to try to kill.

Feeding is carried out by swimming close to the sea surface, skimming off fine plankton through the mouth.

Cows give birth to young every second year, often entering shallow waters to do so. Gestation takes about twelve months, with newborns measuring roughly 6 metres. Sexual maturity occurs within two years.

Prior to the large-scale whaling of this species, it

was known to be gregarious, with schools of more than fifty whales being seen. Nowadays, they are seen either alone or in groups of between two and five.

This species was intensively hunted due to its ease of capture, its presence in temperate waters, and the fact that it floated when killed. From an original stock numbering many hundred thousands, or even millions, this species was reduced to a few thousand individuals by the time it became protected in recent years.

CAUSES OF ENDANGERED STATUS Whaling activities severely depleting numbers to a level from which the species may not recover. In spite of almost worldwide protection since 1935, this species has failed to recover.

NUMBER LEFT Fewer than 10 000. PRINCIPAL ACTION REQUIRED A continued moratorium on killing this species and further research into its biology with a view to aiding the recovery of the species.



A Southern Right Whale, showing the distinctive 'bonnet', a patch of horny skin on its head, in the crevices of which live large numbers of the whale louse. Sea anemones and other crustaceans also adopt these whales as hosts. François Gohier/AUSCAPE International

## CHRISTMAS ISLAND SHREW

Crocidura trichura Dobson 1888

SIZE 128–157 mm; tail 63–75 mm IDENTIFICATION The Christmas Island Shrew is the only indigenous quadruped on Christmas Island. It is also the only species of shrew found in Australian territory.

Shrews are mouse-sized animals with a soft coat and a distinctive flexible, trunk-like snout. There are three groups of shrew, the red-toothed, the white-toothed and the Hero Shrews of Africa. The Christmas Island Shrew belongs to the white-toothed group.

DISTRIBUTION Restricted to a few isolated parts



of Christmas Island in the Indian Ocean. HABITAT Apparently most common in relatively undisturbed habitats on Christmas Island, but this species is

known to live in areas of human habitation.

NOTES In 1900 this species was recorded as being found on all parts of the island, but its numbers apparently crashed a short time later, allegedly because of predation by cats. It was not recorded for more than eighty years and was listed in a number of texts as extinct.



Christmas Island Shrew Crocidura trichura H. Yorkston/ANT Photo Library

The Christmas Island Shrew is active both by day and by night, although it is more likely to be heard at night. In 1900, the shrill squeak of this animal, which sounds like the cry of a bat, could be heard on most parts of the island.

The Christmas Island Shrew lives in holes, among rocks and the roots of trees. Its diet consists of beetles and other small animals, which it ferociously kills. The metabolic rate of shrews is so high that they have to wake every few hours to find more food. If deprived of food for even a relatively short period, these animals will die. Some shrews are known to eat more than their own weight of food each day.

When scuttling about, these animals emit highpitched noises and frequently pause to sniff the air or investigate objects with their long noses. They are usually solitary animals.

To deter predators, this shrew has a distinctive musky odour released from special musk glands; however, many furred predators still kill these animals.

Most breeding activity occurs in the warmer months. Gestation is between two and four weeks. The young are born naked and blind in a breeding nest situated under cover. Young shrews have a tendency to wander and the mother carries stray infants back to the nest in her mouth. After about eighteen days, the young shrews are able to return to the nest themselves.

CAUSES OF ENDANGERED STATUS Introduced cats and rats presumably prey on this species and are probably the major cause of its decline. Phosphate mining has also removed much of this shrew's habitat. NUMBER LEFT Probably hundreds; only two specimens have been caught in recent years in spite of intensive trapping efforts.

PRINCIPAL ACTION REQUIRED Further biological research, perhaps including a captive breeding programme to determine the requirements for the continued survival of this shrew.

#### WHITE-FOOTED RABBIT-RAT

Conilurus albipes (Lichtenstein 1827)

SIZE 475 mm; tail 230 mm; 200 g IDENTIFICATION Grey-brown dorsally, white below. Long, soft, close fur. Separated from all related species by the long bicoloured tail, which has a white tip and white extending along the underside of the tail to the body. The upper surface of the tail is dark brown, and the tail has long and bushy hair. DISTRIBUTION Last century the White-footed



Rabbit-rat was thought to occur in a wide area throughout south-east Australia, from about Adelaide to Brisbane and inland along the ranges and nearby slopes, as

well as in the Murray River valley. No live specimens have been recorded in the twentieth century. HABITAT Little known, but this species is thought to prefer eucalypt woodlands and open forests, which have an abundance of hollow trees in which to nest. This includes river gum habitats along inland watercourses.

NOTES The only information about the biology of this species comes from the records of Gould and others in the nineteenth century. Gould noted that the White-footed Rabbit-rat 'is strictly nocturnal in its habits, for it sleeps during the day in the hollow limbs of prostrate trees, or such hollow branches of the large *eucalypts* as are near the ground, in which situations it may be found curled up in a warm nest of dried leaves'.

Gould also recorded the known distribution of this species, noting that it 'is nowhere very abundant'. Sub-fossil remains of this species have been found this century throughout the former known range.

Nothing is known of the diet of this species, but the closely related Brush-tailed Rabbit-rat *C. pen-icillatus* feeds principally on vegetable material.

The female has four teats and there is a record of one female being caught with three young firmly attached to her teats. When holding on to these teats the young are very difficult to disengage. STATUS Presumed extinct.

CAUSES OF CURRENT STATUS Not known, but probably a result of introduced predators or disease. PRINCIPAL ACTION REQUIRED Nothing can

be done unless new living specimens are found.



The little-known White-footed Rabbit-rat, never very abundant, has probably declined because of introduced predators or disease. Strictly nocturnal, it sleeps by day in hollow limbs of prostrate trees. This lithograph is from Gould's The Mammals of Australia.

Mitchell Library

#### LESSER STICK-NEST RAT

Leporillus apicalis Gould 1853

SIZE 420 mm; tail 230 mm; 150 g IDENTIFICATION Rat-sized. Distinguished from the closely related Greater Stick-nest Rat *L. conditor* by its smaller size and by its tail, tipped with white, untufted and longer than the head and body. The Lesser Stick-nest Rat is light yellowish-brown to grey above and lighter below. The fur is fluffy, the ears are long, the eyes large and the snout is rather blunt. The tail is evenly furred. Animals resting tend to sit in a hunched posture.

DISTRIBUTION Last century this species was



known to occur throughout the southern twothirds of Australia, in South Australia and Western Australia, but not in the eastern states, although it was known

from the lower Murray valley in New South Wales and Victoria. Not known from the far south-west of Western Australia. An unconfirmed capture of this species occurred in 1970 when a bushman found one living beneath a tarpaulin in a cave west of the Canning Stock Route in Western Australia.

HABITAT In the south-eastern part of the range this species apparently inhabited hollow trees on the plains near the junction of the Murray and Darling rivers. In more arid areas, this species prefers rocky hills, particularly those with an abundance of caves. NOTES Nocturnal and gregarious in habits, this species was formerly common in areas where it occurred. Eight to ten individuals were known to have been taken from a single hollow tree, and they were easily tamed. Gerard Krefft tamed some 'so that they kept about the camp, mounting the supper table at tea time for their share of sugar and damper'.

Where the Lesser and Greater Stick-nest Rats occur together, they apparently compete for resources, and according to Krefft were 'always at

war'. The two species would even occupy each other's nests.

Stick nests are constructed of locally available materials, and are often located in caves, which are a preferred nesting site.

Diet is highly specialised and leaves and stems of succulent plants form more than 90 per cent of total volume. These plants are also much sought after as food by livestock and introduced rabbits, which have probably exterminated all stick-nest rats from the Australian mainland.

The decline in Lesser Stick-nest Rats apparently began prior to European settlement, being due to Aboriginal hunting of this species.

STATUS Presumed extinct.

CAUSES OF CURRENT STATUS Alteration of some habitat by stock grazing and the trampling of nests, coupled with the invasion of rabbits, which probably successfully competed against this species by eating all its preferred food.

PRINCIPAL ACTION REQUIRED Searches of possible remaining sanctuaries for this species, and if at all possible capture of specimens with a view to setting up a viable captive colony as the first step in the long-term preservation of the species.



Lesser Stick-nest Rat Leporillus apicalis. Lithograph, Gould's The Mammals of Australia. Mitchell Library

# GREATER STICK-NEST RAT

Leporillus conditor Gould 1853

SIZE 390 mm; tail 170 mm; 180–450 g IDENTIFICATION Larger and darker in colour than the Lesser Stick-nest Rat *L. apicalis*, the Greater Stick-nest Rat is larger than a typical rat and has no white tip on the tail. The tail is also shorter than the head and body.

Dorsally it is yellowish brown to grey, with dark tipped hairs on the back. Ventrally the fur is slate grey at the base with white tips. The front paws have a dark brown patch on the back. The long slender hind feet have a white upper surface with a dark line running along the outer edge. The ears are long, the eyes large and the snout is rather blunt.

DISTRIBUTION Known only from Franklin Island



in the Nuyts Archipelago off the South Australian coast, the Greater Stick-nest Rat formerly had a wide distribution on the mainland. Last century this species

occurred in most parts of South Australia, the lower Murray valley in New South Wales and Victoria, and parts of southern Western Australia.

HABITAT Franklin Island's rocky foreshore, on an area of sloping ground and on exposed limestone cliff overhangs. Formerly a variety of mainland habitats, including sclerophyll woodland, grassland, heathland and saltbush plain.

NOTES Communal nests up to a metre high and 1.5 m in diameter are built by this diligent but placid rodent. When handled, it rarely attempts to bite.

The nest is often built around a bush, which eventually becomes part of the structure. Locally available twigs are brought to the nest in the rat's jaws.

At the centre of the accumulating pile is a core nest of grasses and other soft vegetation. Even after the nest has been constructed, it will be added to or modified over long periods, with one or more tunnels leading from the core nest to the perimeter. The same nest may be occupied by many individuals and over succeeding generations, housing up to twenty.

Diet consists exclusively of the leaves and fruit of succulent plants. The sacculated stomach and large caecum aid digestion.

Breeding occurs from March to July with one or two well-developed young being born after a gestation of about 44 days, one of the longest of native rodents. The oestrous cycle is 14 days. The young remain firmly attached to the mothers teats, being dragged around beneath her before becoming weaned at about 30 days of age.

In good conditions, young may first reproduce at the age of eight months, and produce a second litter within two months of the first. Females may breed over several successive years.

CAUSES OF ENDANGERED STATUS Presumably hunting pressure from Aborigines prior to European settlement, and the introduction of grazing animals, rabbits and foxes since.

NUMBER LEFT 1500–2000 (on Franklin Island only) and about 100 in captivity.

PRINCIPAL ACTION REQUIRED Close monitoring of the Franklin Island population and the active exclusion of pest animals. A second secure population should be established elsewhere.



Greater Stick-nest Rat Leporillus conditor A. C. Robinson/Australian Museum

## THORNTON PEAK MELOMYS

Melomys hadrourus Winter 1983

SIZE 365 mm; tail 190 mm; 156 g IDENTIFICATION Like all *Melomys*, this species is characterised by the mosaic-like pattern of scales on its tail, as opposed to a regular arrangement of rings of scales such as is found in other Australian rodents. The tail has a hairless appearance, although close inspection will reveal small hairs. It has a characteristic thick-necked, short-limbed appearance accentu-

The Thornton Peak Melomys is distinguished from other Australian *Melomys* by its considerably larger adult size, and it is the only Australian *Melomys* to possess a white-tipped tail. The colour is fawn above, paler below, with a pure white throat and chest. The limbs are short and the hindfeet broad.

DISTRIBUTION Known only from the uplands of



ated by the long, fine coat.

the Thornton Peak massif rising from the coastal plain immediately north of the Daintree River in far north Queensland. The known range is only on this massif, which

extends some 20 kilometres north, and about the same distance inland, being separated from nearby mountainous regions by the well-defined Daintree and Bloomfield river valleys.

HABITAT Known only from dense closed rainforest, which receives more than 2500 mm of rainfall annually, and often on steep ground. Specimens have been caught at altitudes ranging from 550 to 1220 metres.

NOTES The species probably eluded scientific attention until 1973 because of the limited access to the area prior to then. It appears to be very closely related to the Light-footed Melomys *M. levipes* found in many parts of New Guinea.

Although all specimens have been caught in traps

set on the ground, it is possible that this species also climbs vegetation. The diet is not known, but the stomach of a captured specimen contained the creamy endosperm of a nut. The presence of subadults in October and November indicates that breeding probably occurs in autumn or early winter.

Using conventional trapping methods, few specimens of this species have been caught, indicating a sparseness of population. There is a possibility, however, that this species is avoiding being trapped. Once, when only two individuals were caught in traps, 217 other native rodents of three other species were also caught.

CAUSES OF ENDANGERED STATUS Increased land development, including proposed subdivision of land in the area, threatens habitat for this species. Further land clearing could help introduced pests invade the remaining habitat.

NUMBER LEFT Probably thousands.

PRINCIPAL ACTION REQUIRED Further population surveys and biological research. Continued preservation of habitat.



Development in the area of the Thornton Peak massif threatens the existence of the Thornton Peak Melomys. Very little is known of this species, so further population surveys and biological research need to be done. Hans and Judy Beste/Australian Museum

#### SHORT-TAILED HOPPING-MOUSE

Notomys amplus Brazenor 1936

SIZE 296 mm; tail 153 mm; 100 g IDENTIFICATION See picture on page 162. Distinguished from other hopping-mice (*Notomys*) by its large size, being about the same size as a domestic rat, by the large ears, which are nearly the length of the head, by the short tail, which is yellow-brown above, white beneath and with a white tip, and by a well-marked gular (neck) region.

The colour is brown dorsally, becoming yellowish white below. Only an undescribed fossil species of *Notomys*, and exceptionally large Long-tailed Hopping-mouse *N. longicaudatus* are as large as specimens of this species.

DISTRIBUTION Two living specimens were col-



lected in the vicinity of Charlotte Waters, near the South Australian— Northern Territory border, in 1894, with remains of further specimens being found in owl

pellets in the northern Flinders Ranges, South Australia. These remains were shown to have been deposited since European settlement; house mouse *Mus musculus* remains were found with them. Extant colonies of this animal are not known.

HABITAT Preferred habitat is not known. Near Charlotte Waters, the habitat includes gibber plain with low shrubs and desert grasses, and sand ridge country in the adjacent Simpson Desert. Adjacent to the rocky Flinders Ranges, the dominant habitat is open plains.

NOTES Both collected specimens were females, and little is known of this species. It was presumably rare at the time of European settlement, and has probably become rarer or extinct since then.

An important feature of hopping-mice is the wide fluctuation in their numbers, depending on the season. Following a good season, some localities may be swarming with large numbers at night, and mice will cross roads in front of vehicles. At other times they are apparently absent from the same areas. Because of this feature, the Short-tailed Hopping-Mouse should not be written off as extinct just yet.

Like most, if not all, species of hopping-mice this species possesses a patch of specialised tissue on the throat, called the gular gland, or on the chest, called the sternal gland, which may even take the form of a recessed pocket or pouch. The organ contains numerous glandular openings and specialised hairs. The organ is believed to be some form of scent gland or similar, used for scent marking, important to the communal hopping-mice, which, though friendly to other members of their own group, are often hostile to outsiders.

North American kangaroo-rats (Family Heteromyidae), though belonging to a different rodent family, are very similar in form and certain habits. However, unlike hopping-mice, kangaroo-rats have their special glands located on the back, between the shoulders, tend to be solitary in behaviour and are often hostile to one another. Although hopping-mice communicate with well-developed vocalisation, North American kangaroo-rats do not appear to have nearly as well developed vocal ability.

There is no evidence that hopping-mice store quantities of food in bad times in their nests, a trait common to some other types of rodent.

Hopping-mice seem to be capable of maintaining themselves on a diet of mixed birdseed without any water at all, even gaining weight. This is due to their remarkable ability to excrete their waste nitrogen in the form of the most highly concentrated urine known in any rodents. Furthermore, they avoid heat and dessication by remaining deep underground during the day.

Hopping-mice dig complex burrow systems, with many entrances, often with vertical pop-holes, which

are blocked up from inside when the mice are within. STATUS Probably extinct.

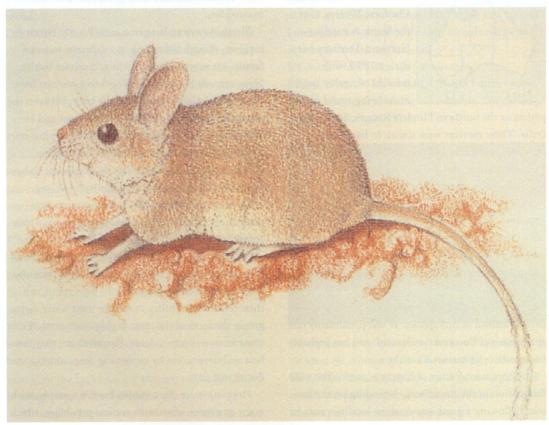
CAUSES OF CURRENT STATUS Not known. Presumably the effects of European settlement have been detrimental to this species, but the specific causes are not known.

PRINCIPAL ACTION REQUIRED. Nothing can be done until specimens are found.

Right. Mainland populations of the Northern Hopping-mouse are extremely small and scarce. The population on Groote Eylandt appears to be secure for the moment. Illustration from Neville Cayley's What Mammal is That?, published by Collins/Angus & Robertson Publishers.

Below. The Short-tailed Hopping-mouse (see page 161) is probably extinct. Illustration from Neville Cayley's What Mammal is That?, published by Collins/Angus & Robertson Publishers.





# NORTHERN HOPPING-MOUSE

Notomys aquilo Thomas 1921

SIZE 102 mm; tail 166 mm; 39 g

IDENTIFICATION Adult body size is that of a large mouse or small rat. Sandy brown above, white below and with thin, fine fur. Both sexes have a throat pouch, which is weakly ridged behind and with a central area of bare skin. Although externally the Northern Hopping-mouse is almost identical to the Spinifex Hopping-mouse *N. alexis*, the two can be distinguished by their distribution.

DISTRIBUTION Known from the western side of



Cape York, Queensland, and parts of the north coastal region of the Northern Territory in the vicinity of Arnhem Land, the Gulf of Carpentaria and Groote

Eylandt. The Spinifex Hopping-mouse is common in the arid zones of Central and Western Australia. HABITAT The Northern Hopping-mouse is known to occupy a number of different types of habitat. On Groote Eylandt it is most abundant in an area of stabilised sand dunes vegetated with acaciadominated scrub, with spinifex as the dominant ground cover. Cadell River (Northern Territory) specimens are known to occur in a rocky habitat with sandy soil and spinifex and small shrubs as dominant components of the local vegetation. NOTES Where this species occurs on Groote Eylandt, it is locally abundant, and lives in small groups in extensive burrows. A typical burrow consists of a long sloping tunnel with a number of vertical shafts. When not in use, the entrances are sealed with sand. Because of the nature of their burrows, pop-hole entrances can be almost anywhere on the ground surface. They may be under spinifex

clumps, close to bushes, or even in the middle of large bare patches of sand.

The reasons for the evolution of the hopping behaviour of these mice aren't fully understood. It has long been thought that the erratic hopping gait of these rodents may be to avoid predation by nocturnal predators such as owls. Recent research has also shown that at higher cruising speeds, the bipedal hopping gait is more energy efficient than the quadrupedal locomotion found in most mammals.

The diet of the Northern Hopping-mouse is mostly grass seeds and similar types of material, but may include some insects.

Breeding biology is little known. Two females collected on Groote Eylandt in June were pregnant with four and five foetuses respectively, while another specimen caught at Cadell River in July was not pregnant. This could indicate an extended breeding season, and breeding might occur at any time of year provided conditions are favourable. It is presumed that nests are constructed in the burrow systems, although none have been found to date. The female has two pairs of teats on the lower abdomen. CAUSES OF ENDANGERED STATUS Mainland populations are extremely small and scarce. Although the Groote Eylandt population is apparently secure, the risk of introduction of alien species that may adversely affect this population is still very high.

NUMBER LEFT Between 10 000 and 100 000. PRINCIPAL ACTION REQUIRED Continued preservation of habitat and continued vigilance against introduced pest plants and animals. Further research into the biology of this species is also urgently needed.

#### **DUSKY HOPPING-MOUSE**

Notomys fuscus (Wood Jones 1925)

SIZE 245 mm; tail 140 mm; 35 g

IDENTIFICATION The Dusky Hopping-mouse is distinguished from other hopping-mice by the following characteristics. It is the size of a large mouse, with a large and deep gular (throat) pouch with fleshy margins, which forms an obvious pocket with a mass of shining, stiff, white hairs within. The incisor teeth are not grooved. Above, its colour is orange to grey, and it is white below.

DISTRIBUTION Formerly abundant over a wide



area of southern central
Australia from Western
Australia, through most
of South Australia, and
nearby parts of the
Northern Territory, to
far south-west Queens-

land and far north-west New South Wales. In recent years, the Dusky Hopping-mouse has only been found in scattered localities within this former range, most notably near Ooldea in South Australia, and in south-western Queensland near Betoota. HABITAT This species exclusively occupies sand dune habitats. Where the dunes are interrupted by gibber plains, Dusky Hopping-mice do not appear to enter the gibber habitat to feed. Often these mice will apparently be common on one dune, but absent on seemingly identical adjacent dunes. Such a pattern of occupation may have become more typical since the overall population of this species has declined since white settlement.

NOTES In 1845, Sturt gave an account of how Aborigines invited his party and eat specimens of this species, when travelling between Fort Grey in northwestern New South Wales and Lake Blanche near the northern edge of the Flinders Ranges, South Australia, and added some biological notes to his account. He said, 'These wanderers of the desert had their bags full of jerboas which they had captured on

the hills. They could not indeed have had less than from 150 to 200 of these beautiful little animals, so numerous are they on the sandhills, but it would appear that the natives can only go in pursuit of them after a fall of rain, such as that we had experienced. There then being water, the country, at other times impenetrable, is then temporarily thrown open to them, and they traverse it in quest of the jerboa and other quadrupeds. Our friends cooked all they had in hot sand, and devoured them entire, fur, skin, entrails and all, only breaking away the under jaw and nipping off the tail with their teeth'.

Anecdotal evidence points to colonies of this species being very stable in terms of where they chose to live. The Betoota specimens were found on a particular sand ridge over three successive years, but never on adjacent ridges. Other hopping-mice, including the Spinifex Hopping-mouse *N. alexis*, do not appear to show such a strong attachment to a given site. Often a different species of hopping-mouse will occupy gibber habitat adjacent to, and within metres of where the species is found.

This largely nocturnal species tends to be most visible in the winter months, when most, if not all, collections are made.

Burrows are constructed on the flat top of a dune. The entrance hole may be up to 10 cm in diameter, and the burrow may be more than a metre deep and 5 m long. The main tunnel may be connected to the surface by up to six vertical shafts not more than 3 cm in diameter. Because the vertical shafts are dug from below, they may emerge anywhere on the ground surface. The width of the entrance shafts is dictated by the need for the mouse to climb out of them by hopping and bracing its back against the sides with its forefeet between hops. When rushing into the shaft, the mouse takes a headlong dive with its back braced against the wall of the shaft and the forelegs being used as a brake. Quite often blockages

within a burrow, caused either by a mouse plugging it or by a cave-in, are cleared by mice digging from opposite sides.

Groups of about five mice tend to occupy one or two adjacent burrow systems, which are connected by well-marked pathways. The nest is placed in a small alcove off the main shaft and is constructed of finely chewed vegetation.

Breeding occurs throughout the year, with one to five young produced after a gestation period of 38–41 days. The young's eyes open at 20 days and they are weaned ten days later. Sexual maturity occurs between 75 and 90 days.

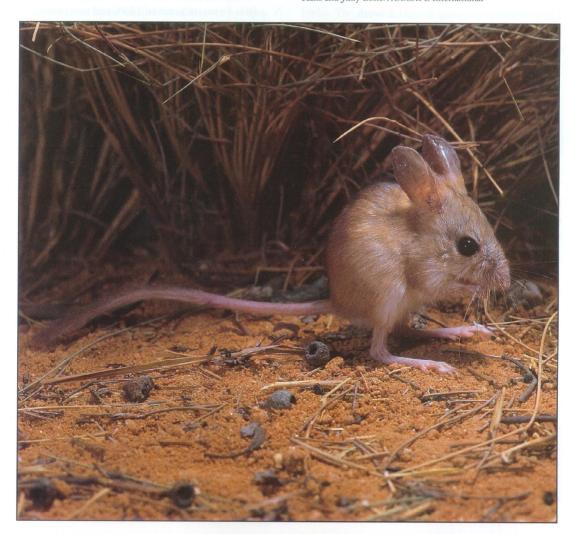
CAUSES OF ENDANGERED STATUS Not

known, but certainly some factor introduced by Europeans. Probably habitat alteration from excessive grazing, as well as introduced species such as foxes and cats, have taken a severe toll.

NUMBER LEFT Possibly thousands. Known populations number no more than a few hundred.

PRINCIPAL ACTION REQUIRED Removal of some specimens from the wild, and the maintenance of a permanent viable captive breeding population. Further research into wild specimens is also required before a more effective conservation programme can be planned.

Dusky Hopping-mouse Notomys fuscus Hans and Judy Beste/AUSCAPE International



### LONG-TAILED HOPPING-MOUSE

Notomys longicaudatus Gould 1844

SIZE 305 mm; tail 180 mm; 100 g IDENTIFICATION Distinguished from other hopping-mice (*Notomys*) by its size, in being as large as a domestic rat, in having small ears much shorter than the head length, and by its extremely long tail.

The incisor teeth are not grooved; the males have a sternal (chest) gland between the forelegs, on the lower neck; the colour is tawny brown above, becoming greyish white below; and the tail is brown above, white below, terminating in a black brush.

DISTRIBUTION No live specimens have been



taken since 1901, when the Spencer–Gillen expedition caught some at Barrow Creek, Northern Territory. The Longtailed Hopping-mouse has only been recorded

alive on four occasions since European settlement. The other three localities and dates were: Moore River, near Perth, Western Australia, in 1844; Coonbaralba Range, near Broken Hill in New South Wales, in 1845; and on the Burt Plains, north of Alice Springs, Northern Territory, in 1894.

Owl casts (pellets) containing remains of this species have been found in the northern Flinders
Ranges, South Australia, and in the Tanami Desert,
Northern Territory.

HABITAT Formerly common in a number of different arid and semi-arid habitats, where vegetation included acacia and eucalypt woodlands, spinifex country and areas dominated by low shrubs. The favourite haunts of the Long-tailed Hopping-mouse were areas with a stiff and clayey soil.

NOTES In 1844, Gilbert reported that this species liked to burrow in the mounds of the Burrowing Bettong Bettongia lesueur and the Greater Bilby Macrotis lagotis. It was also reported as a pest in storerooms, where it fed on sacks of grain, and was

known to be extremely fond of raisins. This species was apparently common at the time.

The nocturnal Long-tailed Hopping-mouse is one of the ten recognised species of hopping-mice known to have occurred in Australia during European settlement. It is one of up to five species now regarded as possibly extinct. The others are: 1. Big-eared Hopping-mouse *N. macrotis*—two specimens, both collected prior to 1844; 2. Short-tailed Hopping-mouse *N. amplus*—two collected in 1894, and never seen since; 3. Darling Downs Hopping-mouse *N. mordax*—known from a single skull and skin collected from a live animal in the 1840s; 4. A large and undescribed species known only from remains found in owl pellets in South Australia this century.

The decline of this species, like that of so many other small native mammals, was incredibly rapid following European settlement, and no principal single cause can be isolated.

STATUS Probably extinct.

CAUSES OF CURRENT STATUS Not known, but in some way connected with European settlement, as this species was apparently widely distributed and fairly common early last century.

PRINCIPAL ACTION REQUIRED Live specimens must be located before any conservation activity can be carried out.



Long-tailed Hopping-Mouse Notomys longicaudatus. Illustration from Gould's The Mammals of Australia. Mitchell Library

#### WESTERN PEBBLE-MOUND MOUSE

Pseudomys chapmani Kitchener 1980

SIZE 135 mm; tail 75 mm; 10 g

IDENTIFICATION See picture on page 168. In many respects this mouse is similar in appearance to the house mouse *Mus musculus*, but is distinguished by larger ears, eyes and tail, and by the smooth inner surface of the upper incisor teeth (which are notched in the house mouse). It also lacks the 'mousy' odour of the house mouse. The Western Pebble-mound Mouse is distinguished from the Central Pebble-mound Mouse by its smaller adult size (125–145 mm; the Central Pebble-mound Mouse is 150–170 mm), and its different range (Western Australia versus Central Australia). It is separated from the more common and widespread Sandy Inland Mouse *P. hermannsburgensis* by its shorter tail, ears and feet, the feet never being longer than 16 mm.

DISTRIBUTION Restricted to the Pilbara region in



Western Australia. Formerly this species also occurred in the adjacent Gascoyne and Murchison districts, as is evidenced by the distinctive mound structures left behind by

this species.

HABITAT The preferred habitat is arid tropical spinifex grassland and acacia woodland on pebbly soil. It does not inhabit sandy deserts,

NOTES For many years the Western Pebble-mound Mouse was confused with the very similar Sandy Inland Mouse, and it was thought that the Sandy Inland Mouse constructed the pebble mounds inhabited by this species. It was not until the late 1970s that biologists realised that this was a separate species, and that the Sandy Inland Mouse only constructs short, simple burrows.

The pebble mounds are constructed of small pebbles weighing an average of about 5 g, but up to 7 g, which are carried to the site by successive generations of mice. The pebbles are carried in their mouths and are shuffled into position by their forelimbs. The mounds typically range in area from 0.5 to 9.0 square metres and are penetrated by U-shaped tunnels connecting with pop-holes.

Mounds are most common on spurs and the lower slopes of ridges where weathering has produced plenty of pebbles of the preferred size, about 4–5 g.

The mound presumably provides good insulation against the harsh outside climate, a moist microclimate and some protection against predators, and is presumably a viable alternative to burrowing in hard soil.

The only fact recorded about the breeding biology of this species is that a newly caught female produced four young in late May.

CAUSES OF ENDANGERED STATUS The range of this species has declined sharply since European settlement. The reasons for this decline are not known. NUMBER LEFT Probably between 10 000 and 100 000 individuals.

PRINCIPAL ACTION REQUIRED Further biological research and population surveys. The establishment of captive colonies would be a safeguard against possible extermination in the wild.



Left. Successive generations of the Western Pebble-mound Mouse (see page 167) collect small pebbles and carry them back to the nest site in their mouths, pushing them into position with their forelimbs. This species is restricted to the Pilbara region in Western Australia.

A. G. Wells

Below. The Desert Mouse has suffered from competition with the house mouse, and its arid habitat has been affected by grazing stock, but several secure populations are still in existence. It generally feeds on seeds, grasses and insects, but thrives on succulent plant material when this is available.

B. G. Thomson/ANT Photo Library



## **DESERT MOUSE**

Pseudomys desertor Troughton 1943

SIZE 179 mm; tail 87 mm; 25 g IDENTIFICATION Distinguished from other native mice (*Pseudomys*) by being mouse-sized; brown with dusky wash above, greyish buff below; white upper lip and chin and with a chestnut orange eye-

ring. The tail is about the same length as the body, brown above and white on the sides and below.

DISTRIBUTION Records over the past 150 years



indicate that this species has, or rather had, a very wide range. It has been recorded on Bernier Island, Western Australia, and a number of other locations in the

central desert regions of that state. Likewise it has been recorded in arid parts of the Northern Territory, South Australia, New South Wales and Victoria. Sub-fossil remains indicate an even wider former range.

HABITAT Known from a variety of habitats in the arid zone. Most specimens have been reported from spinifex Triodia spp. hummocks, or habitats dominated by spinifex. A large colony of this species was found to have established itself on the north-western shore of Lake Eyre in 1968, living in a dense sedge association growing around the overflow channels of an artesian bore, with the adjacent habitat consisting of a cane-grass Zygochloa paradoxa association. NOTES The Lake Eyre colony referred to above was on the Anna Creek station, and after the introduction of cattle around 1971 the colony ceased to exist. It had apparently thrived in the more moderate micro-climate provided by the permanently moist sand and the dense vegetation it supported. The population density was much higher than usual in response to the more favourable environment.

Typically Desert Mice feed on seeds, grasses and insects, but when more succulent plant material is

available it seems to be preferred.

In one experiment six specimens were maintained in a laboratory without water on a diet of dry seeds for several months. Not only did they all appear to maintain their weight, but three actually gained weight in these conditions.

Breeding probably occurs all year, when conditions are favourable. Captive specimens certainly breed throughout the year. The oestrous cycle is 7–9 days; litter size ranges from one to four, averaging three, gestation is 27–28 days and there is a postpartum oestrus. Weaning occurs after 20 days and the mother is aggressive to her young almost immediately after this, thereby breaking the mother—offspring bond. Sexual maturity occurs at between two and three months. This means that the Desert Mouse has one of the highest rates of reproduction among the *Pseudomys* species.

The social organisation of the Desert Mouse appears to be more dispersed than that of other *Pseudomys*, with both sexes having individual territories and there being a mutual repulsion between adults except when mating. The brief copulation occurs without pair-bonding and the female is aggressive to her mate immediately after copulation.

Despite their short limbs, captive Desert Mice are active burrowers, and they also construct conspicuous paths and runways.

CAUSES OF ENDANGERED STATUS Grazing by stock and competition by introduced species such as house mice *Mus musculus*, have eliminated the Desert Mouse from many areas.

NUMBER LEFT Between 10 000 and 100 000. PRINCIPAL ACTION REQUIRED Further biological research, including investigation of factors that affect population levels and may cause local extinctions. Because several apparently isolated, but at this stage secure populations are known, a captive breeding programme need not be a top priority.



#### **SMOKY MOUSE**

Pseudomys fumeus (Brazenor 1934)

SIZE 230 mm; tail 140 mm; 70 g IDENTIFICATION The body of this mouse is about the same size as that of a house mouse *Mus musculus*; smoky-grey above, greyish-white below. The tail is obviously longer than the head and body, being smoky-grey on top and with white lateral stripes. The feet are pink with white fur.

DISTRIBUTION Known from scattered localities



within Victoria, including the Otway Ranges and Grampians in western Victoria, the highlands north-east of Melbourne near Aberfeldy, the Upper Thomp-

son River in central Gippsland, Lakes Entrance in the far east and Mount Coberas near the New South Wales border. Fossil remains of this species have been found in New South Wales including at Wombeyan caves, indicating a wider former distribution. HABITAT The Smoky Mouse only occurs in areas of high rainfall, but like most other coastal Pseudomys its preferred habitat is the drier areas of gravelly heathland dominated by banksias, heaths and legumes. The tea-tree Casuarina sp., which dominates most Victorian heathland, is usually absent from areas where this species is found. Recently burnt areas seem to have the highest population densities. NOTES In some areas, such as the summit of Mount William in the Grampians, this species may attain high population densities. In this population summer food is mainly the seeds of shrubby legumes that are common in the area, the berries of epacrids

No populations of the Smoky Mouse are known to exist within national parks, and the threat of habitat elimination and separation of remaining populations is likely to continue.

John Brownlie/ANT Photo Library

and Bogong Moths. In winter, when few seeds are available, the Smoky Mouse feeds mainly on underground truffle-like fungi that occur commonly around the roots of certain shrubs and grasses. The diet is consistently high in nitrogen.

Reliance on these food sources creates seasonal problems for these Mount William animals, which need a year-round supply of high-quality food. Only in the restricted locations where Bogong Moths are attracted to the blossoms and new seeds are produced can the Smoky Mouse survive the general food shortage from September to November. Those animals whose ranges lie outside the sites of early flowering plants tend to perish. More males than females die, presumably because of their greater wanderings from their place of birth, and their mating activities at this time of year.

Females produce one or two litters, averaging three to four young, from September to April, although most breeding activity is completed by the end of January.

There is some evidence that in hot, dry weather individuals will temporarily move into habitats normally considered too damp, for example, from a heathland hilltop into a moist gully. CAUSES OF ENDANGERED STATUS Habitat elimination and separation of remaining populations. This species seems to have declined sharply in number and range since European settlement. No currently known populations are within national parks, although some do lie within proposed conservation zones. Some reserves may have as yet undiscovered populations of this species. NUMBER LEFT Probably about 10 000. PRINCIPAL ACTION REQUIRED Due to the preference for recently burnt habitats, the active management of habitats and areas where this species remains is very important. This includes controlled burning as necessary.

### GOULD'S MOUSE

Pseudomys gouldii (Waterhouse 1839)

SIZE 190–229 mm; tail 90–100 mm; 50 g IDENTIFICATION This species is the size of a large mouse or small rat. It is ashy-brown, washed black dorsally; greyish white on the belly; and has soft fur with a tail shorter than the body. Distinguished from the similar Plains Rat *P. australis* by the presence of an accessory cusp on the first upper molar.

DISTRIBUTION No living specimens have been



seen since the late 1850s. From the late 1830s to the 1850s the Gould's Mouse was collected from widely separated localities, including inland New South

Wales, possibly including the upper Hunter valley, the junction of the Murray and Darling rivers, on the New South Wales—Victorian border, and the Moore River, Western Australia. Sub-fossil remains derived from owl pellets have been found in large numbers in caves of the Flinders Ranges, South Australia, and elsewhere, indicating that this was once a widely distributed and common species.

HABITAT Gould, who recorded specimens from the Liverpool Plains, South Australia, and Moore River, Western Australia, recorded that this species 'evinces a preference for plains and sandhills of the interior'. NOTES Western Australian specimens were recorded by Gilbert as occupying burrows to a depth of about 15 cm below the surface of grassy hills, in loose soil.

Between four and eight individuals were found occupying the same burrow, or even the same nest, which was constructed of soft dried grasses.

The decline of the Gould's Mouse was incredibly rapid. Sub-fossil owl pellets from Chambers Gorge, South Australia, contain remains of this species, no fewer than nine other species of native rodent, as

well as remains of the house mouse *Mus musculus*, which possibly superseded the Gould's Mouse.

The diet and breeding biology of the Gould's Mouse are not known, but are probably similar to those of most other native mice known from the Group 1 subgroup of *Pseudomys*, which includes the Shark Bay Mouse *P. praeconis*, also described in this book. STATUS Probably extinct.

CAUSES OF CURRENT STATUS Obviously several factors introduced by European man, including the dramatic habitat alteration throughout the known range of this species through land clearing, grazing by stock and rabbits, and possibly the introduction of diseases.

PRINCIPAL ACTION REQUIRED Not much can be done unless further specimens are found. If they are, it is likely that the only short-term hope for the species is to maintain viable captive colonies.



The Gould's Mouse was once a widely distributed and common species, but its decline since the nineteenth century has been very rapid. It can be attributed to dramatic habitat alteration since European settlement, including land clearing, grazing by stock and rabbits, and possibly the introduction of diseases. Lithograph from Gould's The Mammals of Australia.

Mitchell Library

#### CENTRAL PEBBLE-MOUND MOUSE

Pseudomys johnsoni Kitchener 1985

SIZE 160 mm; tail 85 mm; 13 g

IDENTIFICATION Same as for the Western Pebble-mound Mouse *Pseudomys chapmani*, but distinguished on the basis of its larger adult size (150–170 mm; the Western Pebble-mound Mouse is 125–145 mm), and its Central Australian distribution as opposed to the Pilbara range of the Western Pebble-mound Mouse.

DISTRIBUTION Known from twelve specimens



taken from a single locality in Central Australia. Possibly widespread throughout areas of suitable habitat in Central Australia.

HABITAT Preferred

habitat seems to be tropical acacia woodland dominated by spinifex hummocks, and with stony ridges where pebbles can be gathered.

NOTES Very closely related to the Western Pebble-mound Mouse, the Central Pebble-Mound Mouse avoided scientific attention because of its confusion with the more common and similar-looking Sandy Inland Mouse *P. hermannsburgensis* and was only described in 1985, from a collection of twelve specimens.

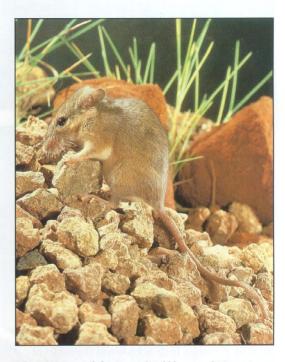
This species sleeps by day in mounds specially constructed to avoid excessively high daytime temperatures. Although the diet of this species is not known, it is presumed to include seeds, other vegetable matter and insects.

Several specimens appear to inhabit a single mound, and the easiest way to detect this species in an area is to look for its distinctive mounds.

Most aspects of the biology of this species are presumed to be similar to those of the closely related Western Pebble-mound Mouse, and, as with that species, little work has been done on its biology to date.

CAUSES OF ENDANGERED STATUS Few specimens are known. The Centralian region has suffered from large amounts of grazing and other human-induced disturbance since white settlement, and this appears to have led to the decline of this species. NUMBER LEFT Probably 1000–100 000 individuals.

PRINCIPAL ACTION REQUIRED Further biological research and population surveys. A captive breeding population should also be maintained.



The pebble nest of the Central Pebble-mound Mouse is constructed in such a way as to provide protection from very high daytime temperatures in the Central Australian region where it lives. Stock grazing and other habitat disturbance since European settlement have led to its decline.

Babs and Bert Wells/Australian Museum

### **WESTERN MOUSE**

Pseudomys occidentalis Tate 1951

SIZE 230 mm; tail 130 mm; 35 g

IDENTIFICATION Distinguished from other *Pseudomys* species by the following characteristics: size of a large mouse; dorsally a mixture of dark grey and yellowish-buff with individual longer black hairs; ventrally greyish-white; feet white; tail much longer than the head and body, and with long black hairs dorsally except for about the last 20 mm, which are white; underside a buff-white.

DISTRIBUTION Known from half a dozen local-



ities in the Western Australian wheat-belt in the far south-west of that state. Fossil records of this species dating from after the arrival of Aborigines indicate a much

wider former range. Fossils are known from as far afield as Shark Bay in Western Australia, the Nullarbor Plain, and Kangaroo Island, South Australia, indicating that this species probably once occurred along most of the south and south-west Australian coastlines, including in areas that are now below sea level.

HABITAT Preferred habitat seems to be virgin bushland, in climax vegetation communities on sandy loamy soils, frequently with a matrix of gravel. Within these areas, the vegetation varies and includes areas of sparse to dense heathland, sparse to dense shrub mallee and woodlands.

NOTES Although little is known of the habits of the Western Mouse, it probably lives in small colonies. Captive specimens will certainly live together and share nests without any hostility to one another. Despite this, captive breeding of this species has proven difficult to date.

Birth of three to five young occurs around October, with weaning occurring about a month later.

From trapping specimens over successive years, researchers at the West Australian Museum have concluded that known populations in nature reserves fluctuate between seasons and from year to year.

Diet appears to consist mainly of seeds and fruits of native plants, although insects are certainly also eaten. Although previous authors have speculated that insects such as beetles have been eaten incidentally, when the mice have been feeding on vegetable matter, this now does not seem to be the case. CAUSES OF ENDANGERED STATUS Long-term decline of this species, accelerated by European settlement and the clearing of most habitat. Remaining habitat is confined to about half a dozen very small and isolated nature reserves, which are highly vulnerable to invasion by pest species from outside. NUMBER LEFT Probably at least 10 000. PRINCIPAL ACTION REQUIRED Further biological research into the Western Mouse, in particular population ecology and the causes of fluctuations in numbers. Further attempts at captive breeding are also essential.

Right above. As the preferred habitat of the Western Mouse is virgin bushland, it has inevitably faced decline with the clearing of bushland for settlement. Its remaining habitat is confined to about half a dozen very small and isolated nature reserves, which are highly vulnerable to invasion by introduced predators.

A. G. Wells

Right below. The Pilliga Mouse (see page 176) is known only from the Pilliga Scrub area north of Coonabarabran in New South Wales, within an area of about 800 square kilometres. Even within this area it is apparently quite rare. It seems to be easily bred in captivity, a hopeful indication for its future.

R. Whitford/Australian Museum





#### PILLIGA MOUSE

Pseudomys pilligaensis Fox & Briscoe 1980

SIZE 130–158 mm; tail 67–79 mm; 10–12 g IDENTIFICATION See picture on page 175. Smaller in size than a house mouse *Mus musculus*. The colour is grey dorsally, graduating to russet on the sides. The belly is white. The tail is darker above than below and terminates with a small black tuft. This species is most likely to be confused with the Delicate Mouse *P. delicatulus*, and the New Holland Mouse *P. novaehollandiae*, from which it is distinguished by the length of the hindfoot. In adult specimens it is 18–19 mm in the Pilliga Mouse, 15–18 mm in the Delicate Mouse and 20–22 mm in the New Holland Mouse.

DISTRIBUTION Known only from the Pilliga



Scrub area north of Coonabarabran, New South Wales. The Pilliga Mouse is only known to occur in an area of about 8000 square kilometres. There is a possibility

that this species also occurs in other areas of suitable habitat in north-west New South Wales, such as the Warrumbungle National Park.

HABITAT The area consists of a mixture of vegetation types, but is dominantly cypress pine forests with associated eucalypts, and a sparse understorey of heath species. This is interspersed with woodland, pure heath and some open grassy areas. The ground is sandy loamy soil.

NOTES In the Pilliga Scrub, a very intensive collecting trip specifically in search of this species revealed only three specimens. The trip, in November 1979, involved more than 1000 trap nights in three suitable localities. The apparent low population density may have resulted from seasonal factors,

or perhaps inadequate collecting methods.

When the species was scientifically described in 1980, the six individual specimens known to science consisted of three live and three dead museum animals. Subsequent captive breeding more than doubled the number of known individuals, and very rapidly.

This nocturnal species constructs burrows in which it hides during the day, and probably lives in family groups. Areas with sparse ground cover seem to be preferred.

In the wild, the breeding season extends throughout the warmer months (October–February), and the gestation period is 24–31 days. Sexual maturity may be attained at seven weeks, but is dependent on local conditions.

Populations apparently fluctuate seasonally, being highest in autumn and lowest in late spring. Diet consists of seeds, insects, other invertebrates, leaves flowers and fungi, depending on seasonal availability.

Although this species is presumably in direct competition with the house mouse and is prey to non-native animals such as foxes, the effects of these on this species are not known.

CAUSES OF ENDANGERED STATUS Rarity within a very limited range, and the vulnerability of this species' population as a result. Displacement by another species, native or non-native, may have disastrous consequences.

NUMBER LEFT More than 1000, in the known range.

PRINCIPAL ACTION REQUIRED Further research into wild populations and searches for this species in potential habitat in other areas, to more accurately ascertain the total population. Continued captive breeding and related research.

#### SHARK BAY MOUSE

Pseudomys praeconis (Thomas 1910)

SIZE 220 mm; tail 120 mm; 45 g

IDENTIFICATION This is the size of a very large house mouse, grizzled dark brown dorsally, becoming buff on the sides. The belly is white. The slender feet are a dirty white colour. The fur is relatively long and shaggy. The fully-furred tail is grey above, white below, and roughly the same length as the body (marginally longer). The tail has a slight tuft at the end. The head is short and blunt with large ears. DISTRIBUTION Currently the Shark Bay Mouse is



only known from Bernier Island, Western Australia, where it is locally common. In 1858, the first and last specimen collected on the mainland was caught on the

Peron Peninsula, some 150 km to the south. Subfossil remains of this species, fewer than 500 years old, indicate a former distribution over a wide area of coastal south-west Western Australia.

HABITAT Although it probably occupies more than one type of habitat, this species is abundant on Bernier Island in a small area of coastal dune vegetation within 10 m of the sea. The vegetation consists of a dense mat of coastal spinifex *Spinifex longifolius* and coast daisy bush *Olearia axillaris*, dead bushes of 'roly-poly' and saltbush in the nearby dune valleys, with piles of dead sea grasses washed up by winter storms at the top of the beach.

NOTES Where this mouse occurs it appears to exist in high population densities. In 1975, ten males were caught in an area of about one hectare. No aggression between captive individuals seems to occur. Although tunnels and runways are found throughout the species' habitat, including through the piles of dead sea grasses, nests are thought to be located in burrows under large clumps of spinifex.

Diet includes a wide range of suitable seasonally

available vegetable material, including the petals of coast daisies, and leaves and stems of other fleshy plants. Small amounts of fungi and insects are also taken. Captive specimens feed on typical rodent diets of mixed seeds and vegetables, and obesity is not an uncommon problem in these animals.

The oestrous cycle is less than two weeks, and three or four young are born after a gestation period of less than a month. The young hang on to the mother's teats tenaciously and are dragged around behind her when she moves. The eyes open at about 15 days of age and within a month the young are weaned and independent. Males seem to exhibit protective behaviour toward their young on some occasions.

CAUSES OF ENDANGERED STATUS Apparent elimination from mainland Australia, and restriction of the total remaining population to an area of only a few square kilometres.

NUMBER LEFT Fewer than 2000.

PRINCIPAL ACTION REQUIRED The removal of goats from Bernier Island appears to have benefited the Shark Bay Mouse. Vigilance in maintaining this habitat and protecting it from the potential introduction of other hostile species is important.



Shark Bay Mouse Pseudomys praeconis

### HEATH RAT

Pseudomys shortridgei (Thomas 1907)

SIZE 170–230 mm; tail 80–110 mm; 55–90 g IDENTIFICATION This large *Pseudomys* is the size of a small black rat *Rattus rattus*, brown dorsally with a sharply contrasting paler belly. The long guard hairs give a fluffy appearance. The feet are brown, but paler than the body. The blunt head has bulging eyes. The ears are covered in fine hairs. The unringed tail distinguishes the Heath Rat from *Rattus* species and is shorter than the body.

DISTRIBUTION Known only from the Kentbruck-



Portland areas, and near Pomonal in the Grampians, both in southwestern Victoria. This species was recorded from Woyaline, east of Pingelly in the south of

Western Australia, in 1906, but has not been seen in that state since. It may still occur in the area. HABITAT The preferred habitat seems to be almost exclusively species-diverse dry heathlands that have been burnt within the past ten years, but not more frequently than every two or three years. Adjacent habitat may contain a few specimens, expelled from areas of preferred habitat.

NOTES The Heath Rat has a distinctive social organisation involving long-lasting pair bonds between males and females. Non-bonded adults of the same sex are very aggressive to one another. Pairs form prior to the breeding season when females are at least six months old, and males are about 18 months old. Breeding occurs when females are at least twelve months of age, with males needing to be at least double that age. The pair bonds apparently last until the death of one of the Heath Rats, whereupon the surviving member of the pair forms a new bond within a month. Individual Heath Rats are known to live for more than five years.

Although the females are strongly territorial, the

males do not appear to be quite as strongly attached to a single area. Many offspring tend to be forced out of the areas where they are born by the territorial adults, from where they may, it is hoped, colonise suitable habitat.

The annual breeding season is late spring and summer, when one or two litters of about three young are produced. Juveniles appear to survive only if they have nearly attained adult size before the onset of autumn rains.

Diet varies according to the seasonal availability of food. During spring and summer, Heath Rats feed mainly on flowers, seeds and berries, turning to the nutrient-poor diet of stems and leaves of grasses, sedges and lilies as the former run out at the end of summer. During the cooler, wetter months, Heath Rats feed mainly on the subterranean fruiting bodies of fungi, which persist until flowers, seeds and berries become available again.

Because of the preference of the Heath Rat for relatively recently burnt, florally diverse heaths, its biology must be geared towards dispersing and finding new habitats, and saturating them once found. Offspring have a much higher survival rate in newly colonised habitat where food is plentiful than in saturated habitat, from where they tend to be expelled and often forced to inhabit sub-optimum habitat. The species survives because some expelled offspring successfully colonise new habitat before the original point of dispersion becomes unsuitable because of either the maturity of the vegetation complex or another burn-off.

The survival of the species depends on there being a localised mosaic of heathland habitat of differing maturity. Since European settlement, the large-scale clearing of potential habitat and the fact that remaining areas tend to have a uniform fire history have tended to cause extinction of this species from large areas. Remaining colonies of this species appear



to be mainly in areas of light human impact. CAUSES OF ENDANGERED STATUS Clearing of habitat, large scale and unfavourably uniform fire regimes, and possibly the effects of certain introduced mammals.

NUMBER LEFT Probably about 10 000.
PRINCIPAL ACTION REQUIRED Active management of remaining habitat by utilisation of a fire regime that maintains plant diversity, with adjacent areas in different stages of succession after fire. Further biological research into the Heath Rat.

Because of the Heath Rat's preference for recently burnt areas, its biology is probably geared towards dispersing and finding new habitat and saturating it once found. Remaining suitable habitat where the species occurs will have to be actively managed if the Heath Rat is not to die out.

A. G. Wells

## FALSE WATER-RAT

Xeromys myoides Thomas 1889

SIZE 208–226 mm; tail 93–99 mm; 45 g IDENTIFICATION This rat is the size of a small rat. The head is long and similar in appearance to that of the Water-rat *Hydromys chrysogaster*. The ears are short and round, the eyes round, and unlike the Water-rat's the feet are not webbed. The uniformly short, water repellant fur is dark slate-grey above and white below.

DISTRIBUTION Not exactly known, but probably



scattered over a wide part of the northern Australian coastline, stretching from lower coastal Queensland to the northern Kimberleys.

Specimens have been

collected on Stradbroke Island and near Mackay in Queensland, on the South Alligator and Tomkinson rivers, on Melville Island and elsewhere in the Northern Territory.

HABITAT Specimens have always been found in habitats with shallow water, either tidal or fresh, close to the coastline and relatively undisturbed by human activity or grazing by stock, including water buffaloes. Swampy habitats where this species has been found include mangrove forest swamps lined with mangroves and sometimes paperbarks, as well as reed swamps with tall grass, shrubs and pandanus palms.

NOTES Although the False Water-rat has a varied diet, it prefers animal to plant material. A wild specimen in Arnhem Land was observed killing and eating a crab larger than itself.

The False Water-rat and the related Water-rat are unique among Australian rodents in that they have only two pairs of molar teeth in the upper and lower jaws.

The False Water-rat is active during the day, at dawn and dusk, and at night, enters water in search

of food and to escape predators, and commonly climbs low trees and shrubs, in particular those whose bases are submerged.

Predators include large birds of prey and reptiles, and a specimen was found inside a Saltwater Crocodile *Crocodylus porosus*. When disturbed, the False Water-rat will hiss loudly in a manner more like that of a dasyurid marsupial than a rodent. If further harassed it will defend itself with its teeth.

One nesting site was described as a large mound of clay about 60 cm tall, sited at the base of a mangrove tree. Near the top of the mound were two nest chambers, some 8 cm in diameter, one lined with mangrove leaves and containing a female with two young. The nest was found in mid-June and the young were more than half-grown at the time. The female had four teats'.

Most of the nest mound would have been submerged during high tides, and the entire mound would have been covered with water during a high spring tide.

Captive specimens rest in burrows that they con-

CAUSES OF ENDANGERED STATUS Habitat destruction and alteration. In northern Australia water buffalo, wild pigs and introduced stock are trampling swamps and lagoons where this species occurs, and thereby making them uninhabitable. Elsewhere, swamps are being drained and mangrove habitats cleared. In other parts of the range, particularly in coastal Queensland, sugar-cane growing and tourist development are having an adverse effect on this species.

NUMBER LEFT Probably more than 10 000. PRINCIPAL ACTION REQUIRED Active preservation and management of remaining habitat, including removal of potential introduced pests such as buffaloes. Further biological research and population surveys are urgently required.



Above. The northern Australian habitat of the False Water-rat has been destroyed in many areas by huffalo, wild pigs and stock, which trample the swamps and lagoons where this species occurs, and make them uninhabitable. Sugar-cane growing, tourism, the clearing of mangroves and the draining of swamps have all contributed to the rat's decline.

Hans and Judy Beste/AUSCAPE International

Right. The Central Rock-rat (see page 182) has probably never been very common, but the introduction of animals such as cats and foxes and house mice has not made its position any more secure. It lives in the ranges of Central Australia. Illustration from Neville Cayley's What Mammal is That?, published by Collins/Angus & Robertson Publishers



## CENTRAL ROCK-RAT

Zyzomys pedunculatus (Waite 1896)

SIZE 220–280 mm; tail 110–140 mm; 75 g IDENTIFICATION See picture on page 181. Distinguished by its thickened tail, which is carrotshaped, being thickest at the base, where fat is stored. The Central Rock-rat has a compact, harshfurred body, a pronounced Roman-nosed appearance, rounded ears and protruding eyes.

Distinguished from the other two members of the genus on the basis of distribution, the other two members occurring in tropical Australia only. The Central Rock-rat is distinguished from the Common Rock-rat *Z. argurus* by its larger adult size, with the hindfoot measuring 25–29 mm as opposed to 20–26 mm in the Common Rock-rat. The tail of the Central Rock-rat is hairier and its body is of smaller adult size than that of the Large Rock-rat *Z. woodwardi*. DISTRIBUTION Fewer than a dozen specimens



have been recorded from the ranges of Central Australia since this species was described nearly 100 years ago. The Central Rock-rat has been recorded from the Mac-

Donnell Ranges, Reynolds Range and the Davenport Range. The most recently recorded specimen was in 1960, when a female was caught raiding a stock camp at Haast Bluff in the Western MacDonnell Ranges. Intensive trapping of native mammals at past capture sights since 1960 has not revealed any specimens.

HABITAT Rocky ranges, consisting of folded sandstones or old metamorphic rocks with igneous intrusions, all with deeply eroded sections and sometimes more than 800 metres elevation. The soils may be sandy or clay, and vegetation may vary with soil or other conditions.

NOTES The extreme fragility of the tail of the Rock-rats of the genus *Zyzomys* has been recorded by many collectors. When grabbed, the outer layer of skin readily strips, leaving the bony skeleton and fatty tissue, which soon dries out and drops off. This characteristic is similar to that shown by skinks, geckoes, and other lizards, and is an asset if the animal's tail is seized by a predator. Rock-rats caught in the wild often have damaged tails. A damaged tail will not regenerate.

The agility of this species in its rocky habitat is enhanced by the short, broad feet, which give it an easy grip on the smooth rock surfaces. It is probable that this species is most common in rock-crevice areas.

Although the breeding biology of this species is not known, it is presumed to be similar to that of other Rock-rats. Females bear one to four young, which mature at about six months of age, at which stage the testes of the male young descend into the scrotum. The female has four teats. Although some individuals live for more than two years, most are not thought to live not much longer than a year.

Native predators presumably include large reptiles and birds of prey. No doubt foxes and cats take a major toll on this species.

CAUSES OF ENDANGERED STATUS This species may have been uncommon prior to European settlement. The main alteration in the position of this species since settlement has not been due to habitat alteration, but more likely the introduction of predators such as cats and foxes, and possibly competing rodents such as house mice.

NUMBER LEFT Probably thousands.

PRINCIPAL ACTION REQUIRED Further specimens must be located and studied in detail.

#### ATHERTON ANTECHINUS

Antechinus godmani Thomas 1923

SIZE Males 269 mm; tail 126 mm. Females 226 mm; tail 104 mm

IDENTIFICATION See picture on page 184. Most likely to be confused with the Yellow-footed Antechinus Antechinus flavipes, from which it can be distinguished by the following characteristics: larger adult size, dull brown body fur and bright orangeish cheeks (versus a slate-grey head and rufous rump and nearby parts in the Yellow-Footed Antechinus). The two are further distinguished by their tails, nearly naked in the Atherton Antechinus but hairier and black tipped in the Yellow-footed Antechinus, which also has characteristic light eye-rings. The Atherton Antechinus has relatively long hair ventrally, which tends to form a crest.

DISTRIBUTION Restricted to an area of about 150



square kilometres where the Cardwell and Walter Hill ranges converge near Ravenshoe, northeastern Queensland. To date it has only been recorded from about half

a dozen separate localities within this range.
HABITAT Densely vegetated forests about 1200
metres above sea level, with an average annual rainfall of more than 1700 mm, and in an area often shrouded in clouds and mist.

NOTES These nocturnal, terrestrial animals forage through fallen vegetation, fallen logs and other ground cover in search of their food, which consists of insects, other invertebrates, and vertebrates, including some the same size as itself. Like all *Antechinus* species, the Atherton Antechinus has a voracious appetite and is aggressive when feeding. Smell and hearing are the more important senses, this species having small eyes, and near-blind specimens with diseased eyes seem to have no problems moving about and feeding.

The mating season is in July, and occurs over a two-week period. It can be a very violent procedure. The powerful males seize the females by the scruff of the neck and force them into position. Females unable to escape may suffer lacerations to the head and neck and have been known to die from these injuries. Copulation typically lasts for several hours. Females may copulate several times during the mating season.

Although females may recover their condition and reproduce the following year, males do not. Males become weak and tend to fall victim to diseases, including eye infections, typically dying a short period after mating, giving them a life span of little more than twelve months.

In August young are produced, with up to six being carried by the female. If excess young are produced they do not survive. The young suckle continuously for about five weeks, hanging from the nipples like grapes. For the rest of the suckling period the young remain in the nest while the female hunts for food.

The Atherton Antechinus does not seem to be very numerous where it occurs; however, it remains little studied. In the past, many specimens placed in museums and labelled as this species were in fact Yellow-footed Antechinus. The Atherton Antechinus appears to have closer affinities to New Guinea species, from which it may have derived. CAUSES OF ENDANGERED STATUS Contraction of potential habitat through agricultural development and logging.

NUMBER LEFT Probably thousands.

PRINCIPAL ACTION REQUIRED Further research into the biology, distribution and population of this species, before a conservation programme can be devised. In the interim, known habitat should not be disturbed; fortunately, a large part of this is within Palmerston National Park.





#### DIBBLER

#### Parantechinus apicalis (Gray 1842)

SIZE Males 255 mm; tail 110 mm; 80 g. Females 235 mm; tail 95 mm; 58 g

IDENTIFICATION Distinguished from similar species by the tapering hairy tail, white ring around the eye, freckled whitish-on-brown appearance of the relatively coarse fur, and the long hairs on the tail, especially at the base, making the tail appear very thick. DISTRIBUTION None had been seen for 83 years



when, in 1967, a pair was caught at Cheyne Beach, in the south of Western Australia. In 1976, two freshly killed specimens were found on farms at Jerdacuttup,

some 225 km to the north-east, indicating that other populations of this species probably still occur in that part of the country.

HABITAT Now only known from banksiadominated heathland, and similar habitat, this species presumably formerly occupied a range of habitats before its distribution contracted with European settlement.

NOTES Most recent specimens have been caught at Cheyne Beach, where this species is still very elusive

Left above. The mating behaviour of the Atherton Antechinus (see page 183) can be so violent that the female dies from lacerations. The male succumbing to disease in his weakened post-coital state is a common occurrence, and male Atherton Antechinuses live for only about a year.

Queensland Museum

Left below. Possibly fewer than 100 specimens of the Dibbler remain, in banksia-dominated heathland in the south of Western Australia. The existence of wild populations is very precarious, but so far captive breeding of the Dibbler has failed.

A. G. Wells

and quite possibly rare. Last century this species was relatively widespread in the far south-west, being found at least from the Moore River region to King George Sound. Geologically recent remains from Shark Bay and Bremer Bay indicate a contraction in range in the period of Aboriginal habitation prior to European settlement.

The principally nocturnal Dibbler may bask during the day in cooler conditions. When foraging, this shy animal has swift and jerky movements and will immediately take cover when startled. Diet appears to consist principally of insects and nectar, preferences probably being dictated by seasonal availability.

Young are produced in March or April. Up to eight pouch young are carried. They are dependent for 12–16 weeks and are sexually mature before the following year's breeding season. Copulation lasts for several hours and may occur several times in the mating season. Both sexes may be reproductive for at least two successive years, and both sexes have a life span of about two to three years.

CAUSES OF ENDANGERED STATUS Clearing of habitat, and introduced pests, including dogs, cats and foxes. The two dead specimens from Jerdacuttup were killed by a dog and a cat respectively. Perhaps the invasion of dingoes along with habitat change caused by the Aborigines' burning activities started the original decline of the Dibbler.

NUMBER LEFT Probably fewer than 1000, possibly fewer than 100.

PRINCIPAL ACTION REQUIRED To date, captive breeding attempts have been unsuccessful. Use of new technology to initiate captive breeding of future captives must be employed to maintain captive colonies of this species. At present the existence of wild populations is too precarious to ensure the long-term survival of the Dibbler, although the Cheyne Beach population is within a 75-ha reserve.

### RED-TAILED PHASCOGALE

Phascogale calura Gould 1844

SIZE Males 254 mm; tail 141 mm; 60 g. Females 233 mm; tail 132 mm; 43 g

IDENTIFICATION Phascogales have a rat-like appearance and a distinctive brushy end of the tail, which, when the animal is active, is held fluffed out like a bottle brush. Unexcited and dead specimens have their tail hairs close together and flat along the tail. The Red-tailed Phascogale is distinguished from the larger Brush-tailed Phascogale *P. tapoatafa* by the reddish base of the tail, located between the body and the brush.

DISTRIBUTION Restricted to parts of the Western



Australian wheat-belt where the annual rainfall averages between 300–600 mm. Last century the Red-tailed Phascogale was widely but patchily distributed in

the lower Murray valley (New South Wales, Victoria and South Australia), and the Macdonnell Ranges, Northern Territory.

HABITAT The preferred habitat was virgin, mature sclerophyll woodland. Current populations exist in isolated reserves exceeding 450 hectares, in densely vegetated wandoo and red oak communities, preferably when the two are adjacent. The wandoo provides plenty of nest sites in the form of hollow logs



Red-tailed Phascogale Phascogale calura Jiri Lochman/Lochman Transparencies

and tree limbs, while the near-continuous canopy of the red oak community gives protection against nocturnal birds of prey and is therefore a preferred foraging ground.

NOTES The fast-moving Red-tailed Phascogale feeds both on the ground and in the foliage above. Diet includes insects, particularly smaller ones, small birds and mammals, including the house mouse, which is a preferred food item when available. Like many small marsupials, this species apparently does not drink free water, even in times of drought.

Breeding occurs annually, with young being produced in mid-winter, from mid-June to mid-August. Eight or occasionally fewer young are weaned by the end of October, with sexual maturity occurring before the next breeding season. Although females can breed in successive years, males appear to die shortly after their first mating, giving them a life span of only about twelve months. This means that for a substantial part of every year, the entire adult population of this species is female.

The agility of this species is extraordinary. When descending trees it will move head first, or remain stationary head downwards with the body pressed flat against the trunk. A captive specimen was recorded as performing a continuous succession of back-flips from the surface of a table.

CAUSES OF ENDANGERED STATUS Habitat destruction. As early as 1843 cats were recorded as preying on this species. This species is now restricted to areas where fluoroacetate-bearing legumes *Gastrolobium* and *Oxylobium* are common, and due to the toxicity of these plants to cattle and sheep, no grazing of such areas has ever taken place. Any grazing activity must be regarded as a threat.

NUMBER LEFT Probably several thousand or more. PRINCIPAL ACTION REQUIRED Where this species remains, it is locally common. Remaining reserves must be very closely managed.

# JULIA CREEK DUNNART

Sminthopsis douglasi Archer 1979

SIZE 220 mm; tail 105 mm

IDENTIFICATION Dorsally this dunnart is brown speckled with grey, and olive buff ventrally. This is the second-largest species of dunnart and is similar in appearance to the smaller Red-cheeked Dunnart *S. virginiae* in having spiny fur, a distinct mid-dorsal head-stripe, reddish cheeks and large pads at the tips of the interdigital pads of the hindfeet. The slightly flattened tail of the Julia Creek Dunnart distinguishes the two species.

DISTRIBUTION Known from a very limited num-



ber of specimens, all collected within the vicinity of Julia Creek or Richmond in northern inland Queensland. HABITAT Not known, but because of its sim-

ilarity to the more common Red-cheeked Dunnart of tropical Australia and southern New Guinea, which lives in woodland, this species is presumed to have similar habitat preferences.

The area where specimens have come from has an average annual rainfall of about 450 mm, and consists of grasslands and woodlands.

NOTES This dunnart is presumed to feed dominantly on arthropods, and is one of the 'thin-tailed' varieties, whose tail never becomes fat, even in optimal conditions. Other 'fat-tailed' dunnarts have tails that become carrot-shaped in good seasons when food is plentiful, and act as a food store in lean seasons.

Dunnarts differ from mice in that their snouts are more pointed and they have a large number of small incisor teeth. When cornered or frightened, a dunnart will adopt a threatening posture with a widely open mouth, usually accompanied by noisy exhalations.

Although some dunnarts can become torpid by

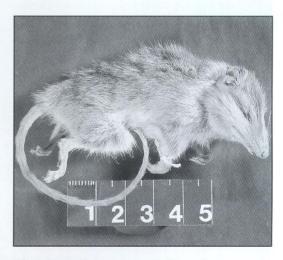
letting their body temperature match that of the environment—usually when food resources are scarce—it is not known if the Julia Creek Dunnart does this.

The only breeding record for the Julia Creek Dunnart is from a wild specimen caught in 1934, which had seven nipples and six pouch young.

STATUS Endangered, possibly extinct.

CAUSES OF CURRENT STATUS Rarity and limited range. The current rarity may be a normal feature of this species, but virtually nothing is known in this regard.

NUMBER LEFT Impossible to estimate.
PRINCIPAL ACTION REQUIRED Location of specimens must occur before any further action can be contemplated.



The Julia Creek Dunnart is only known from a very limited number of specimens taken within a very restricted range. Little is known about this species, and live specimens must be located before conservation work can be contemplated.

M. Archer/Australian Museum

## LONG-TAILED DUNNART

Sminthopsis longicaudata Spencer 1909

SIZE Males 295 mm; tail 205 mm; 15–20 g. Females 270 mm; tail 185 mm; 15–20 g IDENTIFICATION Readily distinguished from all other dunnarts by the tail being more than twice the length of the head and body. Other features include: a flattened head and long snout; the lack of a large tuft at the end of the tail; the tail being scaly with short hairs, except at the tip where long hairs protrude to form a fine brush. Colour is usually grey dorsally, creamy white ventrally and white on legs and feet.

DISTRIBUTION Known from scattered localities in



the Pilbara region, Western Australia, particularly near Marble Bar, with further records from the Gibson Desert, Western Australia, and a single record from an

unnamed locality in 'central Australia'.

HABITAT All specimens caught so far have come from very rocky habitats or areas immediately adjacent, and always with spinifex *Triodia* spp. as the dominant ground vegetation, in which the dunnart is known to frequently take shelter. These areas typically have sandy soils between the rocks. Known only from arid habitats.

NOTES A 1981 expedition to locate this species trapped nine specimens in the Young Range, a series of rocky, flat-topped hills in the Gibson Desert Nature Reserve. All were found on plateaux near breakaways and screes, or on scree slopes. Along

with stunted trees and shrubs, spinifex was a dominant form of vegetation present.

A highly capable climber, the Long-tailed Dunnart appears to be mainly nocturnal in habit. Its tail may be held in a variety of positions when moving or at rest.

Diet is mainly arthropods, in particular beetles and ants, but spiders, cockroaches, centipedes, grasshoppers, flies and various larvae are also eaten. When it is cold, or food supplies are scarce, this species will allow its body temperature to drop along with that of the environment, and become torpid to conserve energy.

Breeding is in late spring and early summer. STATUS Endangered, although status may have to be revised if populations are found to be more widespread or numerous.

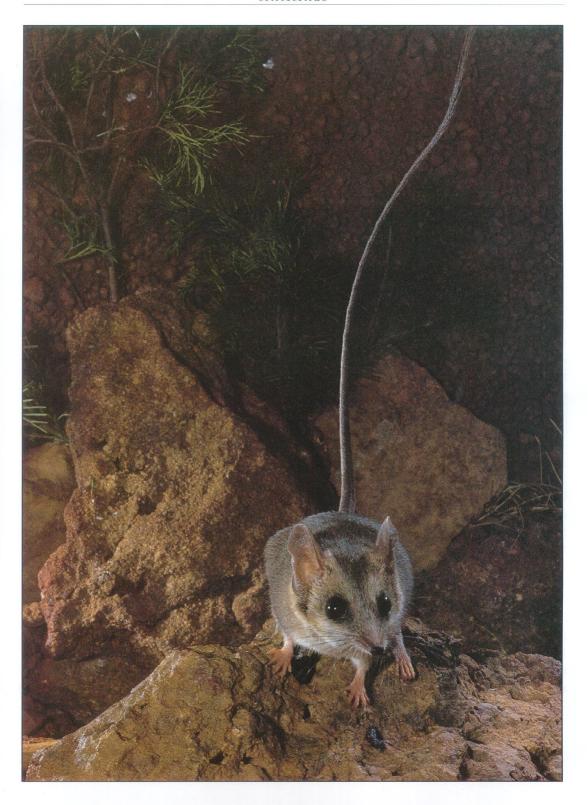
CAUSES OF CURRENT STATUS Relatively few specimens caught so far, despite a reasonable amount of fieldwork in areas where the Long-tailed Dunnart is known to occur.

NUMBER LEFT Probably many thousands.

PRINCIPAL ACTION REQUIRED Location of more specimens in the wild, and detailed studies of the biology of the species.

The Long-tailed Dunnart may be readily distinguished from all other dunnarts by its tail, which is more than twice the length of its head and body combined. It is a capable climber and largely nocturnal, feeding mainly on arthropods.

A. G. Wells



### SANDHILL DUNNART

Sminthopsis psammophila Spencer 1895

SIZE 205–243 mm; tail 114–129 mm IDENTIFICATION Being much larger than a mouse, this is one of the larger 'thin-tailed' *Sminthopsis* species. It is readily distinguished by the crest of stiff hairs 2.5–3.0 mm long extending vertically above and below the last quarter of the tail, particularly on the underside. The soles of the feet, including the toes, are finely granular.

Other characteristics include: a drab grey dorsal colour, with black pencilling continued onto the head in a wedge-shaped patch terminating between the eyes, with the rest of the head pale grey except for black eye rings. The cheeks and sides are buff, while the ventral surface is white. The tail is muscular at the base, pale grey above and darker below. DISTRIBUTION Specimens have only been



recorded from three localities, namely: an adult male collected during the day between Kurtitina Well and Ayers Rock, Northern Territory, in June 1894;

a second adult male found during a burn-off, on a farm at Mamblyn on the Eyre Peninsula, South Australia in 1969; and four juveniles (two male, two female), caught during another burn-off, at Boonerdoo on the Eyre Peninsula, South Australia, also in 1969. The species probably occurs in other areas in South Australia and the Northern Territory, between the known localities.

HABITAT Despite climatic variations where the specimens have been caught, the habitat requirements seem fairly consistent. Preferred habitat is low

parallel sand ridges capped by hummocks of spinifex, with wide swales covered by scrub or stunted vegetation, often occurring in scattered groves. Within this habitat preferred sheltering sites are beneath spinifex hummocks on the slopes of sand ridges.

NOTES Although occasionally active during the day in cooler weather, this species appears to be active mainly during the late afternoon, at dusk and at night.

A captive specimen fed voraciously on a variety of adult and larval insects, spiders and chopped offal.

Highly agile, and usually adept at avoiding danger, when cornered this species will adopt a crouched defensive posture and threaten the assailant with open mouth and short, throaty hisses.

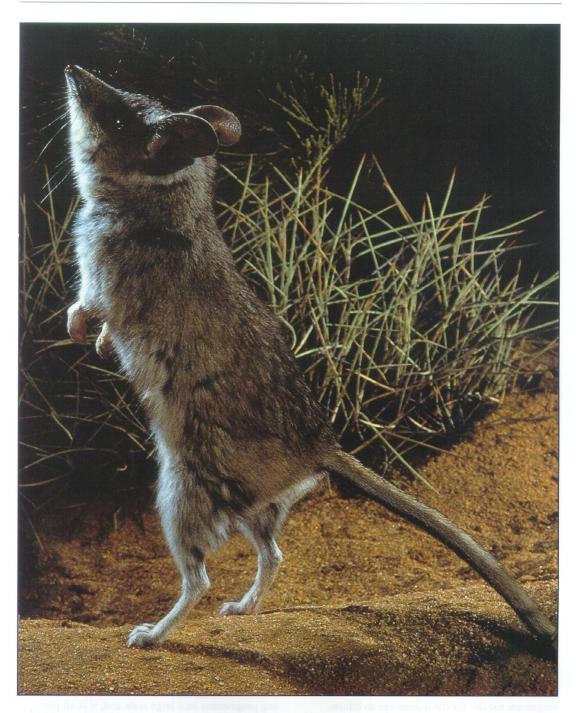
A skull of this species was taken from an owl peller found in a cave at Ayers Rock, indicating one predator of the Sandhill Dunnart. Other predators probably include large snakes and lizards, various birds of prey, introduced foxes and cats.

There are no records about the breeding biology of the Sandhill Dunnart.

CAUSES OF ENDANGERED STATUS Many intensive searches for this species in areas of suitable habitat have failed to yield specimens. With so few individuals known to exist, they are probably extremely vulnerable to the effects of introduced predators, such as cats and foxes.

NUMBER LEFT Probably thousands.

PRINCIPAL ACTION REQUIRED Before a programme to preserve this species can be developed, more specimens must be found and studied, in conjunction with a captive breeding programme.



Very few Sandhill Dunnarts are known to exist, and more must be found and studied before conservation measures can be taken. The species is probably vulnerable to predation by cats and foxes as well as native predators, and some form of protection, probably through a captive breeding programme, will be necessary for their preservation.

A. G. Wells

## **NUMBAT**

#### Myrmecobius fasciatus Waterhouse 1836

SIZE 360–490 mm, tail 160–210 mm, 450 g IDENTIFICATION There is no species similar to the Numbat. Reddish brown dorsally, lighter ventrally. Rump is distinctly darker than the upper back, with prominent white transverse bars. Head is narrow with a sharp snout and a dark horizontal 'eye-stripe'. Tail hairs are long and often erected to give a 'bottle-brush' appearance.

DISTRIBUTION A small area in the Western Aus-



tralian wheat-belt.

HABITAT Restricted to eucalypt forest, particularly areas dominated by wandoo *Eucalyptus wandoo* or jarrah *Eucalyptus marginata*, which

provide shelter in the form of fallen and hollow logs and food for the termites that the Numbat eats. NOTES The sole living member of the family Myrmecobiidae, the Numbat is unique among the marsupials for its adaptations for feeding on termites. Like other anteaters, such as the echidna, aardvark, South American anteaters and Asian pangolins, it has small degenerate teeth and a very long, sticky tongue, which is flicked rapidly in and out of a long snout to collect numerous small insects. Unlike other anteaters, the Numbat lacks powerful digging claws on the forelimbs.

The Numbat locates its termite prey by using its forelimbs and paws to make shallow excavations in the soil under leaf litter and small branches. The termites, which it can scent, are rapidly licked up by the cylindrical tongue, almost half as long as the head and body. The flicking movements of the tongue are too fast for the human eye to follow.

The 50–52 teeth are not used in eating, except in very young animals. Termites picked up by the tongue are swallowed whole. The teeth are used to move small debris in excavation, however, and to

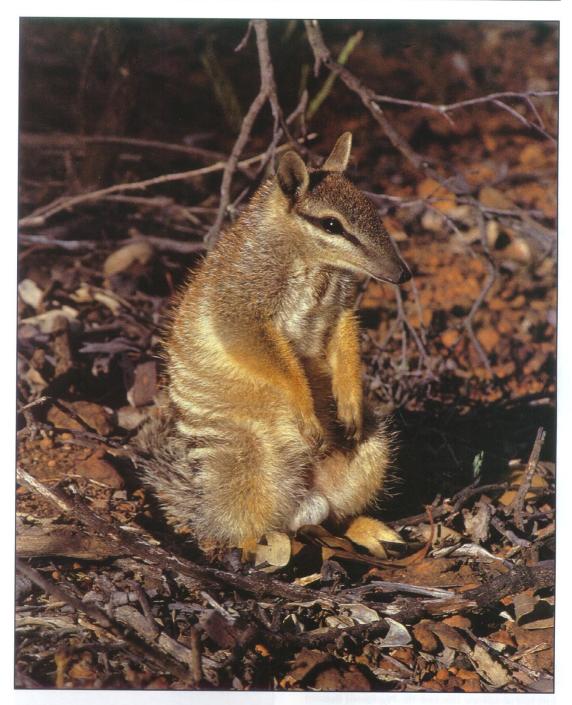
carry nesting material. They are also used to shred the stringy bark of certain eucalypts to produce nest lining.

The Numbat is unique among the marsupials in being completely diurnal, even in hot weather.

Nesting is usually in a hollow log or an underground chamber lined with grass, leaves, shredded bark or other debris, at the end of a burrow typically between 1 and 2 m long. Up to four young are deposited in this nest when furred but unweaned. The female has four teats and gives birth to young between January and March. She has no pouch, and the young cling to the short crimped hairs surrounding the nipples when suckling.

At a later stage, juveniles are carried on the mother's back. Young Numbats feed independently by October, and leave the mother's home range some two months later.

Since European settlement the Numbat has disappeared from large areas of southern Australia, and the present population continues to decline. The population crash can be attributed to several factors. including drought, frequent burning of habitat, habitat clearing and alteration by grazing stock, and, perhaps most importantly, predation by foxes and other introduced predators. It is probable that this species will be unable to survive in a viable selfsupporting wild population in the long term. CAUSES OF ENDANGERED STATUS Introduced pest species along with severe alteration or loss of habitat. Introduced diseases may be the cause of some well-documented population crashes. NUMBER LEFT Fewer than 2000. PRINCIPAL ACTION REQUIRED Captive breeding programme on a large scale and, if at all possible, steps taken to ensure self-perpetuating and increasing wild populations. It is probably necessary to remove further live specimens from the wild in the near future to adequately conserve the Numbat.



The unique Numbat feeds on termites, using a very long and sticky, cylindrical tongue to collect them, and swallowing them whole. It is completely diurnal, even in hot weather, and nests in a hollow log or an underground chamber lined with grass, leaves, shredded bark or other debris.

Jiri Lochman/Lochman Transparencies

#### PIG-FOOTED BANDICOOT

Chaeropus ecaudatus Ogilby 1838

SIZE 370 mm; tail 125 mm

IDENTIFICATION Distinguished from all other bandicoots by having only two functional toes on the forefoot, thus bearing a superficial resemblance to the cloven trotter of a pig or the forefoot of a miniature deer. The tail has a terminal crest of short, black hairs. Ears are long and narrow.

DISTRIBUTION Inland and Central Australia; the



only specimen collected this century was taken from the south-western shore of Lake Eyre North in 1907. Pitjantjatjarra men in the Musgrave Ranges of northern

South Australia reported their last sightings of this species about 1926.

HABITAT Known from widely varied arid and semi-arid habitats, although limited records suggest that the Pig-footed Bandicoot is predominantly a plains dweller with a preferred habitat of woodland with an understorey of shrubs and grasses.

NOTES Available evidence suggests that the Pigfooted Bandicoot had a scattered distribution prior to the arrival of European settlers. In 1866 Gerard Krefft reported the species to be extremely rare on the Murray Plains, where, with the aid of Aborigines, he secured only eight specimens in a twelvemonth period. Other collectors also remarked on its rarity. In 1842, John Gilbert reported that in the area east of Northam, Western Australia, this species was frequently hunted from its nests, the only reference to relative abundance of the species.

If introduced species such as cattle, foxes or rabbits had an adverse effect on the Pig-footed Bandicoot, their effects must have been very rapid. Aboriginal hunting of the species, and perhaps the predations of the dingo, had probably already made the species uncommon. The fossil record indicates

that the species formerly had a much wider range.

The nocturnal Pig-Footed Bandicoot excavates a shallow covered nest of dry leaves, pieces of stick, dry grass and similar material with a lining of soft fibrous grasses. It burrows its way out of its nest from beneath, leaving no opening. Beneath the nest is a short burrow about 30 cm long, 20 cm across and 25 cm deep, which, apart from the nest on top, is left open.

Captive specimens were principally herbivorous and partially insectivorous. Unlike other bandicoots, they did not eat meat and mice. During June, two young are produced. The female has a backward and downward-directed pouch, presumably an adaptation for burrowing. She has eight teats.

STATUS Probably extinct.

CAUSES OF CURRENT STATUS Presumably relatively scarce before the arrival of European settlers, and introduced pests, habitat alteration, disease, or all three, probably sealed this species' fate.

NUMBER LEFT Probably none.

PRINCIPAL ACTION REQUIRED Specimens must be found before any action can be taken.



Pig-footed Bandicoot Chaeropus ecaudatus South Australian Museum

#### WESTERN BARRED BANDICOOT

Perameles bougainville Quoy & Gaimard 1824

SIZE 330 mm; tail 90 mm; 220 g

IDENTIFICATION See picture on page 197. Distinguished by its tail being dark above, and by the fact that the bars across the hindquarters are not strongly marked. Distinguished from the Desert Bandicoot *P. eremiana* (presumed extinct) by its colour (grey-brown; *P. eremiana* is orange) and its shorter tail.

DISTRIBUTION Known only from Bernier and



Dorre islands in Shark Bay, Western Australia. Formerly occurred throughout much of the southern half of Australia, but is now presumed extinct on the

mainland.

HABITAT Formerly occurred in a variety of habitats. On the two islands where the species remains, it is most abundant in sandhills behind the beaches. NOTES The first Western Barred Bandicoot was caught on one of the Shark Bay islands in 1818, with the first eastern Australian specimen being taken in 1839 at the junction of the Darling and Namoi rivers, in New South Wales. Although still regarded as common along the entire length of the Murray River in 1857, the last specimen was recorded from New South Wales just ten years later, at the junction of the Murray and Darling rivers. By 1925 it was regarded as extinct in South Australia. The last recorded mainland specimens were from the plains of western Central Australia, broken by sandhills and outcrops of limestone, vegetated with bluebush, saltbush and stunted acacias.

Like that of other long-nosed bandicoots, the diet consists principally of small invertebrates, including insect larvae, earthworms and spiders, although some plant material is also eaten.

Nocturnal, solitary and highly active, this bandicoot can be very elusive when disturbed. One moment it is in view and motionless, the next it has vanished

Captive specimens become tame, but if harassed will jump at the attacker and scratch with long hind claws. Very intense fighting occurs among individuals of the same species.

The nest is a small excavation in the ground, which contains a flattened heap of sticks and similar materials, usually well concealed in vegetation. There is not a permanent hole in the structure; the bandicoot simply burrows under it and conceals its pathway behind it. Nesting sometimes occurs in hollow logs.

Young are produced in autumn and winter with litters of one to three (usually two) being produced. Inside the downward and backward-opening pouch are eight nipples arranged in a circle.

Although generally abundant on Bernier and Dorre islands, populations are known to fluctuate markedly.

CAUSES OF ENDANGERED STATUS Not really known, but presumed to be one or more of the following: habitat destruction and alteration, introduced pest animals such as foxes, cats and rabbits, introduced toxic plants, introduced diseases.

NUMBER LEFT 600 on Bernier Island, 1600 on Dorre Island.

PRINCIPAL ACTION REQUIRED Possible reintroduction of this species into other secure 'pestfree' island habitats, and maintenance of captive colonies of the species. Bernier and Dorre islands are apparently fairly safe, as they are national parkland.

#### THYLACINE

Thylacinus cyanocephalus (Harris 1808)

SIZE 172 cm; tail 57 cm; shoulder height 60 cm IDENTIFICATION Unlike any other marsupial. Sandy brown, coarse fur, parallel dark brown bands across the rump. Has a dog-like head and general appearance. The rump tapers into a semi-rigid tail. The scientific name *Thylacinus cynocephalus* means 'pouched dog with a wolf head' and adequately describes the animal's appearance. The five-toed footprint distinguishes Thylacine footprints from those of a dog. The toe prints are set about a centimetre from the palm and the fifth shows only as a claw mark. The hindfoot has only four toes.

DISTRIBUTION Formerly occurred in large num-

bers in most parts of Tasmania except for the south-west. No specimens have been seen in the wild since the last specimen was shot near Mawbanna on the north

coast of Tasmania in 1933.

HABITAT Although known from various habitats, the Thylacine was most abundant in open forest, woodlands and grassy plains, with rocky outcrops nearby in which it could hide during the day. NOTES Nocturnal and usually solitary, the Thylacine occasionally hunts in pairs or small family groups. Prey consists of small mammals, birds, reptiles and macropods, which it kills in a characteristic way by crushing the skull with its powerful jaws. (The jaws can gape at nearly a 180° angle.) Often only blood, liver and kidney fat are eaten. An exception to this, however, was the last captive Thylacine in Hobart Zoo, in 1933. Its keeper, Frank Darby, would feed it a rabbit each night and morning, the carcass being crushed by the 'crocodile-like' jaws and completely eaten.

When hunting, the Thylacine is not particularly agile. The hindquarters slope downward and this,

together with the stiffly held tail, which is rigidly united to the spine, forces the animal to run with a peculiar stiff, loping movement.

The lack of speed and agility is compensated for by the stamina of the animal, which will doggedly pursue its prey, for several hours if necessary. The pouch opens rearwards, presumably to protect the young as the mother runs through the bush. Although there are four teats, only two to three young are raised at a time. Young are produced in winter and spring, and after leaving the pouch remain in a nest until weaned, thereafter accompanying the mother until well grown and able to hunt independently.

Males are larger than females. In both sexes the head becomes slightly wider with age. The only noise made by Thylacines is a coughing bark, made when they are anxious or disturbed.

Following the arrival of Aborigines with dingoes on the mainland of Australia, the Thylacine declined rapidly, and became extinct prior to the arrival of European settlers. However, Thylacines survived in Tasmania, which remained free of dingoes.

Because Thylacines took a liking to sheep, they were mercilessly killed throughout the nineteenth and early twentieth centuries. By 1863, Thylacines were confined to remote and mountainous areas, but the hunting remained relentless. After 1900 the population suffered a dramatic crash in numbers, presumably from a distemper-like viral disease. No Thylacines have been seen alive since 1933, and the Tasmanian government gave the Thylacine statutory protection in 1936, by which time it was probably already extinct.

STATUS Probably extinct.

CAUSES OF CURRENT STATUS Hunting, disease and habitat loss.

PRINCIPAL ACTION REQUIRED Nothing can be done until live specimens are found.



Above. Nocturnal, solitary and highly active, the Western Barred Bandicoot (see page 195) can be very elusive when disturbed, and when harassed will jump at its attacker and scratch with long hind claws. Very intense fighting occurs among individuals of the same species.

Babs and Bert Wells/Australian Museum

Right. After 1900, the population of Thylacines in Tasmania that had not been hunted out by Europeans was affected by a distemper-like viral disease, and suffered a dramatic crash in numbers. The same disease attacked the native cat, the Tasmanian Devil and the Eastern Quoll on the mainland.

Dave Watts/ANT Photo Library



#### GREATER BILBY

Macrotis lagotis Reid 1837

SIZE Males 500–840 mm; tail 200–290 mm; 1000–2500 g. Females 490–670 mm; tail 200–280 mm; 800–1100g

IDENTIFICATION Light, delicate build and fine, silky soft fur. Long, rabbit-like ears, long pointed muzzle. Hindfoot lacks first toe. This species may be differentiated from the Lesser Bilby *M. leucura* by its tail, which is black and white with a prominent crest, with the extreme tip naked. The tail of the Lesser Bilby has white fur along the entire upper surface of the tail, with black on the underside of the proximal two-fifths. The Greater Bilby also differs from the Lesser Bilby in its larger adult size.

DISTRIBUTION Mainly confined to desert areas of



Central Australia, with outlying populations in the Kimberley and Warburton regions of Western Australia, and near the Birdsville area in far south-western Queens-

land. Around 1900, the Greater Bilby was found in drier areas of all the mainland states.

HABITAT Varied, but present populations principally occur in hummock grasslands and acacia shrublands with spinifex or tussock grass.

NOTES The Greater Bilby is shy and strictly nocturnal, escaping daytime heat by taking refuge in its burrow. The strong forelimbs are used to dig the burrow, and also in the search for food. Areas that the Greater Bilby inhabits can be identified by the numerous shallow holes, dug to about 10 cm, from which soil has been scattered on every side.

Burrows may be up to 3 m long and 1.8 m deep, and the entrance, usually against a shrub, tussock or termite mound, is always left open. The entrance is often marked by a pile of earth or sand, and usually descends spirally downwards. If one tries to dig a Greater Bilby from its burrow, it will rapidly

attempt to extend the burrow at the closed end.

The diet consists of a mixture of arthropods, seeds, bulbs, fruit and fungi, largely depending on locality and time of year. When foraging for food, the Greater Bilby carries its crested tail like a stiff banner as it canters along.

The long, slender tongue is used to lick the seeds off the ground individually. Substantial amounts of soil are also ingested, showing up in the dung pellets.

Vision is not good, with the senses of hearing and smell being used to locate food.

Greater Bilbies usually live singly, or in pairs, and will shift their home range in response to food availability. In rare circumstances, where a population of Greater Bilbies remains in a single locality because of good long-term food availability, a complex burrow system comprising several entrances and a series of interconnecting tunnels spread over a considerable area may be built.

Breeding may occur at any time of year, although most occurs in autumn. A litter of no more than three, usually two, is produced, despite the fact that the Greater Bilby possesses eight teats in its backward-opening pouch. Pouch life lasts about 75 days. CAUSES OF ENDANGERED STATUS Presumed to be direct predation by and competition with introduced species, in particular foxes and rabbits. Because the Greater Bilby has vanished from areas with little direct human interference, habitat destruction through cattle and sheep grazing is not believed to have caused the rapid decline in this mammal. Foxes and rabbits are either rare or absent where bilbies occur.

NUMBER LEFT Probably a few hundred. PRINCIPAL ACTION REQUIRED As it is probably only a matter of time before all wild populations of this species are eliminated, captive breeding colonies are essential.



The Greater Bilby is presumed to be in direct competition with, and subject to predation by introduced species, particularly rabbits and foxes, which are rare or absent where bilbies occur. Probably only a few hundred Greater Bilbies still exist.

A. G. Wells

#### LESSER BILBY

#### Macrotis leucura Thomas 1887

SIZE Males 365–440 mm; tail, 125–170 mm; 397 g. Females 320–390 mm; tail, 120–150 mm; 311 g IDENTIFICATION See Greater Bilby.

DISTRIBUTION The Lesser Bilby has only been



recorded on six occasions, all in deserts of north-eastern South Australia and the south-eastern Northern Territory.

HABITAT The Lesser

Bilby was last reported alive in 1931 near Concherie in north-eastern South Australia, where it was considered to be reasonably common. Its habitat was sandhills, where free surface water was rarely available. The Greater Bilby, known in the same area, burrowed on the loamy flats between the sand dunes. NOTES Like the Greater Bilby, the Lesser Bilby is an active burrower. However, unlike its larger relative, it closes the entrance to its burrow when in residence. Like the Greater Bilby, the Lesser Bilby does not construct an emergency exit, or a nest structure within the burrow.

The strictly nocturnal habit of the Lesser Bilby is in response to the high daytime temperatures.

When an attempt is made to dig a bilby out of its burrow, the bilby will often dig faster than its pursuer. The Aborigines who used to prize bilbies for food, devised their own methods of catching them. First they would establish the position of the bilby in the burrow, by listening with an ear to the ground. The Greater Bilby was usually at the deeper end. They then would dig down rapidly on top of it. They caught the Lesser Bilby, which usually sat nearer the entrance to the burrow, by digging down behind it to cut off its retreat down the burrow.

The diet of the Lesser Bilby includes smaller mammals and seeds. Two young are usually reared at a time, although eight teats in two rows are present. Unlike the Greater Bilby, which has a strong though not offensive odour, the Lesser Bilby has little odour.

In 1967 a skull from this species, of unknown age, was found in a Wedge-tailed Eagle's nest, south-east of Alice Springs near the Simpson Desert.

When kept in captivity, this species was placid, except when handled. Then it would snap and scratch fiercely.

When sleeping, it squats on its back legs with its tail forward between its back legs, or straight backwards. The head is tucked between the forearms with the ears folded forward along the face.

STATUS Endangered, possibly extinct.

CAUSES OF CURRENT STATUS Presumably the same as for the Greater Bilby: principally the introduction of rabbits and foxes.

NUMBER LEFT Probably none.

PRINCIPAL ACTION REQUIRED An active search of areas where the Lesser Bilby may still occur. If specimens are found, they should be caught in numbers sufficient to establish captive colonies to pre-empt their extinction in the wild.



The Lesser Bilby differs from the Greater Bilby in its nesting habits. It is possibly extinct, for the same reasons as the Greater Bilby is endangered: the introduction of foreign predators into its habitat.

Australian Museum

#### BURROWING BETTONG

Bettongia lesueur Quoy & Gaimard 1824

SIZE 660 mm; tail 290 mm (highly variable over range)

IDENTIFICATION See picture on page 203. Distinguished from other bettongs by the fairly sparse, short hair on the tail, which gives a flat-tailed appearance, with the tip being white in most populations. Other distinctive traits include its yellow to grey dorsal colour, its small, stout build and rounded ears. The fur is soft and dense with a maximum length of about 25 mm. The muzzle tip is naked and flesh coloured.

DISTRIBUTION On four Western Australian



islands, namely Bernier and Dorre in Shark Bay, and Barrow and Boodie off the Pilbara Coast. Formerly found on Dirk Hartog Island and in large numbers through-

out the mainland west of the Great Dividing Range, excluding high rainfall and tropical areas. Early naturalists in many areas reported that the Burrowing Bettong was the most abundant mammal. HABITAT Numerous types of habitat were exploited, so long as there was soil deep enough to dig burrows. For construction of burrows or warrens loamy soils are preferred to sandy soils in sand ridge areas, and burrows are often built into the base of rock outcrops and other rises in the ground. NOTES The Burrowing Bettong is the only macropod to burrow on a regular basis. Although the burrow may be a single hole and short tunnel, it is more often a complex warren with several entrances and numerous deep interconnecting passageways. On Barrow Island a single warren was recorded as having more than 120 entrances and at least 60 individuals sharing the warren. In the warrens are nests lined with grass and other materials carried into the burrows in a bundle held in the bettong's curled tail. This highly gregarious, nocturnal animal feeds on fruits, seeds, roots, other vegetable matter, small insects and fungi. When hopping, the hindfeet are always held together and the forefeet are only used for balance when gathering grass.

The aggressively territorial males will fight one another to defend the females in their social group from other males. Breeding occurs all year, with a 21-day gestation period. The single young remains in the pouch for nearly four months, with sexual maturity being reached about two months later. Up to three young may be raised annually.

Although the decline of this animal was probably due to several factors, rabbits do not appear to have been the most critical factor. Although rabbits occupied disused burrows of this species, both cohabited areas for several decades and were even found using the same warren. Burrowing Bettongs were shot as pests in grazing areas, but foxes and cats seem to have been their greatest predators. The extinction of the species on the mainland was not as rapid as was that of some other similar-sized mammals, but definitely followed in the wake of the establishment of cats and foxes. Last specimens were taken in Victoria in 1863, New South Wales in 1892, the southern half of South Australia before 1910 and northern South Australia before 1940, where they appeared to survive in the Everard Ranges. Total extermination had occurred in central and Western Australia by the late 1950s. On Dirk Hartog Island, introduced cats apparently exterminated this species.

CAUSES OF ENDANGERED STATUS Predation by foxes and cats.

NUMBER LEFT 3400 on Barrow Island, 600 on Bernier Island and 1000 on Dorre Island.

PRINCIPAL ACTION REQUIRED All the remaining colonies are within reserves. Pests, including cats and foxes, must remain excluded. All island populations should be closely monitored.

## **BRUSH-TAILED BETTONG**

Bettongia penicillata Gray 1837

SIZE 370 mm; tail 345 mm; 1.5 kg IDENTIFICATION Distinguished from other bettongs by its tail having long hair at the tip and for some inches back, forming a black crest. Northern Queensland populations may or may not have a silvery white tail tip. Although almost impossible to distinguish by external characteristics from the Eastern or Tasmanian Bettong *Bettongia gaimardi*, they are unlikely to be confused, as that species only occurs in Tasmania. Other features include a bare snout, long nails on the front paws for digging, and long dense fur, which is greyish brown dorsally, becoming lighter in colour ventrally.

DISTRIBUTION Populations are now only known



from the Perup and Dryandra forests and the Tuttanning Reserve in south-west Western Australia, and also two isolated populations in north-east Queensland.

Formerly occurred across most of southern Australia west of the Great Dividing Range and parts of north-east Queensland.

HABITAT Shows a preference for forests and woodlands with a clumped, low understorey of tussock grasses or woody scrub.

NOTES The Brush-tailed Bettong is usually solitary, but is occasionally found in pairs. By day this nocturnal animal rests in an elaborate domed grass nest, which is usually in a shallow excavation at the base of an overhanging shrub or tussock. Nest material is carried with the prehensile tail. Although normally slow moving, when startled it will hop away with its head held down, back arched and tail out-stretched, conspicuously displaying the rear brush. When it is hopping, the front paws are held against the chest.

Diet includes grass, tubers, fungi, insects and

occasionally bones and carrion. In fact, this species has been known to approach campsites in search of food, indicating a lack of the shyness usually found in ground-dwelling marsupials. A relatively high proportion of fungal material, which is broken down by bacteria present in the large sacculated forestomach, is consumed in summer and autumn. The bacteria and byproducts are then digested in the rear part of the stomach and intestine.

Males and females have distinct home ranges, including defined feeding and nesting areas. Nesting areas are territorial and strongly guarded, but feeding areas overlap. The continuous breeding pattern is as follows. At about 170-180 days of age the female produces her first young, and then typically every 100 or so days for the rest of her four-to-sixyear life. Usually only one young at a time is produced, and if more than one is born, only one survives. The young leaves the pouch at about 90 days, accompanying the mother wherever she goes, sharing the nest until the next infant leaves the pouch and displaces the older young. In common with most macropods, this species can maintain partially developed embryos in a suspended state until the pouch is vacated, whereupon one develops and is born shortly afterward. The process is known as embryonic diapause.

Before European settlement, ground-cover density and food resources limited population size and density. CAUSES OF ENDANGERED STATUS Although habitat destruction has certainly reduced numbers, the principal cause of the decline has been predation by foxes and cats. Populations survive where the effects of foxes have been contained.

NUMBER LEFT Between 1000 and 20 000.

PRINCIPAL ACTION REQUIRED All known populations are in conservation areas, which are being actively managed to try to maintain numbers. The establishment of captive colonies is essential.





Above. The Burrowing Bettong (see page 201) was formerly found on Dirk Hartog Island and in large numbers throughout the mainland west of the Great Dividing Range. Early naturalists in many areas reported that the Burrowing Bettong was the most abundant mammal. It now numbers about 5000. Esther Beaton/AUSCAPE International

Left. The Brush-tailed Bettong is usually solitary, but is occasionally found in pairs. Unlike many ground-dwelling marsupials, it is not a shy animal. Habitat destruction has reduced its numbers, but predation by introduced animals has probably been the principal cause of its decline.

## DESERT RAT-KANGAROO

Caloprymnus campestris Gould 1843

SIZE 695 mm; tail 325 mm; 890 g (females tend to be heavier on average)

IDENTIFICATION The general colour is pale. The tail is usually naked on the upper surface, but well haired below. The head is blunt and rounded. The small front limbs are about a third of the length of the long hind legs. The body is solid, with a soft coat and thick underfur. Ventral surfaces are lighter and brighter in colour.

DISTRIBUTION Known from far north-eastern



South Australia, adjoining parts of Queensland, and possibly the Northern Territory.

HABITAT The known habitat consisted of an area with claypans, gib-

ber plains and sand ridges; the sparse vegetation included saltbush, other chenopods, emu bush, and some clumps of stunted corkwood. The sand dunes themselves were not the favoured sites for this species. Surface water was rarely present.

NOTES Despite the extremely high temperatures in the area, this species is not known to burrow. A nest was recorded as consisting of a shallow excavation under a bush or even in the open. The nest cavity was lined with leaves and grasses, with a flimsy roof of twigs and grass stems overlying. Although the entrance was at the side, the animal was able to protrude its head through a hole in the roof of the nest in order to survey the surroundings. Well-worn pathways led to and from the nest.

Large, furred, pouched young have been recorded in December and August, indicating either an extended breeding season, breeding all year, or breeding only when environmental conditions are favourable. The well-developed pouch has four teats.

No two adults share the same nest, and juveniles leave the nest after weaning.

Aborigines caught this species by creeping up to the nest from the opposite side to the entry hole, silently slipping their hands over the top and grabbing the rat-kangaroo within.

The nocturnal Desert Rat-kangaroo's diet is not known, but it is believed not to need to drink free water.

The well-developed hindlimb has a foot longer than the thigh or lower leg, and is a similar length to the head and body. This animal is reputed to have been able to hop at a speed fast enough to tire a galloping horse over several kilometres.

Gould described this animal in 1843, but it was not recorded again until 1931. None have been recorded since 1935. Anecdotal evidence suggests that populations of this species may fluctuate greatly between different years.

STATUS Thought to be extinct.
CAUSES OF CURRENT STATUS Not known.
PRINCIPAL ACTION REQUIRED No action can

be planned until specimens are located.



The Desert Rat-kangaroo—an illustration from Neville Cayley's What Mammal is That?, published by Collins/Angus & Robertson Publishers. Gould described this animal in 1843, but it was not recorded again until 1931, and none have been recorded since 1935. It is thought to be extinct.

## **BROAD-FACED POTOROO**

Potorous platyops (Gould 1844)

SIZE 426 mm; tail 183 mm

IDENTIFICATION Distinguished from other potoroos by its relatively short head and small size, about the same as that of a rabbit.

DISTRIBUTION Known only from fewer than a



dozen specimens, all found in the country to the north and east of the forests of south-west Western Australia, from Pallinup River to Goomalling. Sub-fossil

remains indicate a much wider range, stretching coastally from South Australia to Albany, Western Australia and northward through the wheat-belt towards North-west Cape.

HABITAT Not known from forests, this species presumably occurred in areas of dense ground cover in grassy open woodland habitats. An unpublished manuscript by Gilbert last century stated, 'all I could glean of its habits was that it was killed in a thicket surrounding one of the salt lagoons of the interior'.

NOTES This species was only known to Europeans for 36 years, with the last specimens being taken from the wild in 1875.

In common with other potoroos, the Broad-faced Potoroo was probably strictly nocturnal and omnivorous in diet, feeding on insects, fruit and large seeds. Tough seeds and hard-bodied insects would be held in the paws and cracked open with sharp premolar teeth.

The dense shelter sought by potoroos is probably essential to protect them from predators, including monitor lizards and birds of prey. Where dense cover is removed, either by fire or grazing stock, potoroos are absent, only returning if and when the dense understorey is replaced

Fire and grazing activities probably removed any

remnant populations shortly after European settlement, with the Broad-faced Potoroo not being the only Potoroo to have suffered a serious decline since then. It should be noted that the Broad-faced Potoroo was probably already rare before European settlement, and this rarity could well have arisen as a result of burning activities by Aborigines over the previous 40 000 years. The effects of the dingo were probably adverse, as the most serious decline in range prior to settlement appears to have occurred at about the same time as its introduction, less than 10 000 years ago.

STATUS Probably extinct.

CAUSES OF CURRENT STATUS Uncertain.
PRINCIPAL ACTION REQUIRED Nothing can be done unless a living population is found.



The Broad-faced Potoroo was only known to Europeans for 36 years, with the last specimens being taken from the wild in 1875. Fewer than a dozen specimens were found. Preferring dense shelter, these potoroos have probably died out with the clearing of forests for settlement, though they were probably already rare by the time European settlers arrived. This lithograph is from Gould's The Mammals of Australia.

Mitchell Library

#### LONG-FOOTED POTOROO

Potorous longipes Seebeck & Johnston 1980

SIZE 720 mm; tail 320 mm; 1.9 kg IDENTIFICATION Distinguished from the Longnosed Potoroo *Potorous tridactylus* by its larger adult size, its hindfoot being longer than the head, and there being a pad on the first (big) toe of the sole. The chromosome count is 24, whereas that of the Longnosed Potoroo is 12 in females and 13 in males.

DISTRIBUTION Known only from two sites in a



small part of East Gippsland. May also occur in suitable habitat elsewhere in far eastern Victoria or nearby New South Wales. HABITAT Open forest

of mixed eucalypts, with an understorey of sclerophyll shrubs and a dense field layer of wiregrass, ferns and sedges, on friable clay soils.

NOTES This terrestrial species feeds on roots, tubers, fungi and some insects, which it finds by excavating conical pits with its forefeet. Seeds and grass are not eaten. Dentition of this species differs from that of the related Long-nosed Potoroo, presumably reflecting a slightly different preferred diet. To date, both species have not been found in the same areas, but this is probably a reflection of a lack of fieldwork by experts rather than mutual exclusion by both species. There is, however, a possibility that one species may compete more successfully than the other for most suitable habitats.

These potoroos will climb with ease to get to low branches, stumps or similar in order to survey the surrounding terrain. They may vocalise low 'kis, kis' sounds when under stress or communicating with one another, particularly mother and young.

Unless there are food shortages or other unusually adverse conditions, breeding occurs throughout the year, with the possible exception of mid-summer.

One young is produced at a time, with pouch life lasting about four months. The pouch is well developed and contains four teats.

When building its nest, the Broad-faced Potoroo carries plant material with the coiled tail. Potoroids, bettongs and rat-kangaroos are the only members of the superfamily Macropodoidea with tail prehensility, indicating their early deviation in evolution from the other macropods, including the treekangaroos, which lack a prehensile tail, but would no doubt be advantaged by one. Tail prehensility in these species indicates an arboreal ancestry. CAUSE OF ENDANGERED STATUS Known from relatively few specimens despite its occurrence in a heavily populated part of Australia. All the known habitat is earmarked for logging. NUMBER LEFT Probably thousands. PRINCIPAL ACTION REQUIRED Preservation of known habitat by prohibiting logging. Further research into the biology of this species is also necessary.



Long-footed Potoroo Potorous longipes

# **RUFOUS HARE-WALLABY**

Lagorchestes hirsutus Gould 1844

SIZE Males 600 mm; tail 270 mm; 1580 g. Females 650 mm; tail 275 mm; 1740 g

IDENTIFICATION Distinguished from other hare-wallabies by the following characteristics: rufous above, paler below; orange ring around the eye; long orange hair behind the hind legs; tail brownish black and rufous below; forearms paler than the body; head dark grey or rufous in colour; fur long and soft.

DISTRIBUTION Believed to be restricted to Bern-



ier and Dorre islands in Shark Bay, Western Australia, and the Tanami Desert, Northern Territory. Formerly common and widespread throughout most arid

and semi-arid parts of the western half of Australia. HABITAT Formerly most common in the spinifex hummock grasslands of sand-plain and sand-dune deserts, but also known from other habitat types, including woodlands. Areas burnt a few years previously seem to be a preferred habitat.

NOTES Early explorers and Aborigines used to hunt these 'spinifex rats' in large numbers for food, flushing them out from under their spinifex cover.

By day, this hare-wallaby shelters in a burrow or trench dug into or under a spinifex hummock, or under a similar-sized shrub when spinifex is unavailable. In the heat of summer the burrow may be up to almost a metre in depth.

Studies have shown this species to have a digestive system suited to plant fibre, which constitutes the bulk of the diet. Studies of the Tanami Desert population showed that the animals would often leave the shelter of tall spinifex at night to feed in nearby burned areas, where the short regrowth is usually more succulent and nutritious than the unburnt mature vegetation.

Although always common on Bernier and Dorre

islands, the populations of this species seem to have undergone dramatic fluctuations. In 1906 numbers were high, but they had started to decline by 1910. In 1959 hare-wallabies were found by an expedition to be rare, but they were common again in 1963 and again in 1969. On one part of Dorre Island, burnt in 1964, there has been a very marked increase in numbers.

Natural predators of this species seem to be birds of prey, although pythons and goannas would presumably take juvenile wallabies. On the mainland, foxes and cats are thought to be the main cause of the decline of this species, presumably finding them easy prey when they are resting under low ground cover, and for this reason it is likely that the Tanami Desert population cannot last much longer.

CAUSES OF ENDANGERED STATUS In mainland Australia, presumably the introduction of foxes and cats, and the inherent instability of a formerly widespread species relying on two highly vulnerable island populations for its long-term survival.

NUMBER LEFT 2400 on Bernier Island, 1700 on Dorre Island.

PRINCIPAL ACTION REQUIRED A captive breeding programme is now under way, and should in the long term, when coupled with re-introduction into the wild of captive bred stock, ensure the survival of this species.



Rufous Hare-wallaby Lagorchestes hirsutus Jiri Lochman/Lochman Transparencies

## EASTERN HARE-WALLABY

Lagorchestes leporides Gould 1841

SIZE 770 mm; tail 320 mm; 1900 g IDENTIFICATION Distinguished from the other hare-wallabies by the black patch on the elbow. Other characteristics include: indistinct orange ring around the eye; a grizzled brown colour above with white tipped hairs, greyish below; a faint hip-stripe; greyish feet and forepaws; tail brownish above, whitish below.

DISTRIBUTION Not known. Formerly common



throughout the plains of the Murray–Darling river drainage systems, and nearby areas. No specimens have been recorded since 1890, when one was taken at

Booligal, New South Wales.

HABITAT Formerly most abundant on plains between rivers and mountain ranges. Is recorded as having a preference for open grassy habitats.

NOTES Called the hare-wallaby because, when the grassy plains were being opened up, the white settlers thought that these wallabies behaved rather like the European hare. They made nests under tussocks or in bushes and, when flushed from these, would flee at high speed. Their size is also hare-like, and their fur is similar in colour and texture to that of a hare. The scientific name *Lagorchestes* has a Greek origin and means 'dancing hare'. It was coined by John Gould when he was scientifically describing them in reference to their hairy muzzle and hare-like habits.

John Gould's account of the leaping ability of this species was very vivid. 'While out on the plains of South Australia, I started a Hare-kangaroo before two fleet dogs; after running to a distance of a quarter of a mile, it suddenly doubled, and came back upon me ... I stood perfectly still, and the animal had arrived within twenty feet before it observed me, when ... instead of branching off to the left or right;

it bounded clear over my head'. On a separate occasion, Gerard Krefft estimated that this species could jump to a height of nearly 2 metres.

The decline of the Eastern Hare-wallaby was very rapid. From being 'tolerably abundant' in 'All the plains' of South Australia, as Gould reported in the 1840s, and still common near the junction of the Murray and Darling rivers in the 1850s as reported by Krefft, total extinction seems to have occurred within fifty years. The rapid decline preceded the intensive clearing and settlement of many areas where it occurred, and presumably occurred due to introduced pests, and perhaps an introduced disease. STATUS Presumed extinct.

CAUSES OF CURRENT STATUS Not really known

PRINCIPAL ACTION REQUIRED Nothing can be done unless a population is found, which is unlikely.



The Eastern Hare-wallaby (seen here in a lithograph from Gould's The Mammals of Australia) was once abundant on the plains of the Murray-Darling river system and nearby areas. No specimens have been recorded since 1890, when one was taken at Booligal in New South Wales.

Mitchell Library

### BANDED HARE-WALLABY

Lagostrophus fasciatus (Peron & Lesueur 1807)

SIZE 800 mm; tail 370 mm; 1.9 kg (females are marginally larger)

IDENTIFICATION Distinguished from the Rufous Hare-wallaby and the Burrowing Bettong by its much darker colour and its distribution. Also recognised by the dark grizzled grey colour dorsally, with transverse dark bands across the lower back and rump. Greyish white below. The muzzle is sharply constricted. The long and tapering tail has a dorsal crest of black hairs, which become more prominent toward the tip.

DISTRIBUTION Restricted to Bernier and Dorre



islands in Shark Bay,
Western Australia. Prior
to European settlement
it was distributed widely
in the south-eastern
third of Western Australia. Prior to Abo-

riginal settlement and within the past 5000 years, this species occurred throughout most of the southern third of Australia west of the Great Dividing Range. It has not been recorded on mainland Australia since 1906.

HABITAT By day, these wallabies congregate beneath low-hanging limbs of trees or shrubs, or in thickets often containing thorny species of acacia. At night, they feed in grassy areas nearby, with spinifex on coastal sand dunes being a preferred habitat. NOTES This strongly gregarious species is occasionally seen in groups. Adults of either sex appear to live within well-defined territories, but are rarely aggressive toward each other. Males, however, will display a high level of aggression toward each other when food becomes scarce, a recurring problem on the islands.

Males maintain larger territories than females, often overlapping those of several females. Their mortality rate is correspondingly higher, and there appear to be more females than males on the islands.

The breeding season is extended and occurs at least from February to August, with a single pouched young being carried at a time.

Plants with a high water content appear to constitute the bulk of the diet; grasses and seeds comprise less than half the intake. Water from heavy dews and contained in food appears to satisfy the animal's needs.

Known predators of the Banded Hare-wallaby include owls, hawks and monitor lizards. CAUSES OF ENDANGERED STATUS Extreme vulnerability to habitat alteration, introduced predators or disease on the islands where they survive. NUMBER LEFT 3300 on Bernier Island, 4100 on Dorre Island.

PRINCIPAL ACTION REQUIRED Strict control of the goat population on Bernier Island; both island populations must be monitored and maintained. This species is particularly suited to captive breeding programmes.



Banded Hare-wallaby Lagostrophus fasciatus A. G. Wells

## TOOLACHE WALLABY

Macropus greyi Waterhouse 1846

SIZE Males 1540 mm; tail 730 mm. Females 1550 mm, tail 710 mm

IDENTIFICATION Has a distinct white face stripe, black and white ears, black hands and feet. The last third of the tail is crested with pale hair. Some specimens have a faint barring on the back with ten to twelve bars. When the wallaby is hopping, the head is held low.

DISTRIBUTION Formerly found in the south-east



of South Australia and nearby parts of Victoria. HABITAT Like other large wallabies, the Toolache Wallaby requires thickets or clumps of thick vegetation for

cover. Nearby grazing habitat may include flat to gently undulating land that may become swampy in wet weather. Eucalypt cover is not necessary.

NOTES The Toolache Wallaby was very common in its preferred habitat before European settlement. It was also by far the fastest-moving native animal where it occurred. Few dogs could catch it on grassland, while in tussocky and scrubby locations the Toolache was exceptional in its ability to change direction or length of stride among the many obstacles and still maintain a high travelling speed for long periods. The erratic but rapid gait of this species was often described as being of 'two short hops and then a longer one'.

When it occurred in larger numbers, the Toolache was gregarious, with each group seeming to show a strong attachment to a given area, and returning to it even after significant and repeated disturbance. This aspect of the Toolache's behaviour made it easier for hunters to seek and kill an entire group of wallabies over a number of hunting expeditions.

Because the wallabies also competed with stock for feed, they were even more eagerly hunted, with

devastating results.

It is believed that hunters were the principal cause of the disappearance of this species, and the last positive record of wild specimens was in 1924, although reliable naturalists have seen this species as recently as 1972, long after it was presumed extinct.

STATUS Presumed extinct.

CAUSES OF CURRENT STATUS Habitat destruction was obviously important. However, the presence of this wallaby in open country, its speed of movement and exceptionally fine hide made it a prime target for hunters, who decimated numbers at the turn of the century, to leave few individuals by the 1920s. PRINCIPAL ACTION REQUIRED Live specimens must be found prior to any conservation action being taken. More extensive survey work in potential habitat should be undertaken. Intensive surveys in the mid-1970s failed to locate any Toolache Wallabies.



The fast and agile Toolache Wallaby was once found in the south-east of South Australia and nearby parts of Victoria. Its presence in open country, its speed of movement and its exceptionally fine hide made it a prime target for hunters, who, along with the destruction of its habitat, caused its virtual extinction by the 1920s. Lithograph from Gould's The Mammals of Australia. Mitchell Library

#### PARMA WALLABY

Macropus parma Waterhouse 1846

SIZE Males 1020 mm; tail 515 mm; 5 kg. Females 1000 mm: tail 505 mm; 4.1 kg IDENTIFICATION Dorsally there is a faint stripe descending no farther than the mid-back. Upper lip white; throat, chest and belly white; dorsal colour brownish. Faecal pellets distinctive in appearance, being flattened and squarish in shape. Males are larger and more robust than females.

DISTRIBUTION Coastal and near-coastal ranges



from the Wattagan Ranges to the Gibralter Range, on the mid- to north coast of New South Wales. A substantial population is also on Kawau Island,

near Auckland, New Zealand, where they were introduced last century along with the related Tammar Wallaby *Macropus eugenii*.

HABITAT Preferred habitat is wet sclerophyll forests with thick shrubby understorey associated with grassy patches. Associated dry forests and rainforests are also inhabited.

NOTES The Parma Wallaby is principally active in early morning, at dusk and at night, when it emerges from cover to feed on grasses and other plant material. Except in areas of high population densities, the Parma Wallaby is principally solitary, or seen in small groups.

Hopping Parma Wallabies remain close to the ground in a near horizontal position with forearms tucked tightly against the body. At medium pace, the tail is held horizontally and curved slightly upward.

Breeding occurs between February and July. Sexual maturity in males occurs at 20–24 months. Australian females become mature at about twelve months, whereas their New Zealand counterparts have a delayed maturation of between 24 and 36

months of age, apparently due to the more limited food resources on the island, caused by the greater population density of wallabies there.

As a result of a century of selective pressure, the Kawau Island wallabies appear to be smaller than their Australian counterparts, even when reared in captivity.

The single young is born after a 35-day gestation; its first exits from the pouch are made between 23 and 25 weeks of age, and it quits the pouch when about 30 weeks old and 750 grams in weight.

Weaning is completed at about 40–44 weeks, during which time a second young may be born.

CAUSES OF ENDANGERED STATUS Elimination of most suitable habitat in New South Wales; hunting in the nineteenth century; and competition from other wallaby species.

NUMBER LEFT Presumably several thousand in Australia. Likewise for Kawau Island, New Zealand. PRINCIPAL ACTION REQUIRED Continued monitoring of populations. Some habitat is within national parks and forestry areas. That which is not should be protected and adequately managed.



Parma Wallaby Macropus parma



#### BRIDLED NAIL-TAIL WALLABY

Onychogalea fraenata Gould 1841

SIZE Males 890–1240 mm; tail 380–540 mm; 5–6 kg Females 770–980 mm; tail 360–440 mm; 4–5 kg IDENTIFICATION A white shoulder stripe extends up the neck to the base of the ear. Like all members of the genus *Onychogalea*, it has a horny spur at the end of the tail, of unknown function, very slender upper incisors, which are inclined forward and decrease evenly in size from the central pair backwards, and long, strongly developed claws on the forefeet. DISTRIBUTION Known only from a population



near Dingo, central Queensland, where it is locally common in an area of about 100 square kilometres.

At the time of European settlement it was

common throughout most of the Murray–Darling basin and inland Queensland, west of the Great Dividing Range in brigalow and associated habitats. HABITAT Although formerly known from a wide range of habitats, the present population lives on relatively fertile soils in a district that supports eucalyptus forests, woodlands and brigalow scrub. Areas where scrubby areas border open grassy woodlands are preferred.

NOTES Before the rediscovery of a single population of these animals near Dingo, Queensland, the species was presumed extinct, with the last specimen having been collected in New South Wales in 1924.

The Bridled Nail-tail Wallaby is known only near Dingo in central Queensland, restricted to an area of about 100 square kilometres. Widely shot for its pelt at the end of the nineteenth century, this species appears to have declined principally as a result of the expanding pastoral industry.

John Cancalosi/AUSCAPE International

During the day the Bridled Nail-tail Wallaby rests in a depression scratched out either in or adjacent to cover. From dusk and into the night, the wallaby ventures from its resting place to feed on the roots of various species of coarse grass and herbs found in more open country. As the dry season progresses and food becomes more scarce, specimens are often found feeding further from their resting places, although studies have shown that usually individual animals keep to well-defined small home ranges.

Although mostly solitary, groups of up to four or five animals are commonly observed. When pursued, the Bridled Nail-tail Wallaby will often seek refuge in a hollow log, and John Gould observed one to climb within a hollow tree trunk. Often this species will lie still and low to avoid detection, relying on its cryptic coloration for camouflage, and will remain still even if closely approached. CAUSES OF ENDANGERED STATUS Like all nail-tail wallabies, this species has declined dramatically since settlement by Europeans. Even at the turn of the century, this species was common enough to have been widely shot for its pelt. Because this species has vanished from areas that do not appear to have been excessively cleared for timber getting or overrun with introduced pests, the principal cause of its decline appears to have been the pastoral industry, which introduced stock competition for food, eliminated dense ground cover, and perhaps introduced competition with other macropods. NUMBER LEFT Fewer than 1000 individuals. PRINCIPAL ACTION REQUIRED Most of the remaining population lives within a reserve; however, due to the susceptibility of this population to disease and other threats, a captive breeding programme should be maintained with a view to releasing specimens in suitable areas elsewhere in its former range.

# CRESCENT NAIL-TAIL WALLABY

Onychogalea lunata Gould 1841

SIZE 520–840 mm; tail 150–330 mm IDENTIFICATION This species is differentiated from other nail-tail wallabies by the length of the white shoulder stripe. It runs from the shoulder to the base of the neck, shorter than in the Bridled Nail-tail *O. fraenata*, and longer than in the Northern Nail-tail *O. unguifera*. It is greyish dorsally and lighter below. For other characteristics see description of the Bridled Nail-tail.

DISTRIBUTION Formerly found throughout a



large part of central and south-western Australia, although it may be extinct. The species was definitely still extant in some areas in the early 1960s, and one specimen

was killed between the Tarlton and Jervois ranges, Northern Territory, in 1956.

HABITAT John Gilbert, who first collected this species in 1841, recorded its preferred habitat as open gum forests in the interior where there are patches of thick scrub and dense thickets, interspersed with more densely timbered woodlands. Other habitats are also occupied, including rocky



Crescent Nail-tail Wallaby Onychogalea lunata. Lithograph from Gould's The Mammals of Australia.
Mitchell Library

inland ranges and nearby areas.

Aborigines from the Warburton–Giles area of Western Australia recalled this species preferring mulga country and creeks bordered with river gums. NOTES This species was common in the agricultural districts of south-west Western Australia, until around the turn of the century, whereupon it declined rapidly to extinction within about a decade.

The decline in more arid areas seemed to follow, and Aborigines from areas where this species has been recorded state that they have not seen it for many years.

In cooler weather, this species has been observed sunning itself in clearings, from where it would flee when startled. By day, it will usually rest in a scratched-out hollow in soft ground beneath a shrub, coming out at dusk to feed.

Usually found singly, the Crescent Nail-tail Wallaby can be recognised in the field when hopping by the way its short forelimbs are carried at an awkward angle to the body, and by its whip-like tail.

B. W. Leake, an early settler of the Kellerberrin district, Western Australia, noted that this species, locally known as Wurrung, made for a hollow tree with a hole at the bottom when pursued; it would clamber some distance up inside the tree. To procure specimens for food the Aborigines would light a fire under such trees and smoke the wallabies out. Leake also recorded the disappearance of the Crescent Nailtail Wallaby from Kellerberrin by 1899.

STATUS Probably extinct.

CAUSES OF CURRENT STATUS Not known, although certainly related to the coming of European man. Probably introduced pests or, less likely, an introduced disease.

PRINCIPAL ACTION REQUIRED An intensive search of areas where this species may still occur must be made. If it remains, captive breeding will probably be the only way to guarantee its future.

#### PROSERPINE ROCK-WALLABY

Petrogale persephone Maynes 1982

SIZE 1120–1320 mm; tail 600–680 mm; 5–8 kg IDENTIFICATION The only other rock-wallaby known from the same general area is the Unadorned Rock-wallaby *P. inornata*, which is distinguished by its darker, often black tail tip. On the Proserpine Rock-wallaby *P. persephone*, the tail terminates in a white or yellowish-white tip, 1.5–2 cm in length. Other features of this species include: black feet; grey to brown in general colour; brownish-orange hairs outside the ears, black internally; and some other minor markings, including a whitish chin and yellowish ventral surface.

DISTRIBUTION Known only from a few rock out-



crops near Proserpine, Queensland. May occur in suitable habitats elsewhere along the Queensland coast.

HABITAT So far all specimens have been

caught in the vicinity of rock outcrops in closed canopy forests surrounded by open woodland with a grassy understorey.

NOTES Proserpine Rock-wallabies only became known to science in 1976 when a specimen was killed and frozen for analysis by a Queensland wildlife ranger. Apparently local people had been aware of this species' presence for some time before this.

Presumably the Proserpine Rock-wallaby is a relict of a species that was once much more widely distributed, before its range was eroded by the more recently evolved and apparently more successful Unadorned Rock-wallaby. As different types of rock-wallaby are rarely found in the same places, it appears that newly evolved forms have replaced older forms repeatedly in the past. However, there is a strong possibility that the Proserpine Rock-wallaby was more widely distributed last century, as its closest living relative, the Yellow-footed Rock-wallaby

*P. xanthopus* of inland eastern Australia, has declined sharply in range and numbers since settlement.

As with most other rock-wallabies, males tend to be the heavier sex, being up to 30 per cent larger at maturity. Depending on food availability, sexual maturity occurs at 12–24 months, with breeding activity being continuous, provided that adverse seasonal climatic variation and food shortages do not occur.

Distribution is usually restricted to suitable rock outcrops, where the wallabies rest during the day, to feed on nearby grasses at dusk and at night, although occasionally specimens may migrate between widely separated outcrops. Although grass is the preferred diet, other vegetable material is also eaten.

CAUSES OF ENDANGERED STATUS Competition with the more successful Unadorned Rockwallaby, and the loss of suitable habitat through clearing of land and agricultural development.

NUMBER LEFT Probably no more than a few hundred individuals.

PRINCIPAL ACTION REQUIRED Close monitoring of wild populations, along with preservation of all remaining habitat. It would also be prudent to captive breed this wallaby to safeguard the species in the event of extermination of wild populations.



Proserpine Rock-wallaby Petrogale persephone Lyn Irwin/Queensland Reptile & Fauna Park

# MOUNTAIN PYGMY-POSSUM

Burramys parvus Broom 1896

SIZE Males 254 mm; tail 143 mm; 45 g
Females 251 mm; tail 141 mm; 48 g
IDENTIFICATION Greyish-brown above, occasionally darker in the mid-dorsal area and on the top of the head. A dark ring around the eye. Fine, dense fur. Long thin, scaly, naked-looking tail with some sparse, fine, short hair. Kosciusko (New South Wales) specimens are pale brown or pale grey-brown ventrally, while Hotham (Victoria) specimens are cream-coloured ventrally. Confusion with the Eastern Pygmy-possum *Cercartetus nanus* is unlikely as they do not occur in the same areas.

DISTRIBUTION Known from an area of about 20



km by 10 km in the vicinity of Mount Hotham, Victoria, and an area of about 30 km by 10 km in the Kosciusko National Park, New South Wales

HABITAT Found 1400 metres above sea level in New South Wales, and slightly lower in Victoria. Habitat consists of alpine terrain with low shrubs interspersed with alpine grasses, trees (mainly snow gum) in some places, and large accumulations of boulders, often in the form of old glacial moraines, and largely covered by soil and vegetation. Surface water is plentiful.

NOTES This species was first described from fossil remains discovered in 1895 at Wombeyan Caves, New South Wales. The first living specimen was collected in August 1966 from a ski hut at Mount Hotham, and detailed studies have been conducted since.

The Mountain Pygmy-possum is one of two mammal species found on the summit of Mount Kosciusko throughout the year, the other being the Dusky Antechinus Antechinus swainsonii, a similar-sized carnivorous species.

During the colder winter months the ground is usually covered with a thick layer of snow, and the possum lives among the larger boulders, moving freely in sheltered areas when the temperature is above freezing point. A behavioural aspect of this species that may aid in its survival in this harsh environment is its ability to enter a state of torpor by allowing its body temperature to drop significantly, lowering the metabolic rate and conserving energy reserves.

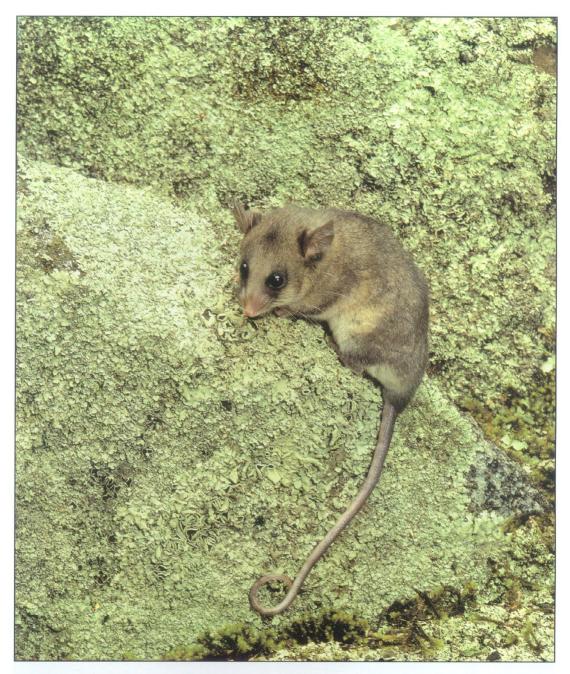
Diet consists of seeds, fruit, nectar, and, when available, certain insects. Occasionally food is stored in heaps in its nest.

Females construct nests chiefly from thinstemmed grasses collected from standing tussocks. Grass is held in the forepaws, cut through with the premolar teeth, passed by the forepaws beneath the hindfeet and held in the curled up prehensile tail. When the bundle held by the tail becomes large enough, it is carried to the nest.

Mountain Pygmy-possums thrive and breed in captivity.

In the wild, young are produced in November and December, with a typical litter consisting of four young. Females have four teats. The young leave the pouch and are left in the nest when only a few weeks old. At this stage the young are still barely mobile, with closed eyes and short, sparse fur.

Growth is rapid, adult size being reached in about five months, before the onset of the next snow season. Possums are sexually mature at 24 months. CAUSES OF ENDANGERED STATUS Only two populations are known, in limited areas. Both are under threat from proposed tourist development, principally related to skiing. Current populations are relicts from wider distribution in the most recent ice age, and if the 'greenhouse effect' raises global temperatures significantly in the future, this species may lose any suitable remaining habitat.



NUMBER LEFT Probably several thousand in each population.

PRINCIPAL ACTION REQUIRED Close monitoring of wild populations. All are within designated national parks, so hopefully any future development of these areas will be adequately restricted.

The Mountain Pygmy-possum lives within an area of about 20 km by 10 km near Mount Hotham in Victoria, and an area of about 30 km by 10 km in the Kosciusko National Park in New South Wales. Both areas are under threat from proposed tourist development.

Jean-Paul Ferrero/AUSCAPE International

### LITTLE PYGMY-POSSUM

Cercartetus lepidus (Thomas 1888)

SIZE 135 mm; tail 71 mm; 7 g IDENTIFICATION Pale soft fawn above. Distinguished from other pygmy-possums by its grey belly and smaller adult size, and from the Western Pygmy-possum *C. concinnus* and the Eastern Pygmy-possum *C. nanus* by the presence of a small fourth molar tooth.

DISTRIBUTION Known from scattered localities in



Victoria's mallee, Kangaroo Island in South Australia, and throughout Tasmania, except some areas near the west coast.

HABITAT Tree-

dominated habitats, with rainfall ranging from 300 mm to 1200 mm. Not found in rainforests. NOTES Although known from a number of areas, populations of this species are best described as sparse.

Fossil records indicate that the range of this species had declined markedly before the arrival of European settlers, perhaps in response to habitat alteration from regular burning by Aborigines. Further extensive clearing of habitats since the arrival of European settlers, along with competition from introduced predators such as cats, has led to the further decline of this species.

Despite being an excellent climber, with gripping feet and a long, prehensile tail that can easily support its weight, the Little Pygmy-possum avoids higher branches of trees, preferring to hunt close to the ground or in thick scrub, presumably to avoid predation by owls.

Diet includes various insects, spiders, small reptiles and some nectar, depending on availability. Lizards are seized with the forepaws and edible portions are torn away with the teeth.

Nests are made in concealed places with strips of fibrous bark and similar material. Abandoned birds'

nests are sometimes used as temporary sleeping places.

When resting, this animal may allow its body temperature to drop almost to that of its surroundings to conserve energy. This behaviour is most common in winter when the need to conserve energy is greatest. The torpid animal curls into a tight ball with its face buried in its lower abdomen. This torpid state may be maintained for up to a week.

Litters of about four are born in spring and early summer. The shallow pouch has four teats, and after the young become too large to be carried about in the pouch, they are left in the nest while the mother forages for food. If the mother has to relocate her nest for some reason after this stage, the young cling to the mother's back.

At about three months, the young become independent, having become almost as large as the mother.

Besides carnivorous mammals and owls, snakes are also known to feed on the Little Pygmy-possum. CAUSES OF ENDANGERED STATUS Virtually the entire habitat of this species is under threat from clearing for agriculture, logging and, particularly in Tasmania, woodchipping. Introduced animals such as cats and foxes continue to place pressure on numbers.

NUMBER LEFT Thousands, possibly more than 10 000.

PRINCIPAL ACTION REQUIRED Preservation of larger tracts of land where the Little Pygmy-possum is known to occur, along with further research into the biology of the species.

The Little Pygmy-possum feeds on nectar, insects, spiders and small reptiles. Almost all of its habitat is under threat from clearing for agriculture, logging and, in Tasmania, woodchipping. Introduced animals such as cats and foxes are also a problem for this species.



### LESSER BILBY

### Macrotis leucura Thomas 1887

SIZE Males 365–440 mm; tail, 125–170 mm; 397 g. Females 320–390 mm; tail, 120–150 mm; 311 g IDENTIFICATION See Greater Bilby.

DISTRIBUTION The Lesser Bilby has only been



recorded on six occasions, all in deserts of north-eastern South Australia and the south-eastern Northern Territory.

HABITAT The Lesser

Bilby was last reported alive in 1931 near Concherie in north-eastern South Australia, where it was considered to be reasonably common. Its habitat was sandhills, where free surface water was rarely available. The Greater Bilby, known in the same area, burrowed on the loamy flats between the sand dunes. NOTES Like the Greater Bilby, the Lesser Bilby is an active burrower. However, unlike its larger relative, it closes the entrance to its burrow when in residence. Like the Greater Bilby, the Lesser Bilby does not construct an emergency exit, or a nest structure within the burrow.

The strictly nocturnal habit of the Lesser Bilby is in response to the high daytime temperatures.

When an attempt is made to dig a bilby out of its burrow, the bilby will often dig faster than its pursuer. The Aborigines who used to prize bilbies for food, devised their own methods of catching them. First they would establish the position of the bilby in the burrow, by listening with an ear to the ground. The Greater Bilby was usually at the deeper end. They then would dig down rapidly on top of it. They caught the Lesser Bilby, which usually sat nearer the entrance to the burrow, by digging down behind it to cut off its retreat down the burrow.

The diet of the Lesser Bilby includes smaller mammals and seeds. Two young are usually reared at a time, although eight teats in two rows are present. Unlike the Greater Bilby, which has a strong though not offensive odour, the Lesser Bilby has little odour.

In 1967 a skull from this species, of unknown age, was found in a Wedge-tailed Eagle's nest, south-east of Alice Springs near the Simpson Desert.

When kept in captivity, this species was placid, except when handled. Then it would snap and scratch fiercely.

When sleeping, it squats on its back legs with its tail forward between its back legs, or straight backwards. The head is tucked between the forearms with the ears folded forward along the face.

STATUS Endangered, possibly extinct.

CAUSES OF CURRENT STATUS Presumably the same as for the Greater Bilby: principally the introduction of rabbits and foxes.

NUMBER LEFT Probably none.

PRINCIPAL ACTION REQUIRED An active search of areas where the Lesser Bilby may still occur. If specimens are found, they should be caught in numbers sufficient to establish captive colonies to pre-empt their extinction in the wild.



The Lesser Bilby differs from the Greater Bilby in its nesting habits. It is possibly extinct, for the same reasons as the Greater Bilby is endangered: the introduction of foreign predators into its habitat.

Australian Museum



### YELLOW-BELLIED GLIDER

Petaurus australis Shaw & Nodder 1791

SIZE 715 mm; tail 435 mm; 575 g

IDENTIFICATION Differentiated from other gliders by its longer tail, which is nearly one and a half times its body length. The head and body are significantly longer than in the Sugar Glider *P. breviceps*, and the Squirrel Glider *P. norfolcensis*, and shorter than in the Greater Glider *Petauroides volans*. Dorsally it is grey, and it is whitish below. It has a well-developed gliding membrane extending from the wrists to the ankles. There is an oblique black stripe on each thigh, and the ears are large and bare. DISTRIBUTION Found in scattered localities of



high rainfall along the east coast and near ranges from the Atherton Tableland in North Queensland to border regions of western Victoria. In North Queens-

land, it only occurs in cooler, high-altitude areas. HABITAT Tall, mature eucalypt forests with adequate numbers of suitable flowering trees, which blossom at overlapping periods and thus provide nectar and pollen for most of the year.

NOTES Although nectar and pollen and eucalypt sap constitute the bulk of the diet for this species, large and small insects are also eaten.

To obtain eucalypt sap, the glider bites small patches of bark out of the trunk or a main branch and licks up the sweet exudate each night, and occasionally during the day in hot weather.

In the southern part of its range, the Yellowbellied Glider feeds on more than twenty species of eucalypt, but in North Queensland only the red mahogany is used.

Yellow-bellied Gliders are social animals, often living in groups consisting of a dominant male and up to five females and juveniles. Scent exchange occurs when a secretion from a gland on the back of the head on one glider is applied to the underside of the base of another's tail.

All group members share the same nest, typically a den in a large hollow tree branch or trunk. The leaves that line the nest are carried there by the glider using its coiled, prehensile tail.

These active animals have a loud, distinctive call, which is often heard as a loud shriek beginning at a high pitch and ending with a throaty rattle. Gliders often run along the underside of a branch, and may rest there without the aid of forefeet or tail. They can groom their bodies and tails, and even mate, while resting in this position. Courtship and mating usually include scent exchange and mutual grooming.

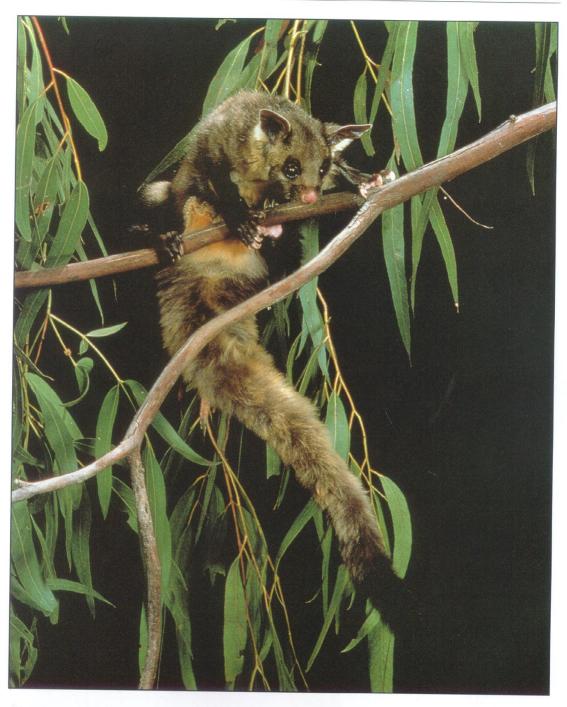
The single young is born in the warmer months from November to May, and remains in the pouch, which has two teats, for about three months. After a further two months in the nest it fends for itself. Because of the strong territoriality of the dominant male, sub-adult males usually have to find another territory; their mortality rate is fairly high.

Because this species requires tree hollows in which to nest, wood getting and clear-felling for the timber and agriculture industries are removing this species from areas where it once occurred. Food trees tend to be sought after by humans, further compounding the problem. This is particularly true of red mahogany, which is used to make furniture. Repeated extensive bushfires in recent years have further reduced populations.

CAUSES OF ENDANGERED STATUS Habitat loss and alteration of remaining forests by extensive tree felling and too short a tree rotation cycle.

NUMBER LEFT More than 10 000.

PRINCIPAL ACTION REQUIRED Remaining populations should be protected in areas of mature forest maintained as sanctuaries. In areas where timber industries remove most trees, greater stands of mature forest should be left between logged areas.



The Yellow-bellied Glider eats mainly nectar, pollen and eucalypt sap, though sometimes it consumes insects as well. To obtain eucalypt sap, the glider bites a small patch of bark out of a tree-trunk or branch, and returns each night, and sometimes during the day in hot weather, to lick up the exuded sap.

G. B. Baker/ Australian Museum

## SCALY-TAILED POSSUM

Wyulda squamicaudata Alexander 1919

SIZE 700 mm; tail 300 mm

IDENTIFICATION Distinguished from other large possums by its tail, which is thickly furred at the base then suddenly naked, with scales giving a rasplike appearance, for about 80 per cent of its length. The dorsal colour is grey, tipped with black, and ventrally it is a creamy white. The fur is relatively short and close.

DISTRIBUTION Only known from the coastal



vicinity of Kalumburu.

region of the north-west Kimberleys, where rainfall exceeds 900 mm annually. Within this area, the distribution appears to be limited to only a few localities.

where it often rests in deep rock piles or sandstone caves during the day, and emerges at night to feed in trees. Usually found in proximity to water.

NOTES Prior to 1960, only three specimens were known to science. With the opening up of the Kimberleys more specimens have been found, and wild populations have been the subject of detailed studies. Some very lengthy biological surveys since 1960 have failed to find any of these possums, despite much searching of suitable habitat. Scaly-tailed Pos-

HABITAT Found in very rugged, rocky country,

The Scaly-tailed Possum is of great zoological interest as it resembles the Brush-tailed Possum, *Trichosurus vulpecula*, being of similar body size and shape, general appearance and many habits, but in

sums seem to be found in largest numbers in the

other respects it more closely resembles Cuscuses *Phalanger* spp., with the naked, prehensile tail.

Specimens disturbed at night when foraging in trees typically try to seek shelter in nearby rock outcrops or rock piles below. Except when mating, this possum appears to be a solitary species.

Wild specimens have been observed feeding on blossoms, although captive animals also took fruits, nuts, leaves and insects.

Field observations suggest that just one young is produced, in the dry season, before June, and by December–January the young is about half grown. CAUSES OF ENDANGERED STATUS Proposed tourist and other developments in the area, and the possible introduction or spread of introduced pests put the few known colonies of this possum at risk. NUMBER LEFT Probably between 1000 and 100 000

PRINCIPAL ACTION REQUIRED At this stage, the specific sites where this possum occurs do not appear to be under threat of habitat alteration; however, this situation must be monitored closely, as it is likely to change in the future. Populations should be monitored in case of a decline, so that appropriate action may be taken if necessary.

The Scaly-tailed Possum is only known to occur in the coastal region of the north-west Kimberleys in Western Australia, where rainfall exceeds 900 mm annually, and it appears to be restricted to only a few places within that region. Proposed tourist and other developments in the area threaten its survival.

Jean-Paul Ferrero/AUSCAPE International



# NORTHERN HAIRY-NOSED WOMBAT

Lasiorhinus krefftii (De Vis 1900)

SIZE 1050 mm; tail 50 mm; 30 kg

IDENTIFICATION The only wombat to occur in inland Queensland. Distinguished from the Common Wombat *Vombatus ursinus* by its silky hair and longer ears. Distinguished from the Southern Hairynosed Wombat *Lasiorhinus latifrons* by the bone structure of the snout.

DISTRIBUTION The Northern Hairy-nosed Wom-



bat only occurs in the Epping Forest National Park, near Claremont in central Queensland. At the turn of the century this species had a scattered distribution with

colonies known from Jerilderie in New South Wales, the Moonie and Balonne rivers, both near St George, Queensland, and at Injunee and Tambo in Queensland. Fossil remains have been found throughout inland eastern Australia.

HABITAT This species is restricted to about 1500 hectares of sandy country in a gully about 100 m wide, surrounded by heavy clay soil covered with brigalow scrub.

NOTES Being a burrowing animal, the wombat has powerful legs and strong claws, well adapted for digging. The head is broad and it has relatively long, slightly pointed ears with tufts of white hairs around the margins. The name 'Hairy-nosed' comes from the short, close brown hairs that cover the muzzle.

The burrows are in groups, in clumps of trees at the edge of the gully. The tree roots strengthen the burrow entrances. Although at last count about a hundred burrow entrances showed signs of wombat activity, the number of wombats in the colony was not estimated because of the possibility of one wombat using more than one burrow. The Hairy-nosed Wombat is principally nocturnal, and concentrates its waste products, enabling it to survive the hot

daytime temperatures.

Diet is entirely of low-protein vegetable matter. The teeth are specifically adapted to gnawing on roots and tough plants with the single pair of upper and lower incisors, and the grinding molars grow continually, compensating for wear. To compensate for the low-energy diet, the Hairy-nosed Wombat's metabolic rate when resting is only about two-thirds that of most other marsupials.

Males are known to fight one another during the breeding season. Copulation occurs in the burrow after the male rolls the female on to her side and mounts her from behind for prolonged intercourse. A single young is produced in spring, taking a year to wean and three years to reach sexual maturity after birth.

Captive Hairy-nosed Wombats have lived for more than twenty years.

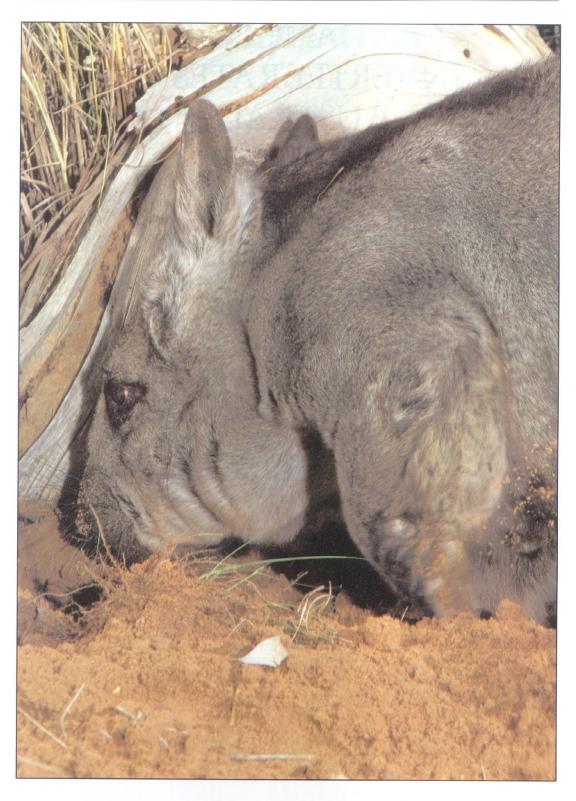
CAUSES OF ENDANGERED STATUS The species was probably in decline before the arrival of European settlers, quite possibly due to predation by Aborigines and dingoes. Only relict populations remained. Grazing of cattle, clearing of land, further killings by farmers, pest animals such as rabbits, and possibly disease have assisted in its elimination.

NUMBER LEFT Fewer than 100.

PRINCIPAL ACTION REQUIRED The current single colony should be split so that the risk of total annihilation through disease is minimised. A programme to boost the extant population of this species must be undertaken to increase its security. This would probably involve large-scale breeding by institutions, with controlled release of individuals into suitable habitat elsewhere.

The Northern Hairy-nosed Womhat is restricted to about 1500 hectares of sandy country in the Epping Forest National Park, near Claremont in central Queensland, and fewer than 100 live in that area.

C. Andrew Henley/AUSCAPE International



# ENDANGERED INVERTEBRATES OF AUSTRALIA

CLASS: MOLLUSCA

FAMILY: CARYODIDAE

Anoglypta launcestonensis Granulated Tasmanian Snail

FAMILY: CYPRAEIDAE

Cypraea queenslandica Cowry (Generic term)

FAMILY: PLANORBIDAE

Ancylastrum cumingianus Tasmanian Freshwater Limpet

CLASS: ARTHROPODA

FAMILY: BLEPHAROCERIDAE

Edwardsina gigantea Giant Torrent Midge

Edwardsina tasmaniensis Tasmanian Torrent Midge

FAMILY: EUSTHENIIDAE

Eusthenia nothofagi Otway Stonefly

FAMILY: HEMIPHLEBIIDAE

Hemiphlebia mirabilis Small Hemiphlebia Damselfly

FAMILY: LUCANIDAE

Phalacrognathus muelleri Mueller's Stag Beetle

FAMILY: PHASMATIDAE

Dryococelus australis Lord Howe Island Phasmid

FAMILY: TETTIGARCTIDAE Tettigarcta crinita Hairy Cicada

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Further information about Australia's endangered animals and related topics can be gleaned from literally thousands of sources, with the list of new material growing rapidly.

As it is not practical to cite all references used in compiling this book, a cross-section of references is provided. The omission of a particular reference due to space limitations does not imply that it is less important than those included. I have tried to include those references that most influenced the content of this text. References have been grouped into several categories in the interests of simplicity, although the information given in many works tends to overlap my arbitrary designations. Australian references have been cited in preference to those which have a more global perspective.

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