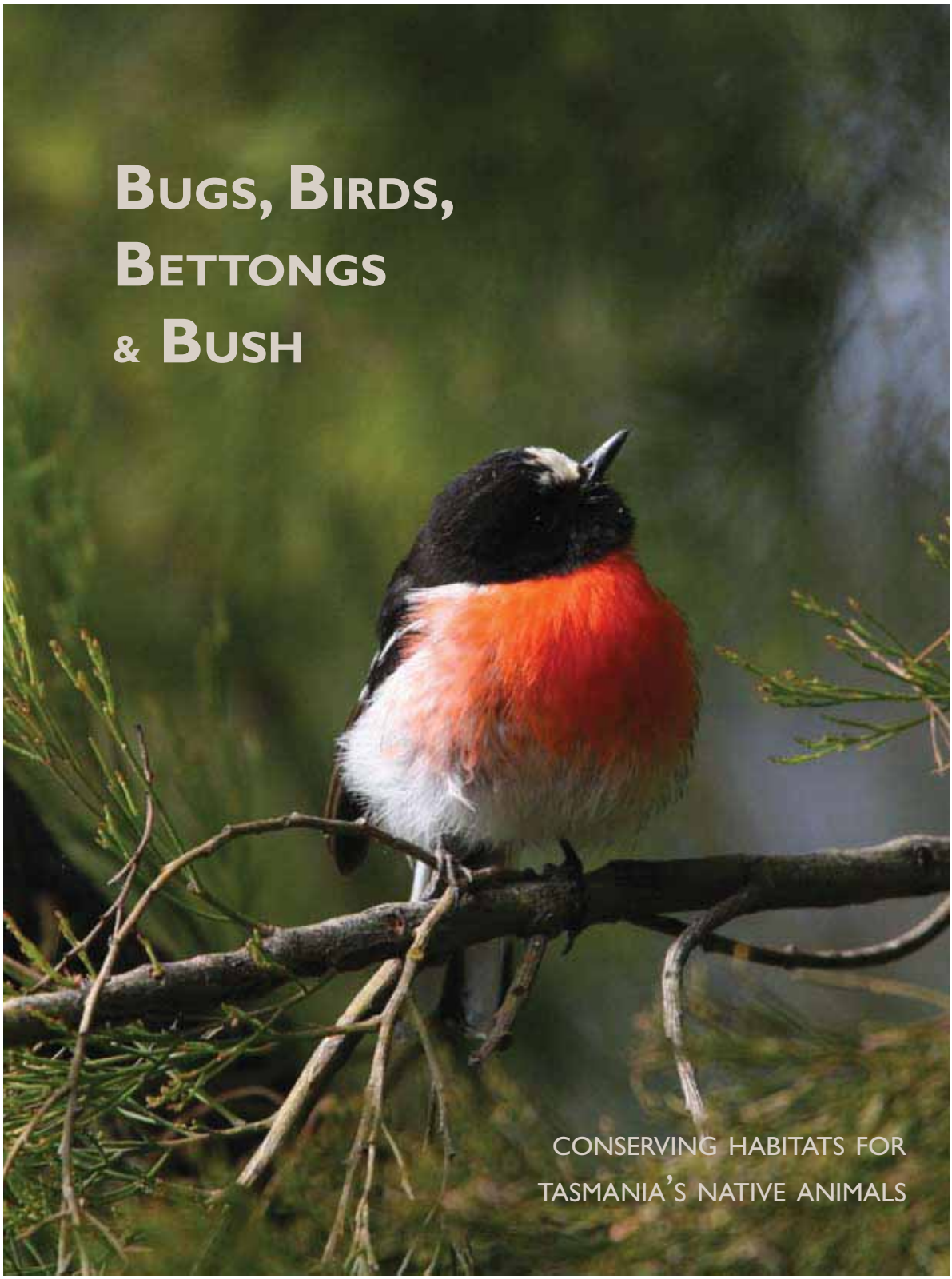

scarlet robin

Sarah Lloyd

ACKNOWLEDGEMENTS

I would like to thank Micah Visoiu, lead author of the first edition of *Bugs, birds, bettongs and bush* on which this book is based.

I also thank the following people for their input in the form of planning, proof reading, donating photographs or identifying and providing information about species described in the book:

Iona Mitchell, Peter Voller, Louise Mendel, Ron Nagorcka, Sally Bryant, Phil Collier, Robin Garnett, the late John Simmons, Jim Nelson, Nicholas Fitzgerald, Gintaras Kantvilas, Kevin Bonham, Phil Bell, Louise Gilfedder, Alister Donnelly, Michael Driessen, Mike Comfort, Ros Wood, Richard Cooper, Nicholas Sheehy, Tony Daley, Tom Thekathyil, Beris Hansberry, Liz Znidersic and Sarah Graham.

The Central North Field Naturalists Inc. subsidised the printing of draft copies of the book.

Design and layout: Sarah Lloyd
All photographs by Sarah Lloyd unless otherwise indicated.

Published by:
Department of Primary Industries, Parks, Water and Environment, GPO Box 44, Hobart, Tasmania 7001.

ISSN: 1441-0680
ISBN (hard copy): 978 0 7246 6649 2
ISBN (pdf web version): 978 0 7246 6650 8

This edition of *Bugs, birds, bettongs and bush* has been funded through the Protected Areas on Private Land program as a resource for new and existing conservation covenant landholders.

This project is supported by the Department of Primary Industries, Parks, Water and Environment through funding from the Australian Government's Caring for our Country.

Cite as:
Lloyd, S.J. (2013) *Bugs, Birds, Bettongs & Bush, conserving habitats for Tasmania's native animals*. DPIPWE, Hobart.

Printed by:

Richmond Concepts & Print
10-12 Wenvoe Street
Devonport, Tasmania 7310

Front cover: bush cricket or katydid (*Caedicia simplex*) on lemon tree, Goulds Country, North East Tasmania
Back cover: Pink robin at Wombat Flat, Waratah, North West Tasmania

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FOREWORD

native bee on forest flaxlily (Dianella tasmanica)

It is with great pleasure that I introduce you to this revised edition of our popular publication, *Bugs, Birds, Bettongs and Bush* by Sarah Lloyd. Sarah is a well-known Tasmanian naturalist, writer and photographer who continues to make an outstanding contribution to our knowledge of Tasmania's wonderful natural values.

This edition brings together the latest information on Tasmania's native fauna and habitats in a highly accessible form. At a time when there continues to be landscape scale change in Tasmania, publications such as this provide valuable support to the community to develop knowledge, skills and capacity to engage in a range of conservation activities. As Sarah points out in her Introduction, an impressive number of people in the Tasmanian community have made commitments to conservation through Land for Wildlife, Gardens for Wildlife, conservation covenants, and generally participating in conservation efforts on their own land and in the broader community.

Sarah has included insights into the history of change in the Tasmanian landscape and implications for wildlife and habitat, along with contemporary conservation thinking and wildlife identification and monitoring techniques that can be used by everybody. Current issues that have emerged or accelerated over the last decade since *Bugs, Birds, Bettongs and Bush* was first published are also outlined, including the dramatic decline of the Tasmanian devil population, the spread of the deathly fungus in native frogs, and other critical invasive species threats, particularly the red fox.

This publication includes some fascinating insights into the unusual and quirky nature of our fauna. Bats for example, of which Tasmania has eight resident species, eat half their body weight in insects every night, while migratory cuckoos lay their eggs in a matter of seconds in the nests of other birds whose eggs they remove, with the hatched cuckoo chick also ejecting any other eggs or chicks in the nest!

I particularly draw your attention to the good ecological practices outlined in the concluding section of this publication. The application of these sound planning and management principles help us as a community to sustain viable populations of native species and the habitats that are so vital to their survival.

I congratulate Sarah Lloyd on the wonderful job she has done in producing this revised edition, including her stunning photographs that richly illustrate the great diversity of native wildlife we have in Tasmania. I trust that you will find the revised *Bugs, Birds, Bettongs and Bush* publication a highly valuable and most enjoyable resource.

Alistair Scott
General Manager, Resource Management and Conservation
Department of Primary Industries, Parks, Water and Environment

Macleay's swallowtail (Graphium macleayanus)

INTRODUCTION TO REVISED EDITION

robberfly (Laphria telecles)

No matter where we live we provide habitat for other forms of life. How we choose to live affects the fauna—birds, mammals, frogs, reptiles and invertebrates—we support. To survive, breed and maintain healthy populations animals, like us, need food and water, shelter from inclement weather, protection from predators and places to breed and raise their young in safety.

A manicured garden of mostly non native plants is likely to be dominated by introduced birds such as sparrows, blackbirds and starlings. A garden with open areas adjacent to dense shrubbery where birds and other animals can hide and nest in safety is likely to have a wider range of species including many invertebrates (e.g. insects, worms, snails, millipedes, spiders etc) and native birds including superb fairy-wrens, honeyeaters and silvereyes. An eastern barred bandicoot or green and gold frog may even turn up in the garden!

At the time of writing there are 842 Land for Wildlife properties, 468 Gardens for Wildlife and 710 covenanted properties in Tasmania covering approximately 136 349 hectares. This is a tremendous commitment by landowners to the conservation of Tasmania's special fauna, and is an important and necessary complement to the National Parks and reserves which alone are not adequate for the preservation of the genetic diversity in the plants, animals, fungi and microorganisms and the ecosystems of which they are part—often referred to as biodiversity. This book describes some of the species present in different Tasmanian habitats with the aim of improving awareness of their conservation needs.

There have been substantial deleterious changes to the Tasmanian landscape in the ten years since *Bugs, birds, bettongs and bush* was first published. Urban and suburban expansion and industrial development on the edges of towns and cities has caused the loss of significant areas of native bushland; agricultural land traditionally devoted to sheep grazing is increasingly being used for more intensive agriculture including dairy farming and irrigated crops. Native forests have been cleared and converted to plantations of pines or eucalypts and plantations have been established on already cleared farmland.

The increase in populations of introduced hollow-nesting fauna including laughing kookaburra, galah and rainbow lorikeet is having an adverse impact on native species. The spread of the red fox, implicated in the decline and extinction of small marsupials on the Australian mainland, has occurred at the same time as the demise of the Tasmanian devil. This, the largest extant living marsupial carnivore, has been afflicted with a fatal contagious cancer leading to a loss of approximately 85% of its population.

The decline of top order predators including the eastern and spotted-tailed quoll, Tasmanian devil, wedge-tailed eagle, white-breasted sea eagle and grey goshawk affects the whole ecosystem in ways that are difficult to quantify.

This revised edition of *Bugs, birds bettongs and bush* contains additional information about Tasmania's animals, as well as those often overlooked components of habitats: the bryophytes (mosses, liverworts and hornworts) and those remarkable organisms, the slime moulds.

It should be noted that the species included under Threatened Species in the habitat sections (pages 58-71) are listed on Tasmania's *Threatened Species Protection Act 1995*. The list is under constant review as species' status change. The DPIPWE website regularly updates the list of threatened species.

TASMANIA: A SPECIAL ISLAND

native bee on forest flaxlily (Dianella tasmanica)

Tasmania has over 6,500 islands, islets and rock stacks (374 are greater than one hectare in size) covering an area of about 6 723 000 hectares. Most are situated between latitude 39°12' and 43°39' south of the equator (Macquarie Island is located 54°30' S and 158°57' E) in the path of the roaring forties, the strong westerly winds that have a major influence on the State's maritime climate of cool summers and mild winters. The prevailing westerlies buffet the wetter western part of the island but the mountains of the west and central plateau prevent much of the precipitation reaching the midlands and east coast which are drier as a result.

The climate largely determines the occurrence of broad vegetation communities such as rainforest, sclerophyll forest, moorland, sedgeland and coastal heath, each of which provide habitat for a different range of animals. Tasmania's rugged topography and local variations in aspect, altitude and soils create a mosaic of different vegetation types that sometimes change over very small distances.

ISLAND BIOGEOGRAPHY

Islands are important refuges for plants and animals and have played an important role in the study of evolution because of their limited area and isolation. The distance of an island from its nearest mainland influences the rate of colonisation of new species and the size of the island determines extinction rates. Islands generally have fewer species of birds, mammals and other organisms than adjacent continents, with the number of species related to the size of the island and the diversity of habitats present. For instance, small offshore islands of a similar size to Tasmania such as Sri Lanka and Ireland have far fewer birds than nearby India and the United Kingdom respectively. Similarly, Tasmania, King Island and Kangaroo Island have fewer bird species compared with areas of similar habitat in southern Australia. In some cases, this is because of the absence of suitable habitats, in other cases there are no obvious reasons.

On the other hand, islands are characterised by a high level of endemic species and sub-species, that is, species that are found nowhere else on Earth. Approximately one third of all invertebrates known to occur in Tasmania are endemic and some of our better known animals such as the Tasmanian devil, Tasmanian native-hen and the largest freshwater invertebrate on the planet, the giant freshwater lobster, are only found in Tasmania. However, many of these species once occurred on the Australian mainland, hence they are 'relict' species rather than truly island-evolved forms such as the Galapagos fauna.

Tasmania is without some species that are widespread and common on the mainland, such as the koala and dingo and many families of birds including babblers, magpie-larks, bowerbirds, bee-eaters and treecreepers.

Although Bass Strait forms an obstacle that slows or prevents the influx of new species, it has until recently also been a barrier to some undesirable animals, most notably the red fox. In Tasmania there are still relatively healthy populations of many animals (e.g. eastern barred bandicoots, bettongs and quolls) that are extinct or nearly extinct on the Australian mainland, something that is mostly attributed to the absence of this wily predator.

A BIRD'S EYE VIEW

Birds are a very conspicuous element of the fauna so we have a reasonable idea of what's around now and, thanks to the writing of James Bischoff and other early naturalists, an inkling of what was around in the early 1800s.

The swift parrot is one of the rarest birds in Australia. Loss of nesting hollows and foraging sites are contributing to its decline.

The feathered tribes of Van Diemen's Land are numerous ...The land birds, generally speaking … are all of them curious and beautiful. The number of the various kinds of parrots and paroquets [sic], clothed in the most beautiful plumage, are almost beyond description … The pigeons are by far the most beautiful birds on the island … The birds that may be called game are very numerous, with the exception of the emu … The quail of which there are three kinds are far more numerous in many parts of the island than the partridge in England … Snipes are found in great abundance from September to March in the lakes and wet valleys. (J. Bischoff 1832)

In their more recent accounts of bird populations, ornithologists Michael Sharland and Bob Green also wrote of abundance. In *The Birds of Tasmania* written in 1958 Sharland described Swift Parrots as 'very common'. It was not known at the time whether they bred around Hobart, or even if they migrated. Now we know that Hobart and other areas in the southeast are breeding hotspots for this bird, and that they do indeed leave Tasmania for the Australian mainland, undertaking the longest migratory flight of any parrot species in the world. Tragically, it is also clear that they are among the rarest birds in the country.

Other birds have benefitted from the changes to the landscape. The masked lapwing, sulphur-crested cockatoo and galah are much more common now than they were decades ago.

THE CHANGING LANDSCAPE

The Tasmanian landscape has undergone enormous change in the 200 years since British settlement, with untold consequences for fauna. The development of cities and towns, many situated near major waterways, and the establishment of farms on the richest soils have changed the vegetation of those areas that would have supported the greatest number of species. In addition, swamps have been drained, rivers have been dammed, and vast tracts of land have been cleared for agriculture, forestry, housing and industrial developments.

We have little reliable information about the population size and distribution of species present in Tasmania in the early 1800s. Nevertheless, we do have accounts of some of the more conspicuous and common species. The eastern barred bandicoot, common ringtail possum and Tasmanian bettong were some of the most common animals in the early years of settlement. The pademelon was very common near the borders of wet forest, and Bennetts wallaby sheltered in scrub and thickets and moved out into grasslands and woodlands to feed at night. Grasslands, open grassy woodlands and heaths were the haunt of the forester kangaroo, which was common in eastern Tasmania and parts of the Central Plateau.

Animal populations fluctuate in response to changing environmental conditions. For example, populations of herbivorous animals build up after wet springs in response to abundant growth, and fall again during subsequent dry years. The modification of the landscape that has occurred in the last two centuries has exacerbated these fluctuations for some species.

Possum populations have changed considerably in the last 100 years. Until the 1940s the ringtail possum was the most common possum in many areas, including the Midlands and northern Tasmania, while the brushtail possum was absent or rare in farming and grazing districts. During the 1940s and 1950s the situation reversed: the brushtail possum became very common in most areas and the ringtail possum became rare. No studies were done at the time so the reasons for this switch are not fully understood and there are probably a number of contributing factors including the rising and falling demands of the fur trade. In addition, the introduction of superphosphate fertilizer in the 1940s and 50s encouraged the growth of nutritious grasses which greatly advantaged the ground-foraging brushtail possum whose numbers increased markedly. It out-competed the smaller, arboreal leaf-eating ringtail possum for nesting sites and succulent eucalypt leaves.

The introduction of myxomatosis in the 1950s had a devastating impact on small animals. This is because the decline of the rabbit after the introduction of the disease left a shortage of prey for their predators, such as feral cats and birds of prey. These species started to target small marsupials, including bandicoots.

The success of myxomatosis also had other effects on wildlife populations. Before myxomatosis was introduced, strychnine and phosphorus poisons were used to control rabbits. These poisons caused a declines in the populations of herbivorous animals, and secondary poisoning affected the Tasmanian devil to such an extent that extinction was thought likely. The decrease in the use of these poisons led to huge increases in the species that were advantaged by improved pastures, fragmented landscapes and large quantities of carrion. For example, edge dwellers such as the pademelon and Bennetts wallaby adapted well to the landscape of improved pastures (where they feed), interspersed with patches of native vegetation where they shelter during the day.

It is difficult to determine the full impact of increasing numbers of browsing animals. However, it is likely to change the makeup of the plant community as they select the tastiest plants to browse. In some cases understorey vegetation is destroyed or eliminated when there's an increasing number of herbivores. To add to the problem, an introduced species, the fallow deer, not only competes with native species, but it also does considerable damage to native vegetation when browsing. Furthermore, their hard hooves damage to the soil.

THE FRAGMENTED LANDSCAPE - HOW MUCH IS ENOUGH?

Changes to the landscape were fairly gradual until about the end of the 20th century. In the past two decades there have been much more significant modifications particularly in those areas suitable for industrial-scale forestry and irrigated agriculture.

Bennetts (red-necked) wallaby

Since European settlement native vegetation has been altered to suit our needs, something that has happened at a faster rate here than anywhere else in the world. In Europe this process happened over thousands of years, in North America it happened over centuries, in many parts of Australia it has happened over decades.

The patches of vegetation that remain after the clearing of productive land for farming have important habitat values depending on their shape, size or distance from large areas of intact vegetation.

Habitat loss and fragmentation can lead to food shortages, altered breeding patterns, disrupted ecological processes (e.g. pollination) and increase prevalence of disease.

Smaller bush remnants are more vulnerable to 'edge effects' than larger bush remnants. They are more prone to weed invasion, strong winds and altered microclimates (e.g. temperature and moisture levels). There is an increased likelihood of nest predation and lower rates of breeding success of birds with territories located at the edges of habitats. Noisy miners are more likely to invade small patches of vegetation.

The habitat requirements of different animals and birds differ markedly depending on the species and season. Scarlet robins, for example, concentrate their foraging during the breeding season and in a healthy productive habitat they may find all necessary resources in an area of 2 hectares; once breeding has ceased they range over a much larger area of approximately 20 hectares. Invertebrates such as velvet worms may spend all or most of their lives in rotting logs within a very small area of suitable wet forest habitat. Spotted-tailed quolls have been radio-tracked travelling over 20 km in one night.

Habitat fragmentation is now a major issue facing native wildlife. Large patches of vegetation are generally more viable than small patches and support more species when they are connected by corridors of vegetation.

EXTINCTIONS

Island populations are small and isolated and have little chance of bringing in individuals from nearby populations. Therefore, they are more vulnerable to extinction than their mainland counterparts. Humans, feral predators and land clearing have inflicted their toll on some of Tasmania's unique species. The early settlers hunted the thylacine and Tasmanian and King Island emus to extinction. The introduction of feral species on Macquarie Island lead to the extinction of the Macquarie Island parakeet and Macquarie Island rail.

The Pedder galaxias is listed as extinct in the wild. (see page 59)

FINDING FAUNA

water rat (Hydromys chrysogaster)

To improve habitat it is important to know what's already there. Direct observation, such as looking under loose bits of bark and under logs and rocks, can indicate the diversity of invertebrates in an area. Searching will also reveal some frog and lizard species.

Keeping regular records of what you observe will, over months, years and decades, illustrate the complexities of the dynamic habitats of which we are part. Records can be simple lists of the birds, frogs or fungi that are regularly observed, a note about unusual sightings such as a large flock of a particular species, or a one-off visit by a rare swift parrot or an eastern barred bandicoot. Contributing to organised projects such as Fungimap, the ongoing Atlas project run by Birdlife Australia or the Atlas of living Australia will increase collective and personal knowledge.

SOUNDS

One of the best ways to find out what's living in an area is to listen.

Birds are easy to detect because they sing in the same frequency range that we use for language and music. With practice, all birds can be identified by their calls. Because terrestrial birds are entirely dependent on other species for their food, shelter, nesting sites and nesting material, they are excellent indicators of biological diversity and ecological integrity. Their presence indicates the presence of all the other plants and animals on which they depend. A bird list from an area can tell us much about the health of the local environment.

Other animals can also be detected by listening. Frogs, cicadas and crickets can be identified by their calls. Rustling in the understorey during the day may indicate the presence of reptiles. Wallabies and pademelons can be detected by the sounds they make as they travel through the bush. At night, marsupials such as ringtail possums and sugar gliders can be heard communicating or moving in the trees.

There are many resources now available to assist in the identification of species. These include bird and frog call CDs, Bird eGuides with photographs and calls available for iPhone, iPod Touch and iPad and numerous websites for identifying invertebrates, some of which include short audio files of the sounds they make. (For details see p. 91)

SIGNS

Scats and footprints can indicate what species are using a patch of vegetation. Trained eyes can identify species by their diggings and the way plants have been browsed. Several mammals form runways through the undergrowth. Small carnivores such as the water rat and antechinus often leave refuse heaps in their favourite dining areas. The water rat in particular leaves piles of shells and bones on flat-topped rocks and logs along waterways.

Accumulated bird droppings on the ground may indicate a favourite roosting site. Looking for splashes of white is a good way of finding the day time roosts of tawny frogmouths that adopt a camouflage pose on dead branches. Nests are also good indicators of the birds that breed in an area. Most nests can be identified to a group of species, if not an individual species. However, handling or even having a close look at nests that are being used can cause the occupants to abandon them. Using a pair of binoculars is the best way to look closely without disturbing

the birds. Some birds use the same nests year after year, so it is best not to damage or remove nests, even if they seem to have been abandoned.

Some large invertebrates can be detected by the signs they leave. Among the most obvious signs are the 'chimneys' constructed at the entrances of the burrows of freshwater crayfish. These chimneys are often found in wet areas in the north and west of the state, and are composed of small mud pellets piled to form a tube around the entrance.

DEAD ANIMALS

Road kills are unfortunate but they provide useful information about the animals that live in an area. Bones, especially skulls, can be used to identify species. They can be taken to the local museum for identification.

DIGITAL TECHNOLOGY

There have been rapid advances in digital technology in the last decade. Digital cameras, audio recorders and motion sensor cameras are now compact, easy to use and affordable. With careful placement digital sound recorders and motion sensor cameras are an unobtrusive way to record the species using an area. They have much less impact on fauna than conventional means such as trapping and spotlighting.

There are numerous motion-sensor cameras on the market and they vary considerably in price, quality, battery life and size of memory card. Check websites or talk to someone who's familiar with the technology. (See p. 91)

pademelon

brushtail possum

long-nosed potoroo

rabbit

Tasmanian native-hen

Photos: Iona Mitchell

In a semi-urban area in southern Tasmania a motion sensor recorded a range of nocturnal and diurnal species, including pademelon, brushtail possums, potoroo, eastern barred bandicoot, rabbit and Tasmanian native-hen.

brown goshawk

Tasmanian devil

spotted tail quoll

fallow deer

Phtos: Richard Cooper

In a remote area of wet forest at the base of the Great Western Tiers, brown goshawk, Tasmanian devil, spotted tail quoll and fallow deer were 'captured' on a remote sensor camera.

MAMMALS

platypus (Ornithorhynchus anatinus)

Australia and New Guinea are the only countries in the world where examples of all three mammalian groups, monotremes, marsupials and placental mammals, are found. Of Tasmania's 33 land mammals, 2 are monotremes, 18 are marsupials and 13 are placental mammals.

Tasmania's terrestrial mammal fauna is considered to be relatively intact compared with that of southeastern Australia. Of the 34 mammals that existed here before European settlement, only the thylacine is extinct. Many populations that have declined on the mainland have been considered secure in Tasmania until relatively recently. But the landscape is changing rapidly. More intensive irrigated agriculture means that those areas traditionally used for dryland farming are now being devoted to cropping. The red fox has been reported from many different regions, and there has been a decline of top order predators most notably the Tasmanian devil and wedge-tailed eagle. All these factors have an impact on mammalian populations.

MONOTREMES

Two of the three extant (i.e. still living) monotremes, the platypus and short-beaked echidna, are among Tasmania's most distinctive animals. (The third monotreme is the long-beaked echidna that occurs in Papua and New Guinea.)

Monotremes (Gk *monos* = alone; *treme* = hole) are egg-laying mammals that suckle their young. They are ancient animals that retain some reptilian traits, including having a cloaca, a single opening used for excretion and reproduction. They lay soft, leathery-shelled eggs similar to those of reptiles.

Platypuses are found only in the eastern part of Australia where they live in burrows in the banks of lakes, rivers, streams and farm dams. Occasionally they venture into salt water at the mouths of estuaries. They have a streamlined, fur-covered waterproof body, strongly webbed front feet and the characteristic duck-like bill. Males grow larger than females and have a venomous spur on the inside of each ankle capable of inflicting a very painful wound. Platypuses can spend up to 18 hours a day feeding. They catch a variety of mainly underwater invertebrates, including worms, shrimps and insects, and come to the surface to breathe and chew their food. They dive when alarmed and will often retreat to thick vegetation or their burrows. They lack a pouch, and lay their eggs (usually two) and raise their young in burrows which have entrances just above the water level often concealed by vegetation. The eggs take 1–2 weeks to hatch and young platypuses are weaned at 4–5 months.

Echidnas are solitary animals with a large home range of about 40 to 70 ha. They are powerful diggers and use their short, strong limbs with large claws to tear at rotting wood or soil in their search for ants and other soil-dwelling invertebrates. They have tiny mouths and toothless jaws and, like platypuses, have electro sensors at the tip of their snout. They use their long sticky tongue, which protrudes from the snout, to collect their prey.

The Echidna lays a single egg that it deposits directly into the pouch. The egg hatches after 10 days and the young echidna sucks milk from the pores (monotremes lack teats). The young remains in the pouch until it starts to develop spines at about 45 to 55 days. The mother places the young in a nursery burrow and returns every five days to suckle it. The young are weaned at seven months. Echidnas have a lifespan of approximately 45-50 years.

MARSUPIALS

Tasmania has 18 native marsupial species including one introduced species, the sugar glider, and one extinct species, the thylacine. All the marsupials have evolved specialized digestive systems to deal with Australia's predominantly hard, dry and leathery (i.e. sclerophyllous) vegetation. They also have various breeding strategies to cope with changing circumstances such as drought.

In 1816 the fundamental difference in the reproductive systems of female mammals was discovered. What are now called marsupials (Gk. *marsupion* = pouch) were originally named the Didelphia (Gk. *di* = two; *delphia* = uteri) a word that alludes to marsupials' two vaginae, two uteri and two oviducts.(Placental mammals have a single vagina, cervix and uterus and only the oviducts are paired.) This is what really sets marsupials apart from the placental mammals and monotremes.

Most marsupial species have a yolky egg with a thin shell from which the embryo is born after 10-12 days. The embryo crawls to the pouch and attaches to the teat. Its lips grow around the teat and the structure of its mouth allows it to suck and breathe simultaneously.

The milk of marsupials changes considerably through the extended period of lactation. While it is supporting the initial growth of the tiny bean-sized young, the milk is a dilute fluid with more sugars than fats. By the time the young become independent at the end of lactation, the milk is rich in proteins and fats with very little sugar. The constituent sugars, fats, proteins, salts and minerals change during the lactation in relation to the needs of the developing young. The sequence of changes seems to be constant for different species.

When there are several young in the pouch, as is often the case, the more advanced offspring will receive high-fat low-protein milk from one teat and the younger offspring will get high-protein low-fat milk from another teat.

short-beaked echidna

pademelon

pygmy possums

BANDICOOTS

John Simmons

southern brown bandicoot

Bandicoots occupy a range of habitats including grasslands, heaths and open forest. They are solitary animals with no social structure. The juveniles have the fastest growth rate of any marsupial and can easily disperse. Because of these factors bandicoots can respond quickly to favourable conditions by reproducing rapidly and colonizing disturbed habitats such as areas regenerating after fire, rubbish tips and gardens in country towns. They are opportunistic feeders with a widely varied diet of invertebrates, underground fungi, grass, seeds and plant roots.

Given their opportunistic lifestyles, it is surprising that many species of bandicoots in Australia have declined or become extinct since European settlement. The wide scale clearing of native vegetation for pasture, the competition for food from introduced herbivores (including cattle, sheep and rabbits) and the removal of vegetation cover that protects them from predators and the sun have taken their toll. The presence of the fox sealed their fate in many areas of the Australian mainland.

Bandicoots' reproductive success is attributed to several factors. Unlike other marsupials, they have a complex placenta more like that of the placental mammals. Their fast growth rate may be attributed to their milk which is richer than that of any other marsupial. By the end of lactation bandicoots' milk has 55% solids - richer than that of all other placental mammals except seals.

COPROPHAGY IN RINGTAIL POSSUMS

Like the koala and greater glider, the common ringtail possum has adapted to a diet almost solely of eucalypt leaves. (It will also eat the flowers and leaves of non native plants.) It has a large caecum, the part of the digestive system where fine and coarse particles of food are separated. The coarse particles pass quickly through the body but the fine particles are retained in the caecum for up to 70 hours. During that time massive populations of micro-organisms ferment the particles and bring about partial digestion.

Common ringtail possum produce two types of faecal pellets. During the night when they forage, they void dry pellets with a low nitrogen content. While resting during the day in their nest (called a drey) they produce moist pellets called caecal pellets. These caecal pellets have a high nitrogen content and are eaten. During their passage through the gut the ringtail gains access to the protein and energy that were the bi-products of the fermentation process.

John Simmons

Tasmanian bettong

The mutual interdependence of potoroos and bettongs, underground fungi and eucalypt trees is extremely important to the health of Australia's forests and woodlands.

Australia has a rich variety of underground, truffle-like, fungi that form mycorrhizal (i.e. mutually beneficial) associations with trees. Fungal hyphae attach to the root systems of trees giving the roots a much greater area over which they can access water and nutrients; the fungus gets nutrients from the tree.

Fruiting bodies of truffle-like fungi are formed approximately 5-20 cm underground. They have a hard leathery outer shell that encases the spore mass and, in certain families, some edible material. The fruiting bodies emit a pungent odour that is particularly attractive to mycophagous (i.e. fungus eating) animals including Tasmanian bettongs and long-nosed potoroos that dig up and eat the fungi.

The fungal spores are dispersed in a number of ways: some attach to the animal's fur, others are dispersed through the air. In some fungal families the passage through the animals' gut is important for germination and ensures they more readily infect the tree roots. Passage through the animals' gut means the spores are carried away from the host fungus and tree when the animals move to other areas.

Underground fungal fruits are an important food source for many marsupials after fire when other plant food has been destroyed. Several species of fungi are stimulated to produce fruiting bodies by the rise in ground temperature during fire or by alterations in the host trees' stress levels as a result of the fire. Interestingly, to make themselves even more attractive to animals many fungal fruits emit a different odour after fire.

Underground fungi are occasionally eaten by other marsupials such as bandicoots, wombats and possums but these animals are unable to thrive on a solely fungal diet. Bettongs and potoroos are specialist feeders and fungi form more than half their daily intake. They cope with a diet of fungi because they have a forestomach where microbial fermentation breaks down the cell walls of the fungi; digestion of microbial protein takes place in the small intestine.

Phil Collier

underground truffle-like fungus

KANGAROOS AND WOMBATS

Over the millennia Australia's extensive grasslands have been exploited by diverse groups of large herbivorous animals including the wombats and the kangaroos. These animals have very different ways of dealing with a bulky diet of plant material, mostly grass: in wombats the fermentation occurs in a large colon at the back end of the gut; in kangaroos the same process takes place in a sizeable forestomach.

FORESTER (EASTERN GREY) KANGAROO

Kangaroos are a remarkably successful group of animals, something that has been attributed to three things: foregut fermentation; hopping; and their method of reproduction known as embryonic diapause.

Having an enlarged forestomach means they can more easily access the bi-products of the bacterial fermentation of grass (the main component of their diet) than hind gut fermenters such as wombats and ringtail possums.

Bipedal hopping gives them the ability to cover long distances without the energy expenditure required for more conventional means of locomotion.

Embryonic diapause occurs in a variety of placental mammals and marsupials including wallabies, most kangaroos and pygmy possums. The tiny embryo enters a state of dormancy: cell division and growth either stop or slow considerably. The embryo is stimulated to grow when the mother chooses, possibly by the release of a specific hormone.

COMMON WOMBAT

Making underground burrows is believed to be a relatively recent adaptation to Australia's drying climate and it may have saved wombats from going the way of other large, hind gut fermenters such as the extinct diprotodonts.

Wombats are the largest grass eating mammal that dig burrows (their impressive burrows can be up to 18 metres long). Other large burrow-diggers are either carnivorous (e.g. badgers) or they feed on concentrated food: armadillos and aardvarks live on colonial insects; porcupines live on roots, tubers and fallen fruit. Wombats favour tough perennial grasses, sedges and rushes that grow in their home range of approximately 20 hectares. Their split upper lip allows them to crop vegetation very close to the ground. They have extremely sharp teeth that continue to grow throughout their lives.

PYGMY POSSUM

John Simmons

Pygmy possums live on a variety of food depending on availability. They have a brush-tipped tongue for licking nectar, pollen and manna; they also eat seeds, fruit or insects and fatten up in autumn in preparation for winter.

Pygmy possums are usually solitary and rest during the day in rotting logs. Sometimes groups of animals will huddle for warmth during cold weather or when they're hibernating.

When high energy food is not available during long cold winters, pygmy possums enter prolonged periods of torpor lasting several days to weeks. They curl up into a tight ball, their large ears go limp, their body temperature drops to within several degrees of the ambient temperature and their metabolic processes slow considerably. Torpor differs from hibernation in that animals in torpor can spontaneously arouse to an active state if weather conditions change.

CARNIVOROUS MARSUPIALS

Tasmania's carnivorous marsupials range in size from the tiny 28 gram white-footed dunnart to the largest living marsupial carnivore, the 9kg Tasmanian devil. The size of their chosen prey largely corresponds to their body size.

The white-footed dunnart is rarely seen. It feeds on insects and other small invertebrates. Most adult eastern quoll weigh less than 1.5 kg. It eats insects, skinks, snakes, small birds and mammals, it will also eat fruits and berries. The largest carnivores, the spotted-tailed quoll and Tasmanian devil, mainly eat possums and pademelons. The devil and both quolls also scavenge on carrion.

The quolls and Tasmanian devil have declined in recent years but the full impact of the loss of these top order predators is difficult to determine. Sometimes it is only when there is a dramatic decline in species that their importance to a properly functioning ecosystem can be fully appreciated.

However, the decline of these predators may already be having an effect on the environment. For instance, the absence of scavengers results in a build up of carrion, thus providing an abundant food source for other carrion feeding species such as forest ravens, feral cats and European wasps. The increase in these animals is likely to have an adverse impact on other fauna. Forest ravens take nestling birds; feral cats hunt birds and small mammals and European wasps take large numbers of native invertebrates, especially in autumn when they are collecting food to sustain their larvae through the winter months.

The recent arrival of the red fox, whose past breeding attempts in Tasmania have probably been thwarted by the devil, could sound the death knell for many of Tasmania's small marsupials, most of which have been extirpated on the mainland by foxes and cats.

John Simmons

white-footed dunnart

spotted-tailed quoll

Tasmanian devil

BIG BANG REPRODUCTION

The carnivorous swamp and dusky antechinus have only one reproductive cycle during their lifetime. This unusual breeding strategy is known as semelparity or big bang reproduction.

In early spring the males of these small, rarely seen, rat-like animals stop foraging and embark on a frenzy of fighting and mating. Prolonged copulation can last up to 12 hours. The males, which are twice the size of the females when the activity begins, lose half their weight and their hair falls out as a result of all the fighting. Elevated levels of hormones lower their immunity to foreign pathogens, leading to an increase in blood born parasites and a quick death.

By the end of the breeding season all the males are dead and the entire population overwinters as pregnant females. Eleven months after mating the females give birth to about eight young.

By dying immediately after mating, the males are not competing with their offspring for a limited food supply.

The strategy is successful where there is a predictable flush of insect food. But events such as wildfires can have a serious impact on antechinus

John Simmons

swamp antechinus (Antechinus minimus)

PLACENTAL MAMMALS

Tasmania has representatives of two very different groups of placental mammals—rodents and bats. They are among the most widely distributed of all the mammals and are a significant proportion of the mammal fauna on every continent except Antarctica. In Tasmania there are five native species and three introduced species of rodents and eight species of microbats.

Rodents are renowned for their fecundity. The introduced brown rat can produce 6–22 young per litter and has, on average, 3–6 litters per year. Native species are not as productive. Nevertheless, most produce 3–6 young per litter and have 2–3 litters per year. Rodents' ability to breed up quickly when food is available makes them an abundant prey species for snakes, large birds and carnivorous mammals.

John Simmons

The swamp rat, although rarely seen, is one of the most common mammals in Tasmania.

RODENTS

Rodents have large, paired, upper and lower chisel-shaped incisors for gnawing. The incisors grow continuously, and have enamel on only one surface. Gnawing sharpens the teeth, and keeps them a constant length.

Only eight of the approximately 60 rodent species that occur in Australia are found in Tasmania. Three of these, the black rat, brown rat and house mouse, are introduced.

Four of the five native rodents, the water rat, long-tailed mouse, New Holland mouse and broad toothed rat, are known as 'old endemics' because their ancestral stock reached Australia 15 million years ago. The remaining species, the swamp rat, is a 'new endemic' because its ancestors reached Australia much more recently.

John Simmons

The water rat has abundant whiskers used when searching for live food under stones and ledges.

NEW ENDEMICS

On the mainland, the swamp rat is restricted to swamps, hence its name. In Tasmania, it occurs in a wide range of habitats, including dry heathland, sedgeland, wet and dry eucalypt forests and high altitude rainforest. It forms extensive runways through dense vegetation by chewing the bases of sedges and rushes that obstruct its path. Like other rodents, it is mostly vegetarian. It mainly eats the stems of sedges, rushes and flag irises. Occasionally, it eats insects and larvae.

Introduced rats are superficially similar to the swamp rat. The best way to tell them apart is to inspect their tails. The swamp rat has a dark grey or blackish tail that is clearly shorter than the combined length of its head and body. The black rat has a much longer tail. The tail of the brown rat is scaly and lighter in colour.

OLD ENDEMICS

The old endemics have specific habitat preferences, and are adapted to their specialised lifestyles. For example, the water rat is well-suited to its aquatic environment. It has a streamlined body of about 30 centimetres, a long, flattened head with abundant whiskers, high set eyes, and small ears. The short, water-repellent, seal-like fur and partially webbed, paddle-like back feet are indicative of its largely aquatic existence.

The long-tailed mouse is endemic to Tasmania. It is widely distributed in high rainfall areas such as rainforest, wet

Courtesy of the Parks and Wildlife Service

The long-tailed mouse favours boulder fields and wet gullies in high rainfall areas.

ECHOLOCATION

Tasmanian long-eared bat (Nyctophilus sherrini)

Echolocation calls are high frequency sound waves made by a bat forcing air through their vocal cords and emitting them through the mouth or nostrils. The calls bounce back (echo) from objects and are detected by the bats' ears. The echoes allow the bats to asses the size, texture and distance of the object and how fast it is travelling.

Some bats emit sounds through their noses rather than their mouths. This enables them to eat and drink while echolocating. It also accounts for some of their strange, grotesque facial features.

Different bat species have different calls depending on their anatomy, habitat and hunting technique.

sclerophyll forest and mountain areas, where it favours boulder fields and wet gullies. The broad-toothed rat is a specialised sedgeland species. It is restricted to the west of the state, where it is found in wet buttongrass moorlands from sea level to subalpine elevations. The New Holland mouse is restricted to some coastal heathlands and woodlands in the north and east.

BATS

Tasmania has eight resident species of bat all belonging to the family Vespertilionidae; one vagrant species, the grey-headed flying fox, occasionally turns up on the Bass Strait Island or on the Tasmanian mainland. Tasmania's resident species are all small, insectivorous bats weighing 4–20 grams. They include two species of wattled bat, two species of long-eared bat (one of which—Nyctophilus sherinni—is endemic), three species of forest bat, and the eastern falsistrelle.

Tasmania's bats are generalist insectivores whose hunting techniques and feeding areas vary between species. Long-eared bats use their well-developed ears to pinpoint prey. Like other bats they also have well-developed echolocation which they use when gleaning insects from the forest floor or foliage. In contrast, forest bats fly with speed and agility and usually feed on flying insects.

Tasmania's bats do not migrate but hibernate during winter, usually in tree hollows, and more often than not in small colonies. They also roost in roofs and under the eaves and ledges of buildings. All species have 1–2 young in late spring or early summer. The young are usually left at the roost while the mothers forage. One species, the Goulds wattled bat, carries its twins while foraging. Bats put a vast amount of energy into their offspring and produce the largest young of any mammal relative to adult size. Young bats are often 25–30% of the mothers' weight at birth; a newly born human is about 6% of its mothers' weight.

Agricultural and forestry activities that lead to the loss of foraging habitat and roosting sites (i.e. tree hollows) are likely to affect the distribution and abundance of bat species.

THE BENEFITS OF BATS

Insectivorous bats burn up huge amounts of energy when flying and when keeping their bodies warm while resting during the day. As a general rule, when actively foraging, bats eat half their body weight in insects each night; lactating females can eat as much as their whole body weight on occasions! Thus an 8 gram bat could eat 4,000 mosquitoes in a night.

Most insectivorous bats are generalist insect predators that eat whatever happens to be in abundance. The number of insects eaten depends on the size of the bat and the size of the prey. Surveys in Victoria have found that insects that are considered pest species make up 80% of bats' diet at certain times of year. Colonies of bats living in old paddock trees are very beneficial to farmers, as well as being fascinating little animals.

BIRDS

The black currawong is one of Tasmania's twelve endemic bird species.

There is hardly a place on Earth where birds do not occur. Since evolving from their reptilian ancestors 160 million years ago birds have adapted to live in almost every conceivable habitat. But despite their remarkable adaptive abilities many birds have been unable to evolve quickly enough to contend with the rapid changes brought about by human activities. Many of the world's bird species are now threatened with extinction and Australia's birds are no exception.

Tasmania has approximately 212 species of resident or regular visitors including 12 endemic species, 2 breeding endemics and many endemic sub-species. (In comparison, Victoria has no endemic species and South Australia has only one.) Of these, about half (108) are seabirds with the remainder being terrestrial passerines and non-passerines. (See p.19)

Tasmania has only about one quarter of the bird species found in equivalent areas in Victoria and some familiar and widespread mainland species such as magpie-lark, willie wagtail, sitellas and treecreepers are absent. Nevertheless Tasmania's bird fauna is of great interest because of the high percentage of endemic species and sub-species that have evolved in isolation and adapted to fill the foraging niches left vacant by the absence of these birds.

ENDEMIC BIRDS

Tasmanian native-hen
green rosella
forty spotted pardalote
Tasmanian scrubwren
scrubtit
Tasmanian thornbill
dusky robin
yellow wattlebird
yellow-throated honeyeater
strong-billed honeyeater
black-headed honeyeater
black currawong

BREEDING ENDEMICS

swift parrot and orange-bellied parrot seasonally cross Bass Strait to breed only in Tasmania
shy albatross
royal penguin (Macquarie Island)

DISTRIBUTION

To survive birds must have an adequate food supply, suitable nesting habitat and the opportunity to find a mate. Climate indirectly limits their distribution because it affects food supply. Excessive cold may limit the production of flowers, or fruits; snow may cover terrestrial food; and many invertebrates are inactive in winter.

In Tasmania the vegetation mainly determines bird distribution. However, given its rugged topography, a mosaic of different vegetation communities can occur over a very small area depending on local conditions of soil type, drainage and aspect. For example the structure or composition of the vegetation on a north-facing slope can be markedly different from that of the south-facing slope of the same hill. Many larger covenanted properties are likely to encompass more than one vegetation community which will cater for the complex habitat requirements of many different bird species.

There is a correlation between the structure (or layers) of vegetation and the total number of bird species present. Therefore, those areas with a complex vegetation structure, such as forests, usually have more bird species than heathlands or buttongrass plains that have fewer layers of vegetation.

HABITATS

In Tasmania eucalypt forests and woodlands with many different layers of vegetation (i.e. ground layer, understorey shrubs and mid storey and canopy trees) generally support more bird species than habitats with only one or two layers.

Several different species of trees of various ages and heights provide foraging and nesting sites on their vertical and horizontal surfaces. Different layers of understorey shrubs and various ground cover plants, including grasses and saggs, provide numerous resources for a variety of birds that spend most of their time on or near the ground. Fallen branches, logs, rocks and a litter layer of bark and leaves are also important because they provide nest sites, nesting material and different niches for insects, spiders and other invertebrates which in turn form part of the diet of many birds.

Most forest birds do not have very specific habitat requirements and will occur in both dry and wet forests. However, some species including spotted quail-thrush, common bronzewing and musk lorikeet are more often encountered in the dry forests and woodlands of the east of the state and olive whistler, bassian thrush and pink robins prefer areas with a dense, wet understorey that are found within both wet and dry forests.

There is a smaller variety of birds in treeless heathland and grassland with their simple vegetation structure. Striated fieldwren and southern emu-wren are found mostly in heathlands, the latter now restricted to areas in the southwest. The shy secretive ground parrot favours areas dominated by buttongrass. A greater variety of bird species occur in heathlands or grassland areas that are fringed or interspersed with patches of eucalypts.

scarlet robin (female)

Tasmanian thornbill

A DISTINCTIVE NEST

The grey fantail builds a neat nest of grass, moss sporophytes, bark, other plant fibres and spiders' web.

The goblet-shaped nest is usually attached with cobweb to a horizontal or sloping branch.

The cup of the nest in the photo is lined with moss sporophytes (see page 77).

Grey fantails nest in understorey shrubs and small trees. Male and female share the nest building, incubation and feeding of young.

Parent crescent honeyeaters return regularly to feed the chicks they keep well-hidden in dense understorey.

FOOD

Most birds have particular feeding niches. This minimises competition for resources and allows many different species to coexist within a given area.

The foliage of eucalypts is high in nutrients and is eaten by numerous insects, especially scarab and leaf beetles, moth larvae, sawfly larvae, stick insects and sap-sucking bugs. Many insects associate with specific plants for food or habitat so a different assemblage, including longicorn beetles, weevils, sap-sucking bugs and moths, is found on silver wattles. Predatory insects and spiders find rich pickings among the foliage, and all these invertebrates are important food for birds such as whistlers, honeyeaters, cuckoo-shrikes and thornbills.

LERP, MANNA, HONEYDEW AND NECTAR

Lerp (a sugary secretion that forms a protective cover over psyllid insects), manna (a sugary substance produced by eucalypts in response to insect attack) and honeydew (produced by sap-sucking insects) are sometimes a more abundant source of high-energy food than nectar. They provide food for honeyeaters and pardalotes.

In certain seasons, wattlebirds, lorikeets and some nectarivorous honeyeaters, especially eastern spinebills, crescent honeyeaters and New Holland honeyeaters are attracted to the rich nectar of eucalypts, banksias, correas and epacrids. Larger birds such as wattlebirds and New Holland honeyeaters often aggressively defend a productive food source and will chase away smaller birds.

The predominantly nectar-feeding honeyeaters, especially crescent honeyeaters, yellow wattlebirds and eastern spinebills, are highly nomadic, travelling seasonally in search of flowering shrubs. They are important pollinators of many of our native plants and in many cases, viable seeds are not produced unless flowers are visited by these birds.

BARK DWELLING INVERTEBRATES

In spring numerous insects, spiders and other invertebrates hide under the bark of certain eucalypts. After the bark peels in summer, they move to the base of the trees or to the ground where they spend the winter hidden in the accumulated bark. There is a corresponding shift in the foraging behaviour of birds that search for prey in the bark. For example, Grey Shrike-thrushes spend more time foraging on the branches during spring, but probe the bark on trunks during late summer. Throughout the year they find numerous insects when searching among logs and litter on the ground.

pseudoscorpion

Strong-billed honeyeaters and yellow-throated honeyeaters also spend most of their foraging time searching for invertebrates by probing at the bark on trunks and branches.

LERP

Psyllids are sap-sucking insects in the order Hemiptera. They exude a sugary substance that hardens to form a protective covering called lerp. Lerps are carbohydrate rich, high-energy food that are defended aggressively by honeyeaters, especially when few plants are flowering. They are important food for pardalotes and honeyeaters.

GROUND FORAGING BIRDS

A variety of birds search for insects on the ground or in low understorey shrubs. Different species have slightly different foraging methods and feeding niches. This minimises competition between species, although there may be some overlap in the colder months when invertebrates are scarce.

The endemic Tasmanian scrubwren is a year round ground forager, and only occasionally feeds in low shrubs. It changes its foraging methods depending on the season. During winter it takes insects from the surface of the litter but it probes deeper into this layer in summer.

Superb fairy-wrens search for insect food on the ground and fallen logs during winter but feed more often on foliage in the understorey during summer.

ROBINS

Tasmania is home to four species of robin. Three species, the flame, scarlet and pink robins have brightly coloured males, with females and immature birds predominantly brown. The endemic dusky robin is a plain brown bird and is slightly larger than the other three species.

Robins have complex seasonal requirements for their breeding and post breeding habitats. Flame and scarlet robins often occur together but the flame generally prefers wet forests and will move to higher altitudes to breed. Pink robins breed in wet gullies and rainforests but like the other two, will move into drier more open areas after breeding. A proportion of the population of flame robins crosses Bass Strait in autumn.

All robins feed on invertebrates that are taken mostly from the ground although they change their foraging strategies depending on the availability of food. In summer, for example, when invertebrate food is more abundant scarlet robins spend more time snatching insects from the foliage and branches of trees while dusky robins mainly forage on the trunks and branches. All robins hawk insects from the air during the warmer months.

SEEDS

Seeds are only available seasonally so seed-eating birds take other food items when this resource is scarce. Many seeds that are eaten by birds pass through their gut unharmed. Acids in the gut can assist with germination. Seed eating birds are important for spreading seeds away from parent plants.

dusky robin

Flame robins move to warmer coastal lowland areas in autumn.

Tasmanian scrubwren usually keep well hidden in understorey vegetation.

beautiful firetail

Common bronzewing, predominantly found in wet forests, and brush bronzewing of drier areas, forage on the ground where they find seeds of acacias, other legumes and fruits of native cherries Their deep 'oom' call, monotonously repeated during the daytime in spring is often erroneously thought to be that of an owl.

Of the three seed-eating finches that occur in Tasmania two are introduced. European goldfinches and European greenfinches feed mostly on the seeds of thistles and other weeds, while Tasmania's only native finch, the beautiful firetail, feeds on the seeds of she-oaks, grasses and other trees and shrubs.

Roaming flocks of yellow-tailed black cockatoo supplement their diet of wood-boring cossid moth larvae with seeds of banksia, pine trees, *Eucalyptus, Acacia, Allocasuarina*, and *Hakea* species.

green rosella

Blue-winged parrots feed quietly on the ground in pairs or small flocks, and are particularly fond of the seeds of wallaby grasses, silver grass and sundew.

Seeds of grasses, shrubs and trees are a major component of the diets of eastern rosellas and green rosellas. Eastern rosellas take mainly herb and grass seeds when feeding on the ground; green rosellas feed on seeds in trees and shrubs. The hard woody seed capsules of eucalypts are available throughout the year but are only eaten by the green rosella.

The spores of treeferns (*Dicksonia antarctica*) are also eaten by green rosellas and the ground under these plants is often festooned with the damaged fronds.

PASSERINES AND NON PASSERINES

Passerines are known as perching birds because of the shape of their feet: all passerines have three toes pointing forward and one back with ligaments arranged so that the foot locks on to a perch when the bird perches or sleeps.

Lots of non-passerines have three toes forward and one back, but they are shaped differently to those of passerines to suit their particular lifestyle. For example, swans, ducks and gulls have webbed feet; cormorants and pelicans have totipalmate feet (i.e. with all four toes connected by webbing); wading birds usually have long toes. Parrots and cockatoos have zygodactylous feet: i.e. two toes pointing back and two forward.

Passerines are also known as song birds because the complex muscles in their syrinx (their vocal organ equivalent to our larynx) enable them to sing elaborate songs that, to our ears at least, are more melodious than the utterings of non-passerines. Some non-passerines have varied vocal repertoires and sing melodiously but many simply grunt, honk, whistle or quack.

NEST SITES

Most birds not only have specific foraging niches, many also have very specific nesting requirements both when locating their nests and in the nesting materials they use. Fifteen species of forest and woodland birds require tree hollows for nesting and roosting. Approximately one third of bush birds nest in the understorey where they especially favour areas with prickly or dense shrubs that provide protection from predators. Some birds, including the satin flycatcher and black-faced cuckoo-shrike almost always nest on horizontal branches that are a feature of mature trees.

The migratory satin flycatcher builds its nest on a horizontal dead branch, 5-25m high under live foliage. Bark strips and moss are tightly bound with spiders' web. Its small neat nest is beautifully disguised to match the colour of the limb. Another summer migrant, the black-faced cuckoo-shrike, prefers a horizontal forked branch beneath the canopy where it builds a shallow saucer-shaped nest of twigs and bark strips, also bound with spiders' web and camouflaged with lichen. This bird eats a significant number of large insects and spiders from the ground or foliage.

Diminutive brown thornbills are constantly on the move, searching the feathery foliage of wattles or the shedding bark of eucalypts for tiny invertebrates. Their untidy nest made of bark shreds, grass, spiders' web, spiders' egg sacs and moss is hidden close to the ground in tussock grass, saggs or bracken.

Unlike brown thornbills, yellow-rumped thornbills feed mostly on open ground adjacent to clumps of trees where they seek shelter. They are one of the few native birds that occasionally nest in introduced trees such as pines. Their nests are often located near a magpie's nest, and they may benefit from this proximity. When breeding, magpies are extremely vigilant at keeping birds of prey away from their young, perhaps also providing protection for the thornbills.

The striking colours of one of our most beautiful bush birds, the male golden whistler, are seldom seen and often the only indication of its presence is its rich, melodious song.

To avoid competition for resources the male golden whistler searches for invertebrates higher in the vegetation than the plain brown female, and more often on eucalypts than other plants, such as acacias. Golden Whistlers feed by acrobatically flying between the foliage, deftly snatching insects from the surfaces of leaves. Their nest is a deep bowl of twigs, bark, leaves and coarse grass, usually situated amongst dense vegetation not more than four meters above the ground.

RAINFORESTS AND WET FORESTS BIRDS

The temperate rainforests of Tasmania are usually dominated by just one or two tree species with little or no understorey. They have fewer bird species than the adjacent eucalypt forests, but have some habitat specialists such as pink robin, bassian thrush and the endemic scrubtit. Other species that are commonly seen in rainforests include the widely roaming yellow-tailed black cockatoo, the Tasmanian thornbill and Tasmanian scrubwren.

recently fledged scarlet robin

golden whistler (male)

golden whistler (female)

Cuckoos

A Tasmanian scrubwren attends to an immature fan-tailed cuckoo that's about twice its size.

shining bronze-cuckoo

All four cuckoos in Tasmania are migratory. After arriving in about mid September they sing repeatedly to attract a mate. Fan-tailed and pallid cuckoos often sing from an exposed perch such as a dead branch, power line or fence: the fan-tailed sings a mournful descending trill, the pallid an octave of rising microtones.

The iridescent green shining bronze-cuckoo usually keeps well hidden in dense wet vegetation, its incessant singing the only indication of its presence. The Horsfield's bronze-cuckoo closely resembles the shining bronze-cuckoo but is usually found in drier vegetation communities or close to coastal areas.

Cuckoos have a particular liking for hairy caterpillars that most other birds find distasteful and avoid. This is because caterpillars have a number of defences that makes them unpalatable. Firstly, toxins from their food plants accumulate in their bodies; and secondly, many are coated in hairs, some of which are urticating. Urticating hairs (like those on stinging nettles *Urtica* spp.) come in two types: some are tubular and contain venom which is injected into the unwary; others simply break off and are small enough to penetrate clothing or skin and cause irritation (something akin to handling fibreglass insulation).

The four cuckoos that breed in Tasmania are brood parasites. They lay their eggs in the nests of other birds and leave the rearing of young to the foster parents. Horsfield's and shining bronze-cuckoos use the nests of thornbills, fairy-wrens, scrubwrens, flycatchers, silvereyes or honeyeaters; pallid cuckoos use the nests of honeyeaters, flycatchers, woodswallows or cuckoo-shrikes; fan-tailed cuckoos lay their eggs in the domed nests of fairy-wrens, thornbills or scrubwrens and sometimes in the cup nests of honeyeaters and flycatchers.

Before laying eggs the unobtrusive female cuckoo will closely watch the nest building activities of a potential host and memorise the locations of the nests in an area. While the conspicuous male cuckoo sings loudly and distracts the chosen host, the female will fly to the nest, remove the host's egg and lay (or place) one of her own. Unlike most birds whose egg laying can take minutes, she can lay her egg (which has evolved to closely resemble the hosts' eggs) in seconds. After hatching, the cuckoo chick will use its flattened back to eject any other eggs or chicks that are in the nest.

Cuckoos and hairy caterpillars

Cuckoos like hairy caterpillars! They cope with the caterpillars' gut contents by first biting off their heads then shaking them about or bashing them on a branch to expel the toxic innards. After this the caterpillar is swallowed whole – hairs and all. The caterpillars' hairs form a felted mat on the cuckoos' stomach lining which they eventually expel as a pellet.

PARDALOTES, EUCALYPTS AND LERP

As regular as clockwork flocks of tiny striated pardalotes return from their winter sojourn along the Great Dividing Range in Queensland and New South Wales to join the resident pardalotes, the beautifully coloured "diamondbird" or spotted pardalote and the endangered endemic forty-spotted pardalote.

spotted pardalote (male)

Pardalotes, at just 8-10 cm long, are among the smallest forest birds and although frustratingly difficult to see, their incessant contact calls reveal their presence as they search for invertebrates amongst the canopy foliage of eucalypts. Pardalotes have evolved stubby, partially notched bills for pecking psyllid insects and lerps off leaf surfaces; thus they fill a specialized feeding niche, a specialization that has driven one species to the edge of extinction.

Psyllids are sap-sucking insects in the order Hemiptera. They exude a sugary substance that hardens to form protective coverings called lerps. As lerps are found mostly on eucalypt leaves, pardalotes are rarely seen where these trees don't occur. By targeting psyllids, which sometimes form large infestations, pardalotes rid eucalypts of insects that can cause defoliation, tree decline and eventual death, particularly if trees are stressed by other factors such as drought.

forty-spotted pardalote

The three pardalote species will often forage together in the canopy foliage probably targetting the same food resource. However, they usually select slightly different habitats: forty-spotteds prefer relatively unmodified forests, spotteds cope with some disturbance while striated pardalotes show no preference. Competition for resources is further reduced because they usually hunt in different regions of the trees and use different foraging techniques.

Spotteds are the smallest and lightest pardalote. They have more rounded wings, are more agile and hover more when foraging. The longer striateds prefer to forage higher in the canopy, often stretching to reach leaf extremities while perched on twigs. Forty-spots employ similar foraging methods to the larger striateds which harass them where they co-occur.

striated pardalote

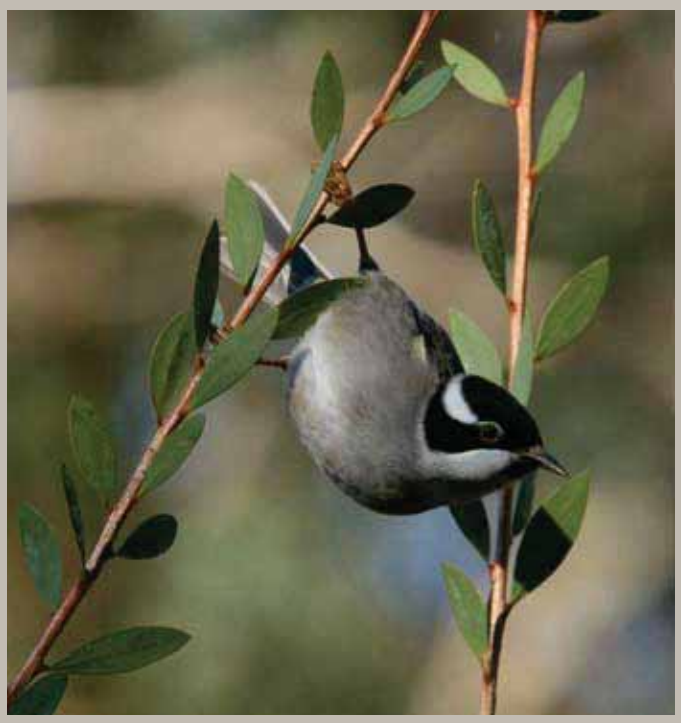
Forty-spotted pardalotes were once locally common in the north and east but are now restricted to coastal south-eastern regions, particularly Maria and Bruny Islands. They are closely associated with white gums (*Eucalyptus viminalis*) and the clearing of extensive tracts of white gum forests is probably the main reason for their decline. Further threats include firewood collecting, continued modification of suitable habitat and competition with striated pardalotes and honeyeaters. The recent prolonged drought adversely affected white gums and the forty-spotted pardalotes have declined alarmingly in the past decade.

Lerps are carbohydrate rich, high-energy food defended aggressively by honeyeaters, especially when few plants are flowering. Competitive interactions are energetically costly for pardalotes and may have driven them to nest in cavities. Spotteds excavate a tunnel in loose soil, sometimes inconveniently in piles of topsoil, gravel or compost in the process of being moved. Forty-spotteds nest in hollows in trunks, branches, stumps, fence posts or fallen wood and occasionally in wall crevices or banks. Striateds usually nest in tree hollows but steep banks, particularly river banks, ceiling cavities and even tractor exhaust pipes can prove suitable. Successful nesting sites are reused in consecutive years with generations of striateds known to return to the same cavities for more than 50 years.

Birds with narrow feeding niches are disadvantaged by their specialization. Lerp-forming psyllids are found only on eucalypts and outbreaks of lerps are seasonal and unpredictable. The clearing and fragmentation of lerp rich forests has contributed to the decline of one pardalote species in Tasmania. The further loss of eucalypt forests may threaten the long-term viability of the two remaining species.

THREE ENDEMIC HONEYEATERS

black-headed honeyeater



strong-billed honeyeater

yellow-throated honeyeater

The strong-billed honeyeater, black-headed honeyeater and yellow-throated honeyeater often co-exist in an area. However, they have slight variations in the size of their bills, claws and wings which enables them to search for invertebrates in different parts of the tree, thus minimising competition for food.

The strong-billed honeyeater has highly curved claws and longer feet than the other two honeyeaters. It can cling to vertical surfaces where it searches for food by probing and tearing at the bark with its long, deep bill. The black-headed honeyeater has a short bill suited to foraging on the surfaces of foliage, short claws for gripping on small perches, such as leaf stalks and twigs, and longer wings adapted to manoeuvrable flight. The ubiquitous yellow-throated honeyeater is a more generalised feeder that has no particular specialised features.

The three honeyeaters have different social systems. The male yellow-throated honeyeater is a large bird that aggressively defends local resources. The strong-billed and black-headed honeyeaters are colonial breeders. In the non-breeding season, they often form small, nomadic flocks that invade the territory of the yellow-throated honeyeater, and plunder its resources.

The strong-billed and black-headed honeyeaters nest high in pendant foliage and in the subcanopy. The yellow-throated honeyeater nests near the ground in small shrubs and tussocks. All three species use similar nesting materials: shreds of bark, grasses, leaves, spider webs, tree-fern fibres, fur and hair. The yellow-throated honeyeater—like its mainland cousin the white-eared honeyeater—has been seen taking hair from human heads!

OPEN PASTURE AND GRASSLAND BIRDS

At the time of European settlement, the masked lapwing was uncommon and restricted to small areas of natural grassland. Land clearing and pastoral development increased suitable habitat and resulted in an increase in its numbers.

The cattle egret was first recorded in Tasmania in 1965. It was originally a native of southern Europe, Africa and Asia, but it has expanded its range worldwide, and is now a common winter visitor to Tasmania.

These and other ground-foraging birds, such as the Australian magpie, forest raven and sulphur-crested cockatoo, feed on invertebrates, such as scarab beetles, molluscs, worms, millipedes, spiders, beetles, caterpillars and grasshoppers, that have the potential to become pests in agricultural areas. For breeding populations to flourish, these birds need shelter and nesting sites in nearby bush.

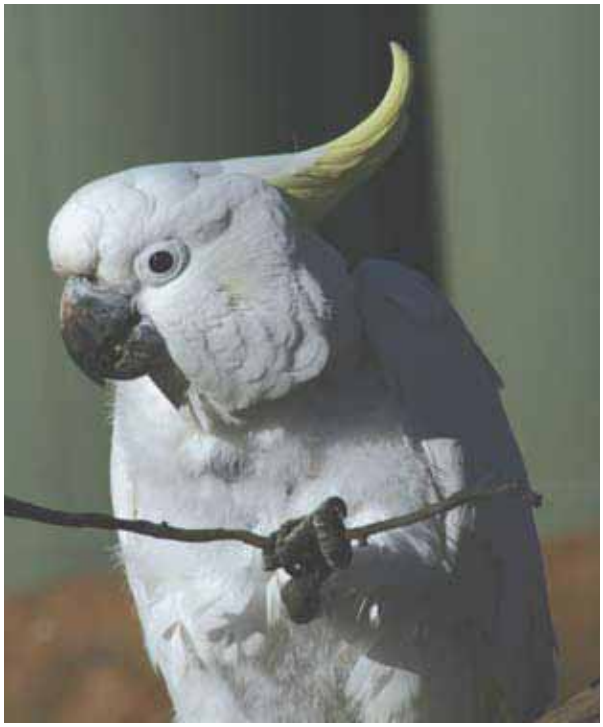
Other birds seen frequently in pastures include white-faced heron, which hunt for invertebrates, frogs and reptiles; the endemic and flightless Tasmanian native-hen, a grazing bird that feeds almost exclusively on green leafy vegetation; and the banded lapwing.

Masked lapwings nest in open pastures, roadsides, school playing fields and urban parks.

SULPHUR-CRESTED COCKATOO

Contrary to popular belief, sulphur-crested cockatoos occurred naturally in Tasmania. They were (and still are) absent from the drier east coast region and were patchily distributed in the remote rainforests, sedgeland plains and wet forests in the west. There were occasional flocks in the midlands including at Ouse and Epping Forest. Since European settlement cockatoo flock sizes have increased dramatically demonstrating the ability of some birds to thrive in the human-altered landscape.

Clearing forests favours some birds and disadvantages others. Sulphur-crested cockatoos nest in tree hollows and feed on open ground. Whereas once winter was a lean time that would limit population growth, the year-round availability of grain from cattle feedlots and agricultural land is a factor in their proliferation.



sulphur-crested cockatoo

Although parrots and cockatoos are similar and both are in the order Psittaciformes, there are significant differences which place them in separate families.

Like parrots cockatoos have strongly-curved bills powerful enough to crack seeds, dig for insect larvae and bulbs, and tear at wood. Their grasping zygodactylous feet (i.e. with two toes pointing forward and two back) are used like hands for feeding and climbing.

Cockatoos (including galahs and corellas) differ from parrots in several respects. Their heads are adorned with moveable crests that are raised and lowered to indicate alarm or excitement. They have a gall bladder which parrots lack. Their powder downs, down feathers that grow continually rather than being lost through the normal moulting process, occur in patches rather than being scattered through the plumage as in parrots. The tips of powder downs break off to produce a fine, talcum powder-like substance with which the birds preen and waterproof their feathers.

Cockatoos are not colourful like parrots because their feathers lack "dyck-texture" a structural element (rather than a pigment) that gives parrots their characteristic colours of blues and greens. Instead cockatoos are

predominantly black or white. The black cockatoos have patches of red or yellow; the white birds are suffused with shades of pink or pale lemon. Galahs are pink and grey.

The earliest known fossil of a cockatoo was found in deposits from the early Miocene (23 mya) at Riversleigh in north-west Queensland reinforcing Australia as the centre of cockatoo evolution. Australia is also the centre of cockatoo distribution; fourteen of the eighteen known species occur in Australia with the remainder found in nearby countries including Indonesia, the Philippines and Papua New Guinea.

The presence of noisy miners usually indicates ecological imbalance.

NOISY MINERS

Noisy Miners are native honeyeaters that live colonially in family groups. They prefer open country with scattered eucalypts or areas of bush with little or no understorey and have been favoured by management regimes that involve the clearing and fragmentation of the bush and/or burning and grazing that eliminates understorey. They constantly bicker amongst themselves, are extremely territorial and hostile to intruders in their territory and will aggressively exclude (and sometimes kill) smaller birds such as pardalotes and other honeyeaters. The birds they either tolerate or that can withstand their pugnacious nature include larger species such as grey butcherbird, laughing kookaburra, Australian magpie, forest raven and eastern rosella. Striated pardalote occasionally survive in miner-dominated areas because, as a cavity nesting species, they can retreat to their nesting hollows to avoid the miners' onslaughts.

Unlike most other bush birds noisy miners are generalist rather than specialist feeders. They forage on the ground, on trunks and branches and in the shrub layer or canopy. In contrast, the birds they exclude are the smaller species with specific feeding niches. They consume numerous leaf-eating invertebrates that left unchecked can sometimes defoliate the trees. Not only do miners colonise degraded farmland, but they cause further deterioration in the health of trees by excluding insectivorous birds.

Noisy miners are associated with dying eucalypts and an absence of other insectivorous birds. Mainland studies have also shown that when noisy miners are removed from remnant bush, other honeyeaters quickly colonise the sites, small insectivorous species return within weeks and the health of the eucalypts eventually improves.

Many areas of bush have been managed in ways that have had adverse impacts on birds. But if given the chance to regenerate naturally, it is likely that the structural diversity of the vegetation will improve, noisy miners will no longer be favoured and small insectivorous birds will get a chance to re-establish.

MIGRATORY BIRDS

Of Tasmania's land birds, 15 (plus the two breeding endemics, the orange-bellied parrot and swift parrot) undertake regular seasonal migrations across Bass Strait.

striated pardalote
silvereye
grey fantail
pallid cuckoo
fan-tailed cuckoo
shining bronze-cuckoo
horsfield's bronze-cuckoo
blue-winged parrot
swamp harrier
tree martin
welcome swallow
satin flycatcher
black-faced cuckoo-shrike
dusky woodswallow
Australasian pipit

WATERBIRDS

Australia's variable and unpredictable climate of droughts interspersed with wet seasons influences the movement, habitat use and breeding of many waterbirds.

Australasian grebe

Local populations of the Pacific black duck, chestnut teal, Australian shelduck, black swan, hoary-headed grebe and Australasian grebe are boosted when the mainland experiences exceptionally dry conditions. Less common species, including the Australasian shoveler, hardhead and great-crested grebe, also seek refuge in Tasmania during these times.

GREBES

Grebes are distinctive waterbirds that frequent farm dams and other waterways. Their legs are placed so far to the rear of their bodies that they are virtually incapable of functioning on land. They are supremely adapted to their aquatic lifestyle. They are excellent swimmers and use their lobed (not webbed) feet to propel themselves underwater when they're chasing prey.

The sight of grebes on newly made lakes and dams attests to their ability to fly long distances, something they usually do under the cover of darkness to avoid predators.

Grebes have several intriguing strategies to cope with disturbance. Sometimes they slowly sink, deflating their internal air sacs and squeezing out the air trapped in their feathers. This reduces buoyancy and allows them to submerge until just their heads are visible. Alternatively they quickly dive, only to re-emerge many meters from where they disappeared, and often in the cover of aquatic vegetation.

If they do resort to flying, something they seem reluctant to do, they first skitter across the water with their toes acting like mini hydrofoils, before their fast flapping wings lift their bodies just above the surface.

Grebes have often been observed eating feathers or offering feathers to their chicks. The reason for this strange practice has long remained a mystery but it is now believed to be related to the production of pellets; small packages of indigestible material that the birds regurgitate.

The pellets of grebes, which feed mainly on fish, crustaceans, tadpoles and insect larvae, consist mostly of plant material and the birds' own feathers. A grebe's stomach has strong acids that can dissolve fish bones. The indigestible plant material and feathers possibly help to retain the bones in the stomach while they are being processed. The indigestible substances that surround the sharp-edged bone fragments may also help prevent injury to the stomach as they are being dissolved or damage to the oesophagus during regurgitation.

All three grebes that occur in Australian are found in Tasmania. Hoary-headed grebes, so called because of the white streaky feathers that adorn their heads during the breeding season, are the most frequently encountered and can be seen on farm dams, lakes and lagoons. The small Australasian grebe or 'dabchick' and the great crested grebe have increased in the past decade since first being recorded breeding here in 1965 and 1971 respectively.

Part of the large flock of wood duck that crop the grass at Waratah.

AUSTRALIAN WOOD DUCK

Wood ducks (also called maned goose) were rare in Tasmania before the 1970s. They occasionally dabble, particularly on the edge of dams where they ingest grit. However, being a goose-like bird means they graze almost exclusively on vegetation. The provision of farm dams adjacent to rich pasture where they find abundant food is undoubtedly a major factor in their increase.

grey goshawk

massive stick nest of wedge-tailed eagle

tawny frogmouth

RAPTORS (BIRDS OF PREY)

Raptors are birds of prey with keen eyesight, hooked bills, and sharp and powerful claws. They hunt mainly live prey, such as small mammals, birds, reptiles and invertebrates. Some also eat carrion.

Tasmania has 10 resident diurnal birds of prey. The swamp harrier is our only migratory species. Three species, the wedge-tailed eagle (the fourth largest eagle in the world), white-bellied sea-eagle and grey goshawk, are endangered because of habitat destruction and persecution by humans.

The pure white morph of the grey goshawk occurs in Tasmania. Consequently, it is often called the white goshawk.

Female raptors are usually larger than males of the same species and they take different-sized prey. For instance, the female grey goshawk hunts for rodents, ringtail possum, rabbits and birds such as rosellas and bronzewings. The smaller male preys on smaller birds, rodents and insects.

Introduced species, such as starlings, sparrows, rabbits, rats and mice, form most of the diet of raptors in areas where native animals have declined. As a result, raptors have an important role in controlling the numbers of these species. Raptors also keep prey populations healthy by taking deformed, weak and old individuals. Some also clean up animal carcasses.

WEDGE-TAILED EAGLE NEST SITES

Wedge-tailed eagles nest in sheltered forests with a minimum area of 10 hectares. They build massive stick nests lined with fresh foliage in the forked branches of old-growth trees that are greater than 27 metres high, The nests are usually located in east facing gullies that are sheltered from cold south westerly winds.

Long term pairs often alternate between several nests in their traditional territories.

NOCTURNAL RAPTORS

Tasmania has four regularly occurring nocturnal raptors: the masked owl, tawny frogmouth, Australian owlet nightjar and southern boobook; the barn owl is occasionally recorded here. Nocturnal birds have developed three remarkable traits that enable them to function in the dark. Owl eyes absorb 100 times more light than human eyes. For them, the darkest night is like early dusk, and dusk is like bright daylight. Their hearing is equally acute. They have large ear openings situated near the facial discs, and flaps of skin on each side of their head. These features direct sound to the inner ears, amplify it and enhance the birds' ability to determine its direction. Owls have wings that are large and broad in relation to their weight. They move silently due to their slow flight and soft velvety feathers.

BIRDS OF SANDY SHORES, ROCKY COASTS AND ESTUARIES

The increasing use of all-terrain vehicles is contributing to the decline of beach-nesting birds, especially the hooded plover, fairy tern and little tern. These birds are particularly vulnerable to disturbance while breeding. Many are now only able to complete their breeding cycles in coastal areas in the more remote parts of Tasmania.

Oystercatchers are also vulnerable to disturbance, especially the pied oystercatcher, which locates its nest above the high-tide mark on sandy beaches. The black-plumaged sooty oystercatcher, with its bright-red bill and legs, is often found on remote, rocky shores and offshore islands.

Gulls and terns inhabit coastal areas, rivers and lakes. The Pacific gull is the largest of the group. The adults are large white birds with black backs and a large, red bill. Immature (less than four years old) Pacific gulls have mottled brown plumage.

The largest tern in the world, the Caspian tern, has a large, red bill. Like other terns, it patrols stretches of water and hovers before diving for prey. Terns have slimmer bodies than gulls, and are mostly white with black caps. The crested tern is slightly smaller than the Caspian tern, and is Tasmania's most common tern. It is about the size of a silver gull and can be distinguished from the Caspian tern by its yellow bill.

Cormorants are distinctive all black or black and white birds that capture their prey by hunting and fishing underwater. The little pied cormorant occurs throughout Tasmania from coastal areas to highland lakes, and is the most commonly encountered cormorant. The similar black-faced cormorant is mostly marine and is more likely to be seen in coastal areas. The great cormorant and little black cormorant are nomadic species that travel in response to the availability of food.

The most common way for animals to cool off is by the evaporation of water from the skin's surface (e.g. sweating or panting) which cools the blood. But birds do not have sweat glands so they must get rid of excess heat by other means. Some birds open their mouths and pant, thus increasing the area of the skin exposed to cooling air.
Cormorants (such as this great cormorant), pelicans, owls and herons have a method of cooling called gular fluttering. They open their mouths wide and vibrate the thin gular membrane of the throat. This movement increases blood flow in the throat and exposes a large featherless area to air, which accelerates heat loss.

hooded plovers

pied oystercatcher

Liz Znidersic

bar-tailed godwit

MIGRATORY WADERS

Tasmania is an important destination for a remarkable group of birds known as migratory or Palearctic waders. Each spring, these birds leave their breeding grounds in Siberia, Alaska and Mongolia to fly 12,000 kilometres to Australia. They spend the Australian summer foraging in areas rich in invertebrates. This enables them to build up their fat reserves in preparation for the long journey back to the Northern Hemisphere in autumn.

Fourteen species of Palearctic waders are seen regularly at various sites in Tasmania including Moulting Lagoon, Pitwater, and East Inlet near Stanley. Another 16 have been recorded occasionally. Large numbers congregate to feed on coastal mudflats especially in the far northwest between Stanley and Woolnorth. A few species, including the sharp-tailed sandpiper, are also seen along the shores of inland lakes and lagoons.

The smallest of the migratory waders, at 13-16 cm, is the diminutive red-necked stint, which uses its short, stout bill to probe for small invertebrates along the water's edge. The largest, at 60-65 cm, is the spectacular eastern curlew, which uses its long, down-curved bill to probe deeply into wet mud for worms, crustaceans and molluscs.

caspian tern

crested tern

The Lathams snipe is unlike the other waders. It breeds in Japan and forages in non-marine habitats. It is often found on private properties in low-lying wet tussock grasslands and swamps, and along the edges of freshwater lagoons. It is an unmistakable bird with short legs, a long straight bill and high-set eyes. Like other waders, its bill is equipped with a sensitive tip that enables it to locate and seize prey underground. Its eyes are set to the back and top of its head, which gives it extensive binocular vision. This enables it to probe the ground for food, and watch for overhead predators at the same time. Its large eyes are indicative of its nocturnal activities, as it frequently forages and travels at night.

silver gulls

FROGS

A brown tree frog (Litoria ewingii) climbs a window on a rainy night.

All native frogs require damp environments in which to live and breed. However, apart from this basic need the different species are found in a wide variety of places. Most native frogs move between quite different habitats during their lives so have very different requirements depending on whether they're breeding, feeding or over wintering.

The two most widely distributed and commonly encountered species are the brown tree frog and brown froglet, both of which are small and remarkably variable in colour. They are found throughout Tasmania from sub-alpine to coastal areas. They will attempt to breed in virtually any area of standing water.

Other species are more specialised, especially in their breeding requirements. Green and gold frogs, banjo frogs and striped marsh frogs favour large and deep areas of water to breed. Wetlands which dry out for part of the year are often very productive because of the constant recycling of nutrients. They generally provide the best breeding sites.

The chytrid fungus (*Batrachochytrium dendrobatidis* or *Bd*) has been present in Australia since about 1978 and was confirmed in Tasmania in 2006. It is thought to have originated in an African frog species that was widely used in laboratory experiments and was a favourite of the pet trade.

To prevent spreading the disease it is important not to collect and take home tadpoles, frogs or eggs. Frogs will quickly move into gardens of their own accord if suitable habitats are created.

TASMANIA'S FROGS

green and golden frog	southern toadlet
Burrow's tree frog (e)	southern banjo frog
brown tree frog	striped marsh frog
Tasmanian froglet (e)	spotted marsh frog
common froglet	southern smooth froglet
moss froglet (e)	

The common froglet (Crinia signifera) is one of the most widespread frogs in Tasmania.

southern smooth froglet (Geocrinia laevis)

Brown tree frogs are variable in colour but the dark line through their eye makes them easy to identify.

Southern banjo frog (Limnodynastes dumerilii) lays eggs in bodies of water such as dams and lagoons. The frogs bury themselves in the ground during summer and are often dug up in bush gardens.

John Simmons

The striped marsh frog (Lymnodynastes peronii) is restricted to the north, north east and King Island. It is also found on the Australian mainland.

Tasmanian froglet (Crinia tasmaniensis)

WHAT HAPPENED TO ALL THE GREEN AND GOLD FROGS?

Green and gold frogs (*Litoria raniformis*) are the most recognisable frog species in Tasmania. Sadly, they are probably more familiar to older members of the community who may remember seeing dozens or even hundreds of these frogs living in drainage ditches or crossing roads and invading backyards on rainy nights. Frog shooting was apparently a common holiday pastime in the 1940s and 1950s for children living around the Mowbray swamp (now the Heritage forest and Churchill Park sports complex) in Launceston. Until about the mid 1970s professional collectors targeted green and gold frogs to sell as dissection specimens to schools and universities. They could collect over 100 frogs per night by spotlighting.

Nowadays green and gold frogs are only occasionally encountered and have entirely disappeared from some areas where they were once common. As well as the activities outlined above, it is likely that the loss and degradation of habitat is a significant factor contributing to their decline.

Like most animals green and gold frogs require a number of different habitats during their lives. A network of small well vegetated ponds and drainage lines are used for foraging and sheltering, while large periodically inundated wetlands with areas of deep water are the best breeding sites. Many suitable wetland systems have been drained, filled in or changed into permanent water bodies. Well vegetated drainage lines and ponds surrounding these areas have been 'cleaned up' or otherwise altered. Messy overgrown drainage lines and paddocks that flood after a few days of heavy rain are important but fast disappearing habitats.

REPTILES

metallic skink (Niveoscincus metallicus)

Australia has a diverse reptile fauna with more snake and lizard species than the rest of the world put together. The reptilian temperature-regulation system is particularly suited to the tropical and hot arid regions of the country. Tasmania has relatively few reptile species compared with similar-sized areas on the mainland. However, our eighteen lizards, including seven endemics, and three snakes are particularly interesting because of the strategies they use to overcome the difficulties posed by our cool moist climate. They are found in almost every terrestrial ecosystem in Tasmania.

Terrestrial reptiles are ectotherms (Gk *ectos*= outside; *therme* = heat). They regulate their body temperature by alternately basking in the sun and seeking shade. As a result, even if air temperatures are low they can function as long as sunlight is available. Some species warm themselves on sun-heated rocks and can remain active for several hours after dusk. Logs and rocks are important basking sites for many species. The three small and cryptic grass skinks are associated with tussocks and grasses.

Tasmania's three snakes and many of its lizards have adapted to the cold climate by giving birth to live young rather than laying eggs. Keeping the young in the body gives the mother more control over the incubation temperature, which increases the chances of survival. The three egg-laying species—the eastern three-lined skink, delicate skink and mountain dragon—are confined to warmer areas of the state.

The Bougainville's skink is peculiar in that it produces live young in Tasmania but its mainland population lays eggs.

Blotched bluetongues (Tiliqua nigrolutea) consume fungi, fruit (they have a particular liking for strawberries) and flowers.

Tasmanian tree skink (Niveoscincus pretiosus)

LIZARDS

All but one of the 18 lizard species in Tasmania belong to the family Scincidae, which are generally called skinks. In Tasmania, they range in size from the 45 centimetre long blotched bluetongue that has a robust cigar-shaped body and muscular legs, to the delicate skink which grows to ten centimetres. The she-oak skink is long and almost snake-like while the Bougainville's skink has an almost legless appearance.

The metallic skink is the most opportunistic and widespread of the lizards. The other species are more specialised in their habitat requirements. The tussock skink, for example, is found only in lowland open tussock grasslands.

All Tasmanian lizards eat insects. Several species also eat nectar and the soft fruits of some native plants.

The mountain dragon is one of the most distinctive lizards in Tasmania. It is our only member of the family of dragon lizards (Agamidae), a very diverse group on the mainland; Tasmania is the most southerly location of dragon lizards in the world. Mountain dragons rely on their beautifully camouflaged patterns and subtle colours to ambush prey and avoid detection. However, anecdotal evidence suggests that they have been eliminated from many areas, probably as a result of predation by kookaburras.

Despite their name mountain dragons can be found anywhere where suitable conditions occur. They prefer warm, sunny situations with lichen-encrusted rocks and leaf litter where they live on a diet of small invertebrates, especially ants.

The white-lipped snake (Drysdalia coronoides) is a specialised feeder on skinks.

The rock-dwelling ocellated skink (Niveoscincus ocellatus) lives near boulder fields, cliffs, rocky forests and coastal rock platforms.

SNAKES

tiger snake (Notechis ater) warms itself on an old log

The three species of snake in Tasmania, the Tasmanian tiger snake, lowland copperhead and white-lipped snake, are members of the family Elapidae, or front-fanged snakes, which include the death adder, taipan and cobra. All three are venomous (the first two are potentially fatal) but they are usually shy and retreat underground if disturbed.

The densest populations of snakes occur in fertile, ecologically productive areas, such as near waterways and wetlands. White-lipped snakes are found from sea level to alpine elevations, and, although rarely seen, are quite common in dry forest, scrub, coastal heath, alpine heath and tussock grassland. Tiger snakes, the most commonly encountered species, are found in virtually every habitat with a large enough prey population. Lowland copperheads are typically found around wetlands and farm dams, and in coastal heath. Despite the name, lowland copperheads are found in subalpine areas in Tasmania.

The diet of Elapid snakes consists entirely of vertebrate prey. White-lipped snakes are specialised lizard predators. The main prey items of lowland copperheads are frogs and other reptiles, including smaller members of their own species. The Tasmanian tiger snake is the most opportunistic feeder and will take reptiles, amphibians, nestling birds and small mammals. It feeds on large numbers of introduced rodents and is a common resident around old buildings and chicken coops where rat and mouse populations are large. Thus it performs a valuable service.

WHY REPTILES ARE IMPORTANT

Lizards provide important food for many animals, so their large numbers increase the ecological productivity of an area in summer. They also help to regulate insect populations that have the potential to become significant pests.

Snakes weed out the weakest members of prey species ensuring the populations remain robust. They are also major predators of introduced rodents.

LIVING WITH SNAKES

Snakes are usually—but not always!— more frightened of us than we are of them and will quickly move away if disturbed. However, children and pets often play in areas where snakes occur. A reptile rescue service with trained people who can catch and remove snakes from an area operates in all districts in Tasmania. (See page 91)

WHY THE SHE-OAK SKINK?

Common names of some animals can be confusing. You could assume that the name 'she-oak skink' (*Cyclodomorphus casuarinae*) indicates an affinity for the she-oak tree in the genus *Casuarina* (now *Allocasuarina*). But this is not so.

Often it's the Latin species name that is the clue to the origin of the common name. In the case of the she-oak skink, the species name *casuarinae* is similar to the previous Latin name of the she-oak tree, *casuarina*. In Latin, casuarina means 'like the drooping feathers of a cassowary' and alludes to the drooping foliage of she-oaks.

The first collected specimens of she-oak skinks were procured during the voyage of Nicholas Baudin, the French explorer who mapped the coast of Tasmania in 1801–02 in the schooner called The Casuarina. Thus, the skink was named after a schooner, not a tree.

The she-oak skink usually occurs in bush with dense undergrowth.

ENDEMIC SNOW SKINKS

northern snow skink (Niveoscincus greenii)

Three endemic species, the mountain skink, southern snow skink and northern snow skink, are confined to alpine and subalpine areas. In areas of the central highlands where the northern snow skink and southern snow skink both occur, the northern snow skink occupies the boulder fields while their southern cousin keeps to areas of heath.

Snow skinks feed mostly on invertebrates including grasshoppers, flies, beetles and winged bullants. Like the other alpine skinks they also take plant material: they have been observed eating berries and taking nectar from the flowers of *Richea* spp.

Richea species (Family Epacridaceae) have an unusual adaptation to Tasmania's alpine conditions where most of them occur. Their corollas are ovoid or conical in shape and the lobes do not open like normal petals but form an operculum, a lid-like structure that encloses the reproductive parts of the plant. While this provides protection from the cold, it prevents entry to pollinating insects. Numerous animals are known to remove these opercula to obtain the nectar, thus exposing the stamens to pollinators.

On Mt Wellington near Hobart southern snow skinks have been observed feeding on nectar after tearing open the opercula and unwittingly exposing the flower parts. As the northern snow skink also takes advantage of this food source it too probably plays a role in the pollination of the *Richea* species.

INVERTEBRATES

native weevil

jellyfish in Tamar Eastuary

There's no doubt that some people can't tolerate creatures with tentacles, membranous wings or more than their fair share of legs. But 95% of the world's fauna—the invertebrates—have these features and they play a pivotal role in the functioning of ecosystems.

Invertebrates are animals without a vertebral column or backbone and they come in a stunning diversity of forms ranging from marine-dwelling sponges, jellyfish, oysters and starfish through to terrestrial species including earthworms, snails, spiders, leeches, millipedes and the largest group of all, the insects.

The incredible abundance of invertebrates means they dominate the functions and processes of almost every terrestrial habitat on the planet. Species that live in the ground such as worms and millipedes play a crucial role in the structuring of soil; bees and many other insects regulate plant diversity by pollinating and dispersing seeds. Decomposers, herbivores and scavengers break down organic matter; predators and parasites control populations of other animals. Invertebrates, in turn, are important food for many other species including birds, mammals and each other.

wood scorpion (Cerophonius squama)

amphipod

millipede (Lissodesmus perporosus)

cuckoo wasp (Chrysis sp.)

CO-EVOLUTION OF INSECTS AND PLANTS

Although some insects have been around for 400 million years, and insects and plants have been coevolving for 300 million years it wasn't until flowering plants began to appear in the Cretaceous Period (146 million years ago) that more advanced insects like butterflies, wasps and flies proliferated. Since then insects have rapidly diversified and now 70% are directly associated with flowering plants.

Being small, insects and their eggs are particularly vulnerable to desiccation, and many species find the humid but well drained environments of plant stems an ideal place to inhabit. But avoidance of their insect enemies has been a significant factor in plant evolution and sticky hairs, spines, poisons, shiny leaves and stems, latex and repellant pigments are all used to discourage insects. Plants have even employed insects for their defense: some nectar-secreting organs are not associated with pollination but instead attract aggressive insects such as ants, which may catch, disturb or deter other invertebrates.

As plants have developed structures or substances to repel insects, insects have evolved to overcome these obstacles. For example, many insects that live on smooth shiny leaves have long terminal leg segments (tarsi), enabling them to get a better grip, while insects found on sticky plants may walk more carefully, sometimes on short tarsi.

Many insects that live on plants are incredibly well camouflaged to escape detection by predators. Examples include green aphids under leaves, brown scale insects on twigs, stick and leaf insects, mantids and the twig-like caterpillars of some moths.

green lacewing (Chrysopa sp.)

collembola (springtail) Acanthanura sp.

caterpillar with mites

shield bugs (Order: Hemiptera)

A well camouflaged looper caterpillar (Geometridae).

POLLINATION

One of the best known and significant functions of insects is pollination. This involves the transfer of pollen grains from the male organ (anther) to the female organ (stigma) of flowers. When this occurs the plants are fertilized and they form viable seeds or fruits.

Many insects, birds and mammals pollinate plants, but bees are universally recognised for fulfilling this important function. Bees have adapted to procure all or most of their food from flowers, obtaining protein from pollen and carbohydrates from nectar.

Australia has an abundant and diverse native bee fauna. Most are solitary and live in simple holes in untrampled ground, or in tunnels in dead stags and logs vacated by beetles and other borers. Many are short tongued species that have probably undergone long periods of co-evolution with native flowering plants such as *Eucalyptus*, *Leptospermum* and *Melaleuca* species that have their nectar in shallow cup-like nectaries.

TRIGGER PLANTS

Trigger plants (*Stylidium* spp.) have an intriguing mechanism to ensure their pollen is spread by the insects that visit their flowers.

When feeding on the nectar insects disturb small filaments in the centre of the flower causing the trigger to be released. Insects are hit with a club-shaped column (a modified petal) that springs up from under the other petals. At the end of the clubbed column are the fused anther (male) and stigma (female) flower parts.

This covers the insect with pollen that it takes to the next flower it visits. The column usually resets itself about an hour after it has been triggered ready to be released again.

There are approximate 250 species of *Stylidium* species worldwide. The greatest number is found in Australia and around 70% occur in the South-west of Western Australia suggesting that this region is the major centre for evolution of this species.

MOTHS AND BUTTERFLIES (ORDER: LEPIDOPTERA)

The number of moths and butterflies worldwide is second only to that of beetles. In Australia there are approximately 22,000 species with an unusually high diversity of very small moths.

Moths depend almost entirely on plants or material of plant origin for survival and thus greatly influence plant growth – either negatively by causing damage to crops, or positively, by assisting in pollination and weed control. They also add nutrients to the soil when they break down leaf litter and other organic matter. They hide from diurnal predators such as birds and lizards by taking refuge in leaf litter, dense vegetation or under loose bark on tree trunks. However, as most moths are nocturnal, they are important food for bats, spiders, frogmouths and owls.

There are only 39 species of butterfly in Tasmania and although some (e.g the Ptunnara brown and Marrawah skipper) are now listed as endangered, several species are common and widespread. Most butterflies are distinctively patterned and are relatively easy to identify compared to moths.

Adult butterflies have a liquid diet and use their long proboscis to probe flowers for nectar. Their larvae have more specific tastes and are strongly associated with particular host plants.

On warm sunny days they bask, opening their wings to face the sun. This reveals the upper wing surfaces that are brightly coloured for sexual signalling, the regulation of body temperature and for deterring possible predators.

Eyespots, which often adorn the wings of moths and butterflies, probably evolved to deter birds and reptiles that feed during the day when butterflies are active. They are usually located on the edges of the wings to attract predators away from the most vulnerable part of the insect.

granny moth (Dasypodia selenophora)

Australian admiral (Vanessa itea)

Donnysa skipper (Hesperilla donnysa)

CHAOSTOLA SKIPPER

Phil Bell

The threatened butterfly Chaostola skipper (*Antipodia chaostola leucophaea*), is found in dry lowland vegetation communities on relatively infertile soil where the caterpillars' food plants, thatch sawsedge (*Gahnia radula*) and slender sawsedge (*G. microstachya*) occur. The Chaostola skipper has been recorded from around Hobart, the Huon Valley, Kingston, Little Swanport, Bicheno and the Freycinet Peninsula.

The Chaostola skipper has brown and yellow markings. The adults fly for only a few weeks between October and December. The caterpillars (larvae) have a yellow body with a faint grey mid-dorsal line. They feed at night and rest head downwards by day in a conical shelter of rolled up leaves of the food plant.

The Chaostola skipper has a very long stage of approximately two years as a caterpillar. The adults are generally found in the vicinity of the larval food plant and feed on nectar from nearby flowers.

BEETLES (ORDER: COLEOPTERA)

Approximately 40% of all known insects are beetles. Their distinguishing feature is their hardened forewings called elytra which form a protective sheath that covers their membranous hindwings. Elytra may also help conserve water and trap air and possibly account for their enormous success.

Beetles are found in every habitat on earth except the open sea. They are significant scavengers, pollinators, predators and parasites and feed on almost all types of living or dead organic matter.

Of all the beetles, ladybirds are universally appreciated for their ability to suppress aphids and scale insects.

beetle takes off showing membraneous hindwings under hardened forewings called elytra

ladybird (Cleobora mellyi)

ADAPTATIONS OF AQUATIC BEETLES

Some beetles have developed intriguing adaptations that enable them to spend their lives in water.

Carnivorous diving beetles (Dytiscidae) have streamlined bodies for swimming. They come up to the surface of the water to get oxygen, which they store in a bubble under their hardened forewings.

A close relative, the whirligig beetle (Gyrinidae), has extraordinary eyes divided in two by a ridge at the waterline. This enables the beetle to look upwards into the air and below into the water simultaneously. Adult whirligig beetles also secrete a surfactant, which reduces the surface tension of the water. This allows them to spin around on the surface of the water.

Riffle beetles (Elmidae) are restricted to fast-flowing oxygenated water. They obtain oxygen from a plastron, a thin film of air trapped by the many microscopic hairs on their bodies.

THE FARMER'S FRIEND

The dung beetle is appreciated in farming communities for its beneficial role. Large dung beetles were imported into Tasmania to break down the huge amounts of manure deposited by domestic animals. After digging burrows with their broad front legs, the adults take the dung underground to feed themselves and their larvae. This returns nutrients to the soil, and eliminates potential fly habitat.

The native dung beetle (*Macroprocopris symbioticus*), which breaks down the small dung of native herbivores, has a bizarre adaptation. It uses its large, hooked claws to cling tightly to the hair around the anus of its hosts: kangaroos and wallabies. This enables it to travel with its host.

blue metallic flea beetle (Altica pagana)

Wasps, bees and ants are important insects when it comes to maintaining balance in the animal and plant kingdoms. Although some, like stinging wasps and invading ants are considered pests, the overwhelming majority are beneficial. They play an important role in the pollination and seed dispersal of many plants, and they control populations of other arthropods.

Wasps are one of the main enemies of spiders, and they attack live spiders and their eggs. Tiny (0.5–2.5 millimetres) native baeine wasps are found in almost every terrestrial habitat. They are parasitic on spiders' eggs, and are believed to be responsible for 30–40% of egg mortality in some spiders. Larger wasps that threaten spiders include the sand wasp, solitary wasp and ichneumon wasp.

In areas where there is suitable habitat and adequate nectar from summer and autumn flowering shrubs many wasps play an important role in controlling farm pests. Some adult wasp species lay their eggs in the eggs of cockroaches, scarab beetles, grasshoppers and mantids. Others collect caterpillars, grasshoppers, bugs, flies, slugs and beetles for their larvae.

Australia boasts the largest and most primitive ants in the world. The genus *Myrmecia* includes the bulldog ants, jack jumpers and inchmen. In Tasmania, their nests are excavated in the soil, or located under rocks and logs. Each nest contains a few hundred to several thousand workers, and consists of a mainly vertical array of well-formed, large galleries and chambers that extend to a depth of 1–2 metres. Many have conspicuous mounds decorated with objects such as small pebbles, tiny snail shells, animal droppings, bits of bone, pieces of charcoal, twigs and gum nuts. The reason for the decorated mounds is not fully understood, but they may provide a heat bank and insulation, and aid drainage and defence of the colony.

Bullant (Myrmecia forficata) collects a slug for its larvae.

The endemic bullant (Myrmecia esuriens) has bright red legs, mandibles (pincers) and post-petiole, i.e. the node near the end of the body. In this photograph several M. esuriens attack and cary off the larger more common bullant (Myrmecia forficata).

A tiny red wasp lays eggs into a recently fallen log—either into a developing larva or the eggs of another insect.

Jack jumper (Myrmecia sp. pilosula complex) drags a stick to add its mound of small stones.

MUD-DAUBER WASPS

In summer some wasps seek dry cool conditions which are ideal for keeping anaesthetised spiders alive to feed to their larvae. The wasps build mud nests under rock ledges, in keyholes, behind pictures and in the exhausts of mowers and other equipment. The female wasps paralyse the spiders which they store in mud cells. They lay an egg on each spider. After they hatch, the wasp larvae feed on the spiders in the safety of the cells.

SEEDS, ANTS AND STICK INSECTS

The seeds of approximately 1500 Australian plants (e.g. wattles and peas) have a special surface structure called an elaiosome that secretes and stores oil and is particularly attractive to ants. Ants collect the seeds, carry them to their colony and feed the elaiosome to their larvae. The seed is occasionally eaten, but more often it is simply discarded and remains in the ground until conditions are suitable for germination.

It is believed that seeds collected by ants have a better chance of germinating and surviving than those not collected because they are often placed in the ants' refuse piles which are nutrient-rich and sheltered. Many seeds require some heat to trigger germination but they need to be buried slightly to avoid being burnt. And, being close to aggressive ants means they are less likely to be attacked by seed predators.

In an example of convergent evolution, where unrelated organisms develop similar external morphology, the eggs of stick insects closely resemble seeds with elaiosomes and are also taken underground by ants.

Stick insects feed high in the foliage of trees and simply drop their eggs on the ground while feeding. The eggs take from one to three years to hatch and are extremely vulnerable to both fire and predation during this period. Transportation by ants to the safety of their underground colonies ensures the survival of the next generation of stick insects.

stick insect (Order: Phasmatodea)

AN ASSOCIATION BETWEEN ANTS, PLANTS AND BUTTERFLIES

Many of the small black ants encountered in the bush belong to the genus Iridomyrmex, one of the largest and most ecologically important group of ants because of their interactions with other invertebrates and plants.

The prickly box (*Bursaria spinosa*) is a widespread plant that flowers profusely in summer. It is the food plant of the nocturnally feeding larvae of the bright copper butterfly. The larvae use some of the nutrients from the plant to manufacture honeydew which they secrete from special glands. Ants are attracted to and get nutrients from the honeydew.

The larvae of the bright copper butterfly often spend the day in the nests of the small black ants at the base of prickly box. In return for the nutritious supply of honeydew, the aggressive ants protect the butterfly larvae from other ants, predatory wasps and parasitic flies.

bright copper (Paralucia aurifera)

SOUND IN GRASSHOPPERS AND CRICKETS

garden cricket or katydid (Caedicia simplex)

Grasshoppers and crickets are noted for their sound-producing abilities. The two most commonly used mechanisms to produce sound are the tooth-and-comb technique which involves rubbing specialised veins on the bases of the forewings, and the washboard technique that involves friction between a ridge or row of pegs on the inside of the hindleg and one or more pronounced veins on the forewing.

The sound is used mainly by males to advertise territory and attract mates, and for defence. In some families, however, the male and female sing mating duets.

The ears of grasshoppers and crickets are found on their abdomens or legs. Some have such acute hearing that they can detect bats 30 metres away — long before bats detect them.

Mole crickets shape their burrows to amplify their song, which can be heard 2 kilometres away.

CICADAS: THE LOUDEST ANIMALS!

Cicada song is one of the most familiar sounds of summer. Some species produce a sound of nearly 120 decibels which at close range approaches the pain threshold of the human ear. The song is generated by ribbed membranes called tymbals, which are located on each side of the abdomen. Muscles control the 'click' mechanism (similar to a tin lid clicking in and out) and abdominal air sacs act as resonating chambers, which amplify the sound.

Although the main purpose of the song is to attract mates, the sound also repels birds—their major predator—because they find it painful, and it interferes with their communication. The ventriloquial nature of the sound makes it difficult for vertebrates to locate.

white flash cicada (Cicadetta torrida)

FLIES (ORDER: DIPTERA)

Flies are an easily recognisable group that includes some of the most despised insects such as disease-spreading mosquitoes, blowflies that cause flystrike, and march flies and midges that can inflict a painful bite.

However, these nuisance flies are a tiny percentage of this group of insects that in Australia numbers approximately 7800 species—most of which are beneficial. Many pollinate plants, some control plant weeds, yet others are active predators or parasites of other insects.

Flies play an important role in regulating the populations of plants and animals. Some species predate other invertebrates, some pollinate plants, and many lay their eggs in rotting vegetation, animal remains or dung and the larvae feed on this material.

Sphenella rucifeps lays its eggs in the flower heads of members of the daisy (Asteraceae) family, particularly Senecio species. such as fireweed.

Adult Scaptia patula species feed exclusively on nectar; their larvae are predators of snails and insects.

Robberflies (Asilidae) are predatory on other insects; their larvae feed on soil organisms and rotting vegetation.

DANCING DADDY LONGLEGS

The dancing 'daddy longlegs' that congregate in the shadowy corners of many outside buildings in summer are craneflies in the fly family Tipulinae; their elongated palps and forewings without discal cells are characteristic of the genus *Dolichopeza*. There are nine recognised *Dolichopeza* species in Tasmania, of which at least half are endemic. The flies are very sensitive to light and spend the day resting in dark protected places with the different species preferring different haunts. It is quite common to find more than one species in the swarms.

Craneflies range in size from 2-3 mm to over 60 mm in body length. They belong to the fly family Tipulidae, the largest family of Diptera with about 15,000 species worldwide. The three subfamilies, Tipulinae, Limoniinae Cylindrotominae appear in fossils from the Upper Cretaceous, upper Triassic and the Eocene respectively.

Adult craneflies feed on liquids of plant and animal origin; larvae feed on rotting organic matter and soil organisms.

SPIDERS

Tasmania has an interesting spider fauna with many endemic species and many relict species i.e. species that were once widespread globally but now occur very locally. It also has many of Australia's tiny litter-dwelling families which are of immense biological significance because of their ancient origin and evolutionary links.

Spiders inhabit every terrestrial niche where their basic requirements of shelter, moisture and sustenance are met. They feed mostly on insects so their occurrence is dependent on the cycles and movements of insect populations.

Spiders can be roughly separated into two groups – those that use webs to capture their prey and those that don't.

The non web-building spiders are open range hunters such as wolf spiders, huntsmen and jumping spiders. They rely on their keen eyesight, speed and strength to hunt insects amongst rocks, tree trunks and foliage. Wolf spiders, so called because of their great speed when running down prey, either dig their own underground burrows with their fangs, or they take up residence in cavities left vacant by cicada nymphs or moth and beetle larvae.

The characteristic flattened body of huntsman spiders allows them to dwell between rocks or in the cracks and crevices of trees, particularly eucalypts and casuarinas. They are nocturnal, and hunt by running down or springing on their prey.

Web building spiders lack the eyesight, physical strength or venom of the aggressive hunters and rely on their elaborate silken constructions to catch their food. These spiders need a complex three-dimensional array provided by vegetation, branches and fallen twigs to build and maintain their snares.

Many birds use spiders' web during nest construction both as an important binding material and to fix nests to branches and twigs.

jumping spider

Garden spider (Eriophora sp.) on leaf

spider on leaf

AQUATIC SPIDERS

Nursery web or fishing spiders (*Dolomedes* species) are large (30 millimetre), fast-moving hunters that closely resemble wolf spiders. They can run quickly on water and land, and are skilled at swimming and diving: a formidable combination of skills for capturing tiny fish, tadpoles, insects and skinks.

Instead of using silken snares to capture food, fishing spiders remain motionless at the water's edge — sometimes for hours. Several legs touch the water, so they can detect ripples created by potential victims. The hairs on their bodies play crucial roles in their aquatic lifestyle. The fine, air-trapping hairs on their tarsi (feet) act as tiny floats, which enable them to walk on the water's surface. Air trapped by the dense, waterproof hairs that cover their bodies stop them from becoming waterlogged, and enable them to hunt underwater. They evade predators, such as birds, by staying submerged for long periods and breathing oxygen trapped in the hairs around their lungs.

CRUSTACEANS

Tasmania's has one of the most diverse freshwater crayfish faunas on Earth with many endemic species including the largest freshwater invertebrate in the world, the giant freshwater lobster. This and its smaller relatives, the eastern freshwater lobster and the southern freshwater lobster are found only in the rivers and streams in Tasmania.

Engaeus leptorrhynchus is found in the northeast highlands

Lobsters prefer the cool, clear waterways that flow through relatively undisturbed well-vegetated areas. Adults hide in the deep, shady pools beneath submerged, decaying logs while the juveniles take refuge in smaller streams in the catchments. They feed on decaying wood, leaves, small fish, rotting flesh and other detritus.

FRESHWATER CRAYFISH (*ENGAEUS, OMBRASTACOIDES* AND *SPINASTACOIDES* SPECIES)

Fifteen freshwater crayfish in the genus *Engaeus* occur in northern Tasmania and numerous other similar species of different genera are found in western Tasmania.

Burrowing crayfish spend most of their lives underground, and the characteristic 'chimneys' made of soil pellets piled around the entrance of their burrows signal their presence in wet, swampy areas. They are the most terrestrial crayfish in the world, and their reduced tails and enlarged claws reflects their lifestyle of digging rather than swimming.

These small animals superficially resemble yabbies, but unlike yabbies very few of them live in free water. Although common in the eastern states on the Australian mainland yabbies did not occur in Tasmania until brought here, probably by early settlers who stocked their dams to provide a ready food supply. The yabbie is considered a threat to Tasmania's rich crayfish fauna and it is illegal to have a specimen in your possession.

TASMANIA'S LAND SNAILS

Tasmania has 89 native land snails—none of which are pests. In wet forests and damp riparian areas, there is a close association between native snails and the leaf litter of some understorey shrubs such as dogwood (*Pomaderris* spp), musk (*Olearia argophylla*) and blanket leaf (*Bedfordia salicina*). Leaf litter from these plants is important not only because it provides calcium but also because it crumples in such as way as to provide extra hiding places. Many small snails (chiefly members of the family Punctidae) can often be found grazing or hiding on the underside of fallen leaves which helps the snail to obtain food, shelter and calcium from a single source. These plants also provide other benefits by producing a shady and therefore less harsh microclimate and because their mossy branches and flaking bark make ideal habitats for small arboreal snails.

Pedicamista sp. "Chisholm"

northeast forest snail (Anoglypta launcestonensis)

DRAGONFLIES

Fossil specimens from the Permian period (270 million years ago) indicate that primeval dragonflies had wingspans of 70 centimetres, making them the largest insects known. Their modern-day equivalents have wingspans of only 16 centimetres. However, apart from being smaller, modern-day dragonflies are virtually unchanged in appearance and lifestyle.

Adult dragonflies lay their eggs in aquatic plant stems and water. The mostly aquatic nymphs predate numerous animals, including tadpoles, small fish, small crustaceans, worms, and mosquito and midge larvae.

The diurnal and mostly territorial adults have large, multifaceted eyes comprising up to 10,000 telescope-like units, which enable them to see in all directions. The four large wings can operate independently, which gives them great manoeuvrability, and enables them to capture flies, mosquitoes and other flying insects.

Despite being one of the fastest flying insects—they fly up to 14 metres per second—dragonflies are a significant food source for aerial-feeding birds. The dusky woodswallow can provide a continuous supply of dragonflies for its nestlings.

FRESHWATER MUSSELS

Sarah Graham

Tasmania's two freshwater mussels, the large *Velesunio moretonicus* (60–95 millimetres) and smaller *Hyridella narracanensis* (20–60 millimetres), are found only in the South Esk River system. They belong to a family of large freshwater mussels found only in Australasia and South America.

Freshwater mussels are similar to marine mussels in appearance and habit. They dwell in the muddy bottoms of watercourses, and feed by extending two siphons (tubes) out into the water. Oxygen and food are extracted as water is drawn in though one siphon. Waste and carbon dioxide are expelled through the other siphon. Fully grown freshwater mussels have the ability to clear a bucket of muddy water overnight by filtering in this way.

Freshwater mussels have an interesting life history. The eggs are fertilized in the female's gill chamber. The larvae — miniature replicas of the adult — produce a sticky thread, which they use to attach themselves to a small fish, such as a galaxias. With the aid of a hook on each tiny shell, they further anchor themselves to the host fish, and become parasitic. They consume flesh in the vicinity of the attachment, and drop off when the parasitic stage is complete. The attachment to the fish is important because it prevents the growing mussel from being swept out to sea by fast-flowing flood waters before it is strong enough to bury itself in the mud or attach itself to an anchorage.

The hard shells of freshwater mussels, which are held together by powerful muscles, ensure that they have few predators. The only animal that eats them is the water rat that places the closed shells in the sun, and waits for them to be opened by the sun's heat.

VELVET WORMS

Velvet worms have features of both annelid worms (leeches and earthworms) and arthropods. They live in moist forested areas with abundant leaf litter and rotting logs where they feed on invertebrates such as worms and insects. They capture their prey by squirting glue from turrets located on either side of their heads.

Velvet worms have various ways of reproducing. Some lay thick-shelled eggs in which the young develop outside the mothers' body. Some are born live after developing in thin-shelled eggs which hatch inside the mother; yet others are born live after the embryos are nourished by the mothers' placenta (like humans).

Fertilization of eggs is just as varied, with each group of velvet worm employing different methods: males of some species have ornamented structures on their heads, which deliver sperm directly into the genital opening of the female. Other species have a more conventional method, mating genital to genital. Dermal-insemination is perhaps the most bizarre method. The male places a package of sperm almost anywhere on the female's skin. Her body wall ulcerates allowing entry to the sperm. They swim in her body cavity until they reach their destination. This is usually the ovary where the eggs are fertilized; or it can be in storage organs where sperm can be stored for years.

AN INTERACTION BETWEEN PLANTS, FUNGI AND INVERTEBRATES

Many plants can react to attack from specialised invertebrates (e.g. mites, nematodes and insects) or bacterial and fungal infections by forming growths called galls. Galls form in the leaves, stems, flowers and roots of the plant.

Galls induced by insects, such as flies, beetles, moths and wasps, are a response to chemicals secreted by the feeding insects. Developing galls is a strategy used by plants to localise the insect damage; it also provides continuous nourishment for the insect. Gall-forming insects include some of the most specialised plant feeders that target a specific part of a specific plant.

An interesting example of a plant, animal and fungal interaction can be seen in the round galls that form on silver wattles and other acacias. These galls are the result of infection by the rust fungus *Uromycladium tepperianum*. Young, stressed trees and older, declining trees are particularly susceptible to attack from the rust fungus, which forms large galls on the stems, phyllodes (leaves) and tips of the flowering shoots. Sometimes, new galls develop on older ones. If this happens, the galls can become large, globular masses that damage branches and kill mature trees.

Studies in Tasmania have found that 32 species of insects, including moths, beetles and wasps, use the galls formed by *U. tepperianum* as a food source or refuge. Some beetles and their larvae feed on the spores that cover the outer surface of the fungus, while some insects use the tunnelled-out galls as refuges. Parasitic wasps, in turn, hunt in and around the galls. Some species of moth lay their eggs and complete their development within the galls. These gall-inhabiting moths probably have a mutually beneficial association with the fungus. The moths benefit because the galls give them protection and a food source. The fungus benefits because the moths disperse the spores when they emerge from the galls and travel to other acacias.

Numerous plants have associated galls including (from left) Pultanaea juniperina, Cassinia aculeata and Eucalyptus species.

FUNGI AND ARTHROPODS

Fungi provide sustenance for a range of invertebrates including snails, mites, gnats, collembola, beetles, moths and nematodes. Some are generalists that feed on any of the fungal parts; others are specialists that feed on just the hyphae or spores.

Sun flies (*Tapeigaster* species) are large flies and one of the more conspicuous invertebrates associated with fungi. During late summer after rain has stimulated the appearance of fungal fruits, territorial males sit on top of a fungus while the females lay their eggs on the gills or pores beneath.

sun fly (Tapeigaster bruneifrons) on native amanita

Fungi provide a food source for the developing grubs of many log-inhabiting invertebrates especially weevils. The adult beetles bore into dead or dying trees and deposit their eggs inside the tunnels. Before laying eggs, the tunnel walls are inoculated with mycelium and fungal spores that are carried in a special body cavity called a mycetangium. Fungi soon cover the walls of the tunnel and the exuded yeast (called ambrosia) provides food for the beetle larvae.

Stenocarpha hamiltoni on bolete

endemic fly (Diplogeomyza hardyi tasmanica) on starfish fungus or anemone stinkhorn (see p. 79)

The canary worm (*Geoplanus sugdeni*) is a common, bright yellow flatworm that is usually found in or under logs in moist, forested areas. Like other flatworms, its lower surface is covered with minute bristles that, along with a thin layer of mucus, aid locomotion and help it adhere to substrates. The mucus is also used to capture its prey of slugs, earthworms and occasionally carrion.

Land flatworms are hermaphrodites (i.e. they have both male and female sex organs) that lay their eggs in a jelly-like mass under logs or in soil. They can also reproduce asexually. They have the remarkable ability to split voluntarily, and can regenerate after being cut in two to form two new individuals.

ROLE REVERSAL

In a reversal of roles, several groups of plants around the world have evolved to catch and 'eat' insects. In Tasmania, there are two groups of carnivorous plants. Sundews (*Drosera* species) have leaves bearing numerous small tentacles that secrete droplets of sticky fluid on which insects become trapped. Protein-digesting enzymes in the fluid absorb the soft parts of the insects. The nutrients acquired enable the plant to inhabit very poor soils. Fairies aprons (*Utricularia* species) live in shallow water and waterlogged soils. They produce tiny, capsule-like traps under the water or ground. Tiny invertebrates, such as insects and mites, venture into the traps, and are caught and digested.

fly on Drosera sp.

fairies aprons (Utricularia sp.)

INTRODUCED SPECIES

Laughing kookaburras

Many mammals, birds and invertebrates have been deliberately or inadvertently introduced into Tasmania, with varying effects on native ecosystems. Even relatively benign species compete with native fauna to some extent. Other species, particularly the carnivorous predators such as the feral cat and red fox can have a devastating impact, especially on the local bird and small mammal populations.

house sparrow

MAMMALS

Herbivorous mammals, such as the European rabbit and fallow deer, were brought to Australia in the early nineteenth century. They feed extensively on pasture crops and can stop the regeneration of native plants by browsing the seedlings.

(Contact the Game Management Unit of DPIPWE if you would like a 'Property-based Game Management Plan'. This will help to manage deer as well as large populations of native herbivores such as Bennetts wallaby, brushtail possum and pademelon.)

Non-native rodents hitched a ride on the ships of the first European settlers. Black rat and brown rat feed on nestling birds; house mice consume copious amounts of grain and are a nuisance in some seasons.

European wasps feed voraciously on this live gum moth caterpillar.

BIRDS

Several Northern Hemisphere birds were introduced in the nineteenth century. They include the spotted turtle-dove, which is mostly restricted to urban areas; and the house sparrow, common blackbird and common starling, which are well-established in urban and rural areas. The common starling, a cavity-nesting bird, has been implicated in the decline of some native hollow-nesting species including the swift parrot and blue-winged parrot. European goldfinch and European greenfinch were also introduced into Tasmania.

Laughing kookaburra, galah and rainbow lorikeets are hollow-nesting species that compete for cavities with native birds. Kookaburras are predators of reptiles, frogs and large ground-dwelling invertebrates.

The superb lyre-bird was introduced to the Mt Field National Park in 1934 and Hastings in 1945. It has become well-established in rainforest gullies where it uses its powerful feet to scratch rotting logs and the litter layer; it has been seen stripping the bark off standing trees.

Rainbow lorikeets compete with native species for nesting hollows.

INVERTEBRATES

The European honeybee was introduced in the early 1880s and is now the basis of a thriving export industry. Its impact on Tasmania's indigenous flora and fauna is difficult to determine. However, some plants need to be pollinated in specific ways. For example, many species of the guinea flower (*Hibbertia* species) that need buzz pollination (where the pollen is vibrated out of the anthers) cannot be pollinated by honeybees. In many cases even though honeybees visit flowers and take nectar they are not efficient pollinators, something that may have consequences for native bees and native plant communities. As well, honeybees feed on the nectar of native flowering trees and shrubs, which is a significant part of the diet of honeyeaters.

The European wasp is a voracious predator of native insects, especially in autumn when it collects food for the larvae that spend winter in its underground nests. Insecticide dusted around the entrance to their nest quickly and effectively kills all occupants.

The introduced yabbie is extending its range. It may have an adverse impact on Tasmania's crayfish fauna, which is among the most diverse in the world.

FISH

The brown trout was introduced into Tasmania in 1864 to form the basis of a recreational fishing industry. It is regarded by some as the 'fox of waterways', and by others as a great asset. Its great fecundity and aggressive nature have affected many native populations. The decline of native fish populations have been attributed to predation by the trout.

The mosquito fish (Gambusia sp.) is now well-established in the Tamar Estuary where it is feared it could have an adverse impact on the green and gold frog.

The European carp has changed the ecology and muddied the waters of many mainland rivers. In Tasmania it is still confined to one or two lakes. Other introduced fish include red-finned perch, rainbow trout and brook trout.

LATER ARRIVALS

Time will reveal the full impact of more recent introductions. The red fox is responsible for the decline and extinction of many small animals and ground-nesting birds on the Australian mainland and has the potential to do the same in Tasmania. The European bumblebee already competes for nectar with native honeyeaters and swift parrots.

SPARROWS AND SALMONELLA

In June 2009 there were reports of dead and emaciated house sparrows from southeast Tasmania The dead sparrows were found to be infected by *Salmonella typhimurium DT160*. It was the first record of significant mortality from this Salmonella type occurring in Australia, and it could pose a threat to Australia's native bird fauna.

There have been similar outbreaks of illness caused by *Salmonella typhimurium* DT160 in New Zealand, Norway, Sweden and Japan where sparrows were acting as Salmonella-shedders, spreading the organism at food sources such as grain silos, poultry facilities and street-side cafes.

In Tasmania, house sparrows are a potential vector for salmonella infection for caged birds such as commercial poultry, private collections or captive-managed threatened species. They are also a source of infection for native birds that are lured to bird feeders by an easy meal of seeds. Bird baths are another likely transmission point.

Dead and dying sparrows potentially spread thebinfection, as they become easy prey for domestic and feral dogs and cats and for predators such as raptors. Thus, there is the potential for this and other disease-causing pathogens harboured by sparrows to be transferred to raptors.

BASIC HYGIENE PROTOCOLS WHEN HANDLING DEAD BIRDS:

Wash hands after handling birds (and other animals) and before eating.

Promptly dispose of carcasses before they are taken by predators.

Exclude wild birds from aviaries and poultry runs.

Decontaminate water supplies and avoid faecal contamination wherever possible. Prevent wild birds getting access to spilled seed and other aviary waste.

Don't feed birds!

GARDENS FOR WILDLIFE

female spotted pardalote, Reedy Marsh

In the hills above Hobart one of the country's rarest birds, the swift parrot, finds abundant nectar and tree cavities suitable for breeding just kilometres from the city centre. In Launceston, musk lorikeets zoom around the streets of Riverside searching for flowering eucalypts. Striated pardalotes sing in the middle of St Helens and skinks and marsupials scurry around on the outskirts. Green and gold frogs and eastern barred bandicoots are frequently seen in gardens in Westbury.

All city, town and suburban gardens in Tasmania are relatively close to either small reserves within town boundaries or extensive areas of surrounding bush. Thus they are—or have the potential to be—extremely important for native wildlife.

Planting or maintaining a garden for fauna involves having plenty of dense shrubbery where birds and other wildlife can shelter from inclement weather and hide from predators. A variety of plants, preferably local native species, provides hiding places and food for insects, spiders and other invertebrates, many of which become food for birds, small mammals and each other.

Piles of coarse garden clipping, small branches or old logs provide habitat for insects, warm places for reptiles and hiding places for frogs. Rock piles warm up quickly and are favoured by skinks.

Native plants are preferable, but non native plants such as fuchsias and pineapple sage provide nectar for birds including eastern spinebills and other honeyeaters; other flowers are visited by a plethora of butterflies, native wasps, bees and flies.

Bush crickets—or katydids—(Caedicia simplex) are very common in urban and country gardens and in the bush. They make a high pitched ticking sound, especially in the evenings, but their camouflage makes them remarkably difficult to locate. (See front cover) However, once found they can be closely observed because they often remain on the same plant—even on the same leaf—for several days or weeks. They sometimes hide behind a leaf if they know they're being watched.
Bush crickets often take on the colour of the plants on which they feed and rest. The moulting katydid pictured above had been living on a mountain correa (Correa lawrenciana) for weeks. It took several hours to complete its moult, after which it ate its exoskeleton.

Gardens for Wildlife is a voluntary scheme that supports and encourages people who wish to make their urban or suburban garden friendly for local wildlife. (See page 94)

New Holland honeyeater

little wattlebird

yellow wattlebird

TOO MANY GREVILLEAS?

Tasmania's dry bush and forested areas do not have an abundance of plants that flower profusely all year round.

Trying to replicate the nearest native bush is the best approach when designing a garden to attract native birds. Intact native bush usually has ground layer vegetation of grasses, rushes and sedges and small herbaceous plants; some dense patches of understorey; and mid storey and canopy trees. It also has copious quantities of leaf litter and logs on the ground.

The most common mistake when planting a bird friendly garden is planting too many nectar producing plants such as hybrid grevilleas and callistemons. These plants flower prolifically for most of the year and attract aggressive species including New Holland Honeyeaters and wattlebirds. These birds defend a rich nectar source and chase away small birds such as thornbills and fairy-wrens.

DON'T TIDY UP!

Tidying up may impress the neighbours, but it's often the worst thing to do as far as birds and other fauna are concerned. When leaf litter, fallen branches and logs are left to break down—rather than being cleaned up or burnt—they release a bounty of nutrients. Hundreds of species of insects feed on the fungi that speed up this process. As most birds and small marsupials eat insects at some stage in their development, this organic material is essential for their survival.

SPIDERS!

Not only do birds eat spiders, many use spiders' webs in the construction of their nests. Spiders are an important component of any ecosystem. Some feed on seed eating insects that are responsible for poor germination.

Leaf curling spiders (Phonognatha sp.) are common in town and country gardens.

'THE LEAST FAITHFUL BIRD IN THE WORLD'!

Almost every garden in country Tasmania (preferably without a cat) would have at least one pair if not a small family group of superb fairy-wrens. It is one of the most common and well-known bush birds because it likes the changes we have made to the landscape. Pasture or lawn for foraging next to dense shrubs for shelter and nesting sites is just about all this bird requires to breed and maintain stable populations. In early spring one or more bright blue males with an entourage of brown birds (young males and females) forage on the ground for insects and spiders. They build a messy side-entrance nest in low understorey (even in pot plants!) and raise two or three young. Young birds are vulnerable to attack by cats, snakes and predatory birds (e.g. grey shrike-thrush, grey butcherbird, raptors).

University campus grounds provide plenty of suitable habitat for blue wrens and consequently their habits are well documented. During long term studies some intriguing facts have come to light.

About one-third of Australian land birds, including the superb fairy-wren, breed cooperatively. Typically, one or more males share their father's territory and help rear the young. But superb fairy-wrens are becoming as well known for their adulterous lifestyle as they are for their cooperative breeding efforts.

In the breeding season, family groups occupy defined territories, but males often visit females from adjoining territories. During these encounters, courting males display their bright plumage, and sometimes even present gifts of brightly coloured flower petals. However, these visits never result in copulation.

DNA testing and radio tracking have shown that in the hours before sunrise fertile females leave their territories to mate with the bluest bird in the neighbourhood. They have good reason for their philandering! The male they seek is the most brightly coloured bird who has moulted into his breeding plumage months before the beginning of the breeding season and before most of the other males have acquired their bright plumage.

BECOMING BLUE

Male fairy-wrens that attain their blue plumage earlier than other males risk being taken by predators because their bright colour makes them more conspicuous. In addition, early blue plumage indicates high levels of testosterone, which suppress the immune system and make them more susceptible to infection. Males that become blue early ***and*** survive winter (the harshest time of the year) in robust health must have better genetic material than other males. Therefore, they are the most desirable birds to father offspring.

superb fairy-wren (male)

Recently fledged chicks hide in tangled understorey.

superb fairy-wren (female)

Silvereyes shelter in dense understorey.

IN PRAISE OF SILVEREYES

Many people are aware of the wondrous mimicry of the superb lyrebird, whose repertoire can include sounds ranging from the songs of other birds to the mechanical clicks and whirrs of cameras and chainsaws. But few people know that this skill is shared by other, less spectacular birds.

Silvereyes, much maligned because of their propensity for taking or damaging fruit, are accomplished mimics. In early spring as they prepare to breed, they will alternate their own distinctive song with snatches of sounds of other birds including those of swift parrots, grey goshawks, green rosellas and Tasmanian scrubwrens—to name a few. In autumn recently fledged birds sing a whisper song, also known as subsong. This quiet warbling, sung from the cover of dense shrubbery, is a practice song akin to a baby's babbling. It is a continuous stream of imitation interspersed with silvereye notes.

Silvereyes belong to a large family (Zosteropidae) of approximately 90 species that are found throughout Africa, Asia and the islands of the Indian and Pacific Oceans. Many are called 'white eye', a name that alludes to the distinctive ring of white feathers that encircles the eyes of most members of the family. Some species are endangered because they are restricted to small islands; others are widespread, highly mobile and have the ability to colonise distant lands. The extinct robust white-eye of Lord Howe Island befell the fate of many island endemics by succumbing to predation by introduced rats.

Some of the Tasmanian silvereyes are year round residents in warmer coastal regions but some regularly migrate and spend winter in southern Queensland. In the early 1900s the Tasmanian subspecies colonised New Zealand. The Maori name for silvereye 'tauhou' means 'stranger'. While vignerons and orchardists may think that the appearance of this 'pest' in New Zealand was cause for concern, the opposite occurred. Silvereyes were greeted warmly and won the positive appellation 'blightbirds' for almost eliminating the woolly aphids that caused American Blight on apple crops.

Silvereyes are beautifully camouflaged in sombre tones of browns and greens, colours that enable them to hide and nest where trees and shrubs provide dense cover. In Tasmania small flocks return to their breeding areas just as plants begin to flower in spring. Pollen from understorey trees and shrubs supplemented with protein from tiny insects gleaned from foliage or hawked from the air provide enough nutrients to get breeding underway. They lay two to four blue/green eggs in a loosely woven cup-shaped nest placed in dense shrubbery.

In late summer, when spring flowering has ceased, silvereyes lick the nectar of banksias with their brush tipped tongues. They also consume voraciously the fruits of native cherry and native currant and spread seeds away from parent plants; they are among the few fruit eating birds in Tasmania.

Before they begin their migration north, silvereyes rid many plants of the countless aphids that have proliferated in the warm summer weather. Then they turn their attention to grapes and other cultivated fruits: surely a well deserved reward for providing the important ecological services of controlling insects, pollinating plants and dispersing seeds.

Silvereyes are among the few seed eating birds in Tasmania and are therefore important in spreading the seeds of native plants.

'A WELCOME INDICATION OF THE APPROACH OF SPRING'

The peskiness or otherwise of welcome swallows depends on your point of view. Most people welcome their annual return to Tasmania, but others are inconvenienced by nest building activities that deposit mud near front doors, or their preference for perching on gutters which can foul the water supply.

The highly migratory nature of most swallow species – their tendency to simply disappear once the weather cools – has caused them to be the subject of many misconceptions. Greek philosopher and scientist, Aristotle, for example, believed that swallows spent the winter at the bottom of lakes. This idea persisted for centuries and even the preeminent Swedish naturalist, Carl Linnaeus, famous for devising the binomial system of classifying plants and animals, thought that they wintered in the water. An 18th century naturalist was convinced that they went to the moon! Many Tasmanians have an unshakeable belief that the swallows that occur here arrive in spring from the northern hemisphere.

Welcome swallows and their close relatives, martins, belong to a family of over 80 species that are widespread throughout the world's temperate regions. While several northern hemisphere species make fleeting visits to the southern hemisphere, there are three species that breed only in Australia. The most widespread of these is the welcome swallow which it is found throughout the continent, particularly in the south. It is the only swallow species found in Tasmania.

Swallows are highly visible as they fly acrobatically over cities, towns and farmland and they are beautifully adapted to their aerial lifestyle. They have a slender, streamlined body, long pointed wings and a deeply forked tail. Their short legs and weak feet are not required in their pursuit of prey and are consequently not well developed. Their triangular shaped bill is edged with rictal bristles. These stiff hair-like feathers are found in many aerially feeding birds and are believed to protect their eyes as they chase scaly insects.

Welcome swallows are often seen in the company of the closely related tree martin and both will congregate to feed on low flying insects, particularly before stormy weather. Tree martins have a distinctive white rump and lack the forked tail of swallows.

Welcome swallows are predominantly birds of open areas, so they have extended their range since European settlement because of the clearing of forests and woodlands. The provision of artificial watering places in semi arid and arid areas has also been to their liking.

Whereas centuries ago they would construct their mud nests on the vertical surfaces of cliffs, rock walls or in hollow trees, options for nest sites increased markedly once buildings started springing up around the country. Nowadays most birds take advantage of human-made constructions and place their nests in sheltered sites under bridges, roofs, verandas or other overhanging structures. Conveniently placed clothes lines and fences provide ideal perches close to their nest sites.

Adult and young welcome swallow

As the weather cools and flying insects are no longer abundant, swallows congregate in pre-migration flocks and line up along fences and overhead wires in preparation for their northward flight to warmer areas. Most welcome swallows in the southern parts of the country migrate to east and northeast Queensland and the Torres Strait Islands; those in warmer regions have a readily available supply of insects throughout the year and have no need to depart.

In early spring when insect activity increases in response to increasing temperatures, swallows fly back to Tasmania. They are, as noted by British ornithologist, John Gould, who assigned the 'welcome' epithet, a 'welcome indication of the approach of spring.'

WINDOW STRIKES

> '*Short of habitat destruction … studies clearly indicate … that more birds are killed at sheet glass … than any other human-associated avian mortality factor worldwide. Glass is not only universal, but also totally indiscriminate, killing the fit and the unfit.*' (Daniel Klem Jr., www.wildlifeprotection.net).

Windows with large panes (greater than 2 m^2) near the ground or greater than 3 m high are usually the worst offenders.

STEPS THAT CAN BE TAKEN TO REDUCE THE RISK OF BIRD STRIKES INCLUDE:

Replace clear or tinted panes with frosted or non-reflective glass.

Windows located on opposite sides of a room look like a clear flight path. If corner or other windows give the sense of a clear throughway they should be covered with curtains, blinds or shades to block the perception. Deterrents (e.g. paper spots, wind chimes) can be placed strategically on or in front of windows;

Windows should be left dusty or otherwise covered (shade cloth or film) so they do not reflect. Cobwebs left around windows provide a visible barrier; they are also used by birds as nesting material.

IF YOU FIND A STUNNED OR INJURED BIRD:

Approach the bird quietly from behind, directly opposite the way its beak is pointing. This will put you in the bird's blind spot, and make it less likely to be startled.

Quickly (but without startling the bird) cup your hands around the bird and place it into a small covered box.

Place the box in a dark, quiet place and let the bird rest.

After about an hour check the bird or listen for signs of activity. If the bird is alert, it can safely be released. To release a bird, take it to a quiet place. Either place the bird on the ground or allow it to fly of its own accord.

If the bird has not recovered, take it to a vet.

If the bird is suffering an obvious injury such as a broken wing it should be taken to a veterinarian who specialises in native wildlife.

This painted button-quail recovered after crashing into a window.

For immediate help or advice phone the DPIPWE Injured and Orphaned Wildlife Hotline on 6233 6556.

WATERWAYS AND RIPARIAN AREAS

Lake River, Great Western Tiers

Just as in terrestrial ecosystems, plants are the principal energy source influencing aquatic environments. Aquatic plants provide habitat and food for tiny invertebrates at the bottom of the food chain. Organic material that ends up in rivers and streams mostly comes from plants growing along the length of the waterway dropping leaves, twigs and other woody debris into the water.

Boulders, fallen trees, branches and logs give structure to underwater habitats. They are attachment sites for invertebrates and provide shelter from sunlight and fast flowing water. They provide sites for territories and spawning, nursery grounds, feeding areas and places to hide from predators or to wait for prey.

Rivers and streams flow through all vegetation types including rainforest, wet scrub, dry scrub, heathland and wet and dry eucalypt forests.

The vegetation along waterways (called riparian vegetation) is generally more ecologically productive than the surrounding bush because the proximity to water results in luxuriant plant growth. Shrubby bushes that grow thickly along rivers and streams not only provide dense hiding places, but most years they flower profusely and provide abundant nectar and pollen for many insects, birds and marsupials.

Animals from the surrounding bush rely heavily on riparian vegetation. It provides shelter, foraging sites, nesting sites and safe corridors that are especially important during drought. Many animals use riparian bush to travel between patches of wet forest.

Riparian bush protects adjacent aquatic environments, so is essential for the survival of many native animals that live in rivers, streams and wetlands. It shades and cools the water, filters out most of the sediments, and reduces evaporation by reducing wind speed. Fallen leaves and logs provide food for many aquatic insects and freshwater crayfish. Logs in the water are essential breeding sites of many animals. Rocks, woody debris and leafy litter provide habitat for many aquatic species.

Riparian bush is extremely susceptible to disturbance from weeds and fire. Many riparian plants have not evolved to survive fire so burnt riparian bush takes many years to recover fully and provide

Lowland copperhead (Austrelaps superbus) frequent lagoons and waterways where abundant frogs form an important part of their diet.

Dragonflies lay their eggs near or in fresh water.

damselfly (Coenagrion lyelli)

good habitat. Riparian invertebrate fauna within dry bush may become locally extinct. Riparian areas are valuable refuges for animals during and after fire.

Hard-hoofed animals disturb native animals using the area for shelter; they also damage the vegetation and stream banks.

Streams and rivers that are allowed to flow naturally will establish their own course and support a diverse array of aquatic animals. Log-jams teem with life because they accumulate large amounts of litter and debris where small aquatic insects proliferate. These become food for larger species. Logs and other large woody debris are as important to waterways as they are to bush and forest environments.

THREATENED SPECIES

The wedge-tailed eagle often nests in or close to riparian areas, usually in large trees on the slopes above streams.

The azure kingfisher, an endemic sub-species, occurs mainly along forested margins of river systems along the north and northwest coasts of Tasmania. Clearing of riparian vegetation probably caused local extinctions.

The glossy grass skink is found mainly in grassy and sedgy riparian vegetation.

SOME FRESHWATER AND RIPARIAN FAUNA

platypus
water rat
lowland copperhead
tiger snake
green and gold frog
Azure kingfisher
Lewins rail
Lathams snipe
purple swamphen
Tasmanian mudfish
galaxias spp.
paragalaxias spp.

There are numerous threatened invertebrates in and around waterways: forty-three species of aquatic Hydrobiid snail are listed as threatened. Most are restricted to small catchments where they depend on native riparian vegetation to maintain a suitable stream environment. Three species of burrowing crayfish, the Burnie, Mt Arthur and Scottsdale burrowing crayfish are found in riparian areas. The giant Tasmanian freshwater crayfish is found in north Tasmania in streams and rivers with intact riparian vegetation.

The blind velvet worm and giant velvet worm inhabit rotting logs (usually eucalypt) and are most commonly found in riparian areas. A number of caddisflies are threatened in Tasmania; several species rely on riparian vegetation to maintain suitable habitat.

FISH

Tasmania has 25 species of native fish of mainly freshwater habitats of which 11 are endemic. Eight species have been deliberately or accidentally introduced.

A significant component of Tasmania's fish fauna is the fifteen species of galaxias, small scaleless fish that are found throughout the cool temperate regions of the Southern Hemisphere.

Most galaxias species have very restricted ranges. Some are found only in a few highland lakes or tarns or in areas with slow flowing freshwater. Many survive only where natural barriers such as waterfalls, steep cascades and marshes prevent the incursion of three introduced fish species with voracious appetites, the brown trout, rainbow trout and redfin perch. They also need areas with abundant shelter within the stream and from streamside vegetation. Galaxias feed mostly on terrestrial and aquatic insects and crustaceans.

John Simmons

spotted galaxias (Galaxias truttaceus)

Some species of galaxias are milky coloured and covered with small dots, so these 'fish of the Milky Way' were given the scientific name galaxias, which is also used as their common name.

THREATENED FISH

The Pedder, Swan, Clarence, swamp, saddled, dwarf and golden galaxias, Arthurs, Great Lake, Shannon and western paragalaxias and the Australian grayling are threatened in Tasmania.

The Pedder galaxias is regarded as extinct in what remains of its natural habitat—Lake Pedder and its tributaries. Its extinction is attributed to loss of nursery habitat: the shallow sandy-bottomed lake used by larvae and juveniles; and the stream habitat the adults used for spawning. Predation by brown trout and competition from the native climbing galaxias that thrives in the dammed lake also contributed to its decline.

A translocated population was established in the fishless, invertebrate-rich Lake Oberon. However, its long term success is not necessarily assured because of genetic effects: the population is derived from just 34 individuals. Furthermore, the introduction of the Pedder galaxias into this food-rich lake is likely to affect the food chain which may eventually threaten the survival of the fish.

GRASSLANDS AND GRASSY WOODLANDS

forester (eastern grey) kangaroo, Narawntapu National Park

Some Land for Wildlife or covenanted properties have areas of open pasture or grassland between the house and the nearest bush. These open areas are either traditional farmyards with domestic livestock and vegetable gardens interspersed with sheds and farm machinery; or they are native grasslands or grassy woodlands with tussock grass, kangaroo grass, sedges and scattered trees. Although these house zones are usually excluded from covenants, they are nevertheless important for many faunal species.

Native grasslands on fertile soils have lush grasses and herbs that provide food for browsing native animals including forester kangaroo, Bennetts wallaby and wombat. Nocturnal animals such as eastern barred and southern brown bandicoot use their pointed snouts to forage for soil-dwelling invertebrates.

Dense tussocks provide habitat for many smaller vertebrates and invertebrates. By burrowing deeply into the base of tussocks, insects and lizards can hibernate during the colder months, safe from low temperatures, predation and fire.

Native grasses produce large quantities of seed, which is an important food source for many insects and several bird species, including the beautiful firetail and blue-winged parrot.

Isolated trees, dead or alive, are extremely important because they provide shelter and vantage points for many mammals, birds and insects. They also provide stepping stones in the landscape for migratory or nomadic species.

Australasian pipit

common brown (Heteronympha merope)

Threatened species

The wedge-tailed eagle uses native grasslands for hunting.

The glossy grass skink is found in some areas of riparian grassland in the north of the state. The tussock skink is confined to lowland tussock grasslands.

The Tunbridge looper moth is confined to saline grasslands in the Tunbridge area. The Ptunnara brown butterfly is found in tussock grasslands, usually above 300 metres

Plumage colour of green rosellas reflects age and individual variations.

skipper butterfly on kangaroo grass

blue-winged parrot

flame robin (female)

SOME PASTURE AND GRASSLAND FAUNA

forester kangaroo
eastern barred bandicoot
southern brown bandicoot
Tasmanian bettong
wombat
eastern quoll
golden-headed cisticola
Australian kestrel
Australian hobby
stubble quail
tussock skink
glossy grass skink
Australasian pipit
blue-winged parrot
flame robin
brown falcon
geometrid moth (*Lackrana carbo*)
snail (*Tornatellinopsis jacksoniensis*), a naturally rare litter snail in Furneaux group
invertebrates including moths, butterflies, wasps, grasshoppers, crickets, spiders, ants and beetles

DRY BUSH

Bruny Island

Sclerophyll (Gk: *scleros* = hard; *phyll* = leaf) refers to the hard thick leathery leaves, the characteristic foliage of most plants in Australia. Dry sclerophyll bush can have a grassy, heathy or shrubby ground layer and understorey. In some areas sheoak and bulloak rather than eucalypts are the dominant tree species. Dry bush occurs mostly in the drier eastern parts of Tasmania from sea level to subalpine elevations.

As in other forests and woodlands, old-growth trees are extremely important for all hollow-nesting fauna. Old-growth eucalypts flower more profusely over a larger area than smaller trees, and attract many birds and insects when flowering.

The dead branches of canopy and understorey trees and tall dead emergent stags are important vantage points for birds. It gives them a clear view of the surrounding area so they can survey the landscape for predators or prey.

Stands of silver banksia (*Banksia marginata*) are common in dry bush. When in flower, banksias are centres of activity, and many insects, birds and mammals are attracted to feed on their nectar. Centres of ecological productivity like this, even when present for only a short time each year, increase the number of animals that can live in an area.

The importance of dry bush is often underrated because, for some people, it lacks the aesthetic appeal of the tall wet eucalypt forests. However, it is an extremely important habitat and has a greater diversity of plants, birds and other animals than other vegetation types.

assassin bug (Gminatus australis)

gumleaf grasshopper (Goniaea australasiae)

THREATENED ANIMALS

The swift parrot feeds in swamp gum and blue gum forests, predominantly along the east coast. The forty-spotted pardalote is found in white gum forests on Bruny, Maria and Flinders Islands and some isolated coastal areas.

The Tasmanian masked owl needs old-growth trees with large hollows in which to shelter and nest.

The wedge-tailed eagle uses dry sclerophyll forests for hunting and occasionally nesting.

The New Holland mouse, Tasmania's most threatened land mammal, is found only in some dry heaths and forests in the northeast of the state.

The spotted-tailed quoll is sparsely distributed in most vegetation types in Tasmania, including dry forests.

hanging fly (Harpobittacus australis group)

Recently fledged dusky robin hides in tangled understorey.

BIRDS OF DRY BUSH

brown quail
brown goshawk
collared sparrowhawk
wedge-tailed eagle
brown falcon
Australian hobby
peregrine falcon
painted button-quail
common bronzewing
yellow-tailed black-cockatoo
sulphur-crested cockatoo
musk lorikeet
green rosella
eastern rosella
swift parrot
blue-winged parrot
pallid cuckoo
fan-tailed cuckoo
Horsfield's bronze-cuckoo
shining bronze-cuckoo
southern boobook
masked owl
tawny frogmouth
Australian owlet-nightjar
laughing kookaburra
superb fairy-wren
spotted pardalote
forty-spotted pardalote
striated pardalote
Tasmanian scrubwren
brown thornbill
yellow-rumped thornbill
yellow wattlebird
little wattlebird
noisy miner
yellow-throated honeyeater
strong-billed honeyeater
black-headed honeyeater
crescent honeyeater
New Holland honeyeater
eastern spinebill
scarlet robin
flame robin
dusky robin
spotted quail-thrush
olive whistler
golden whistler
grey shrike-thrush
satin flycatcher
grey fantail
black-faced cuckoo-shrike
dusky woodswallow
grey butcherbird
Australian magpie
black currawong
grey currawong
forest raven
beautiful firetail
tree martin
welcome swallow
silvereye

SOME DRY BUSH FAUNA

all Tasmania's bat species
mountain dragon
white-lipped snake
tiger snake
echidna
little pygmy possum
ringtail possum
brushtail possum
eastern quoll
spotted-tailed quoll
Tasmanian devil
long-nosed potoroo
Tasmanian bettong
forester kangaroo
Bennetts wallaby
Tasmanian pademelon
southern brown bandicoot
eastern barred bandicoot
many litter-dwelling invertebrates including:
centipede (*Cryptops* sp.)
snail (*Discocharopa vigens*)
pseudoscorpion (*Neopseudogarypus sculettatus*)
geometrid moth (*Niceteria macrocosma*)
centipede (*Tasmanophilus* sp.)
'Hobart' stag beetle (*Lissotes basilaris*)

musk lorikeet

WET FOREST

near Branxholm, North east Tasmania

Wet sclerophyll forests are found in most areas of Tasmania from sea level to subalpine elevations. Their closed canopy maintains a cool, damp microclimate, which allows a great diversity of animals to flourish.

Many of the invertebrates in wet forests are found on the forest floor in decomposing wood and the deep, friable leaf litter. Tall old-growth trees in wet forest are ecosystems in themselves. They support a huge diversity of invertebrates, which, in turn, support local bird populations. Sometimes, these trees provide nesting sites for wedge-tailed eagles.

While eucalypts undergo mass regeneration after fire, many also regenerate readily in areas that have been opened up by fallen trees and selective logging. Such natural regeneration does not disturb the litter layer and large woody debris, and it leaves the faunal communities largely intact.

THREATENED ANIMALS

The spotted-tailed quoll is sparsely distributed in most vegetation types in Tasmania.

The Tasmanian masked owl needs old-growth trees with large hollows in which to shelter and nest.

The wedge-tailed eagle usually nests in wet eucalypt forests.

Five species of stage beetle are listed as threatened in Tasmania. All live in leaf litter and among rotting logs in wet eucalypt forests and rainforests.

The blind velvet worm, giant velvet worm and northwest velvet worm inhabit rotting logs (usually eucalypt) in wet forests and gullies.

John Simmons

dusky antechinus (Antechinus swainsonii)

Tasmanica skipper (Pasma tasmanica) on guitarplant (Lomatia tinctoria)

native bee on blanketleaf (Bedfordia salicina)

Austroleria sp.

WET FOREST BIRDS

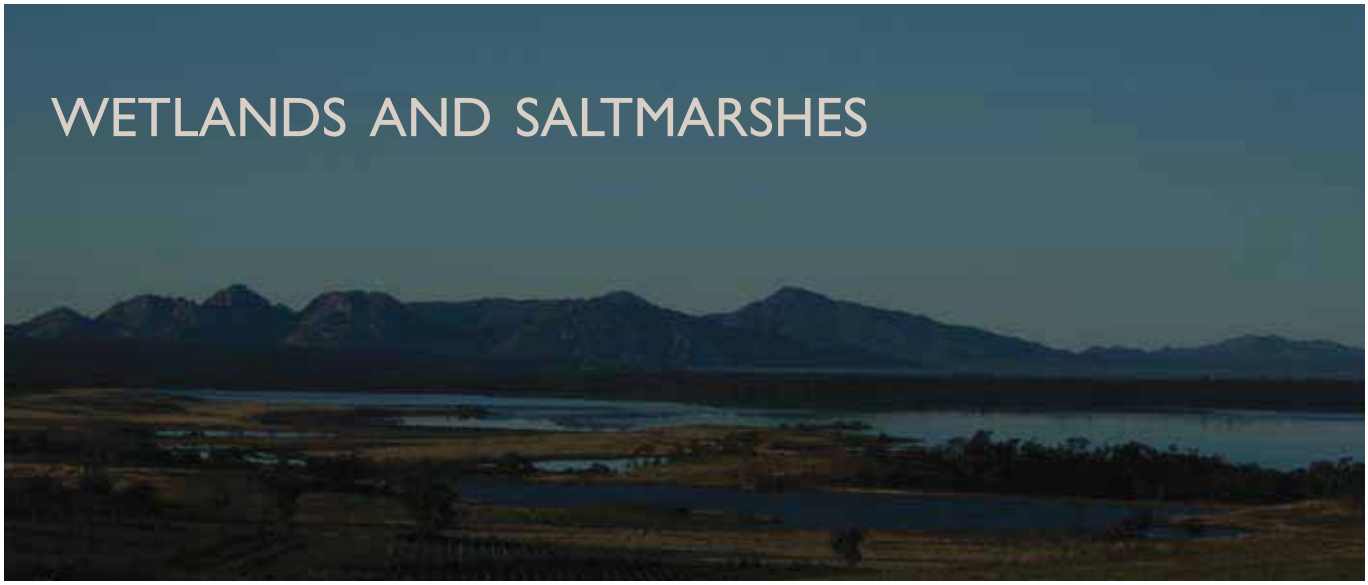
brown goshawk
collared sparrowhawk
wedge-tailed eagle
brown falcon
brush bronzewing
yellow-tailed black-cockatoo
sulphur-crested cockatoo
green rosella
swift parrot
fan-tailed cuckoo
shining bronze-cuckoo
southern boobook
masked owl
tawny frogmouth
Australian owlet-nightjar
laughing kookaburra (i)
superb lyrebird (i)
superb fairy-wren
spotted pardalote
striated pardalote
Tasmanian scrubwren
scrubtit
brown thornbill
Tasmanian thornbill
yellow wattlebird
yellow-throated honeyeater
strong-billed honeyeater
black-headed honeyeater
crescent honeyeater
New Holland honeyeater
eastern spinebill
scarlet robin
flame robin
pink robin
dusky robin
olive whistler
golden whistler
grey shrike-thrush
satin flycatcher
grey fantail
black-faced cuckoo-shrike
black currawong
grey currawong
forest raven
beautiful firetail
welcome swallow
silvereye
bassian thrush
(i) = introduced

SOME WET FOREST FAUNA

little pygmy possum
ringtail possum
spotted-tailed quoll
eastern quoll
Tasmanian devil
long-nosed potoroo
Tasmanian pademelon
southern brown bandicoot
dusky antechinus
long-tailed mouse
several frog species
all three snakes and several reptile species
diverse array of litter-dwelling and log-dwelling invertebrates, including amphipods, mites, beetles, velvet worms, spiders and snails
15 species of primitive moths (Family Hepialidae)

brush bronzewing

WETLANDS AND SALTMARSHES



Moulting Lagoon near Freycinet NP is a Ramsar listed wetland that supports a high number of breeding waterbirds.

Wetlands and saltmarshes are ecologically productive areas that support large animal populations. They accumulate nutrients from runoff from surrounding areas, which means they can support abundant annual plant growth. The lush foliage provides food and shelter for many birds, frogs and invertebrates. When the annual plants die down in autumn and winter they provide a mat of mulch which provides habitat for a range of invertebrates. Unnaturally high nutrient levels can accumulate in wetlands in agricultural and urban areas. In these situations, undesirable algae can flourish and choke plant growth.

Wetlands and saltmarshes can support a variety of vegetation communities, including reed beds, shallow-water and deep-water aquatic wetlands and marginal herbfields. They are important for a variety of animals. Reed beds in deep water are important nesting sites for waterbirds. Shallow-water aquatic wetlands have the greatest diversity of aquatic insects. Marginal herbfields are important grazing areas for native birds and marsupials.

Some species can only use wetland and saltmarsh areas if the surrounding vegetation is intact. Several species of frog and many bird species need this vegetation for shelter and nesting. It also reduces wind speed, which allows insects, such as dragonflies, damselflies, caddisflies and mayflies, to fly more frequently.

Islands in wetlands provide safe roosting and nesting sites for waterbirds. Trees — dead or alive — in wetlands are also important, because they provide roosting sites for waterbirds.

The health of aquatic faunal communities depends on water quality. As soon as the water becomes turbid, the diversity of aquatic fauna decreases, leaving only a few common species rather than a large diversity of species.

Livestock disturb the vegetation and muddy the water which reduces the diversity of aquatic communities. They also disturb feeding and nesting waterbirds, and trample frogs and reptiles.

Any patches of native vegetation in the vicinity of wetlands, including individual paddock trees, are important for wetland animals. They provide foraging and hibernating areas for frogs, and nesting sites for some wetland birds. Many insects have aquatic and terrestrial stages in their lifecycles, so they need both types of habitats.

Fluctuations in water level can vary widely, and produce permanent, seasonal or ephemeral wetlands. The fauna and flora communities in wetlands have been adapting to these local

praying mantid (Family: Mantidae)

fluctuations for hundreds or thousands of years. Any changes to the natural regimes, such as increasing or decreasing the amount of water, will lead to changes in the faunal communities.

Invertebrate communities that inhabit wetlands and saltmarshes vary according to the salinity, acidity, nitrogen and phosphorous content, water depth and water temperature.

Turning artificial water bodies, such as farm dams and garden ponds, into valuable habitat for native animals can be simply a matter of designing the areas so they have some areas of shallow water and an island where native plants can establish.

THREATENED SPECIES

The dwarf galaxias is found in some riverine wetlands in the northeast, northwest and on Flinders Island.

The glossy grass skink is found in reed beds and wet grasslands in the north.

The green and gold frog breeds in wetlands and farm dams. The striped marsh frog is restricted to areas around Waterhouse and Smithton.

The chevron looper moth and saltmarsh looper moth are found in some saltmarshes in the southeast.

The salt-lake slater is found on some saline lakes in the Midlands.

The Australasian bittern inhabits shallow freshwater or brackish swamps, especially those with sedges, rushes and/or reeds. It feeds on fish, eels, frogs, freshwater crayfish and aquatic insects.

Tasmanian native-hen

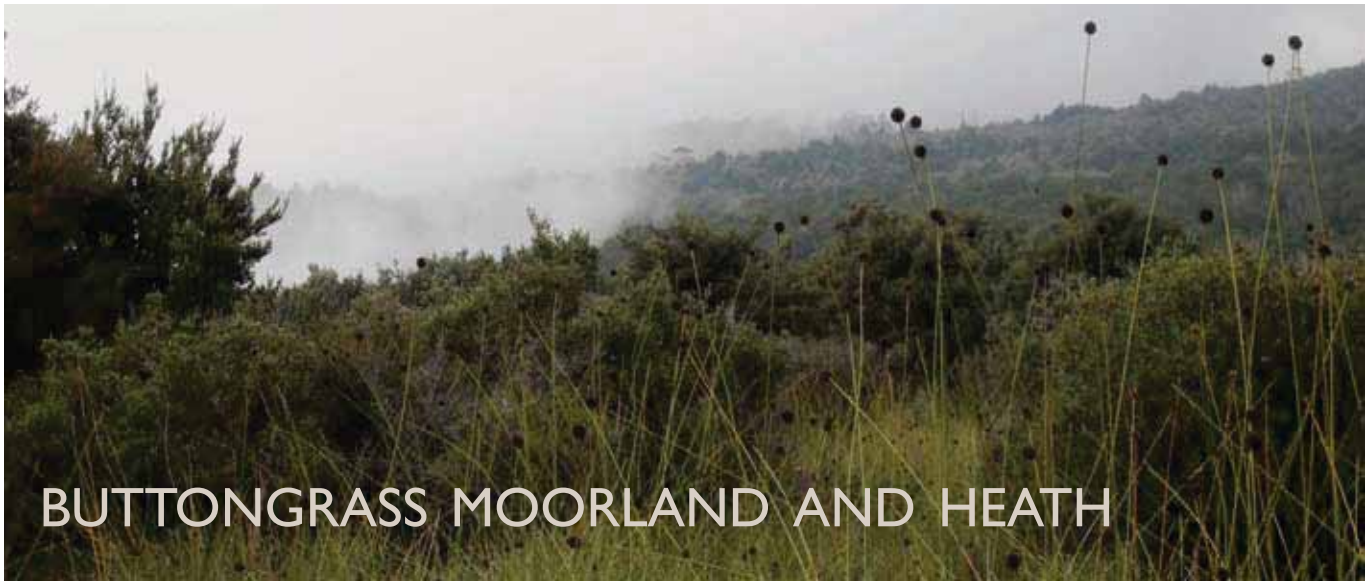
Micah Visoiu

green and gold frog (Litoria raniformis)

white-faced heron

SOME WETLAND FAUNA

Australasian shoveler
hard head duck
Lathams snipe
swamp harrier
blue-billed duck
dusky moorhen
whistling kite
rufous night heron
Tasmanian tree frog
Tasmanian froglet
glossy grass skink
lowland copperhead
tiger snake



BUTTONGRASS MOORLAND AND HEATH

near Mt Victoria, Northeast Highlands

Lowland buttongrass moorlands and heathlands have a diversity of low-growing plants found in a range of nutritionally poor environments from wet and even waterlogged areas to others that are very dry.

The dense ground-level vegetation of buttongrass moorlands and heathlands is important for small animals such as the swamp rat, broad-toothed mouse and ground parrot. Their runways are often completely covered with undergrowth, which gives them protection from birds of prey.

In some heaths the diversity of flowering plants that bloom at different times provides a year-round source of nectar and pollen for a range of animals, especially insects.

THREATENED SPECIES

The New Holland mouse is found only in some dry heaths and forests in the northeast.

The orange-bellied parrot breeds in the southwest and feeds in heathy buttongrass moorlands. During migration it may stop to feed anywhere along the west or northwest coasts including the Hunter Group and on King Island.

The Scottsdale burrowing crayfish has a restricted distribution in buttongrass moorlands near North Scottsdale.

native flower wasp (Thynnus sp.)

SOME BUTTONGRASS AND HEATHLAND FAUNA

ground parrot
tawny-crowned honeyeater
southern emu-wren
striated fieldwren
up to eight species of lizard
all three species of snake
swamp rat, broad-toothed mouse
echidna
dusky and swamp antechinus
white-footed dunnart
eastern quoll
wombat
many litter-dwelling invertebrates
burrowing crayfish

White's skink (Egernia whitii)

ALPINE AND SUBALPINE

Cushion plant communities are composed of several different plant species. Pine Lake, Central Plateau

Alpine and subalpine areas are a patchwork of boulder fields, cushion plant communities, eucalypt woodlands, grasslands, heaths, moors and coniferous rainforests. These mosaics are interspersed with small lakes and tarns and provide an array of habitats that support a variety of faunal species. As in other habitats mosaics of several vegetation types within an area support more animals than do similar-sized areas of a single vegetation type.

THREATENED SPECIES

The Ptunarra brown butterfly is endemic to Tasmania and is restricted to tussock grasslands above 300 metres.

The pencil pine moth is found in association with pencil pine trees on the Central Plateau. The Lake Fenton trapdoor spider is found near Mt Field. The Miena jewel beetle is found in the Great Lake area.

The wedge-tailed eagle uses subalpine and alpine areas for foraging.

The Mt Arthur burrowing crayfish has its stronghold on Mt Arthur and nearby subalpine areas. The Flinders Island burrowing crayfish is found only on Mt Strzelecki and Mt Munro on Cape Barren Island, which approach subalpine elevations.

SOME ALPINE AND SUBALPINE FAUNA

southern snow skink
northern snow skink
mountain skink
three species of snake
five species of frog (it is the primary habitat for the moss froglet)
black currawong
striated fieldwren
crescent honeyeater
flame robin
silvereye
brown thornbill
Tasmanian thornbill
wombat
eastern quoll
Tasmanian devil
Bennetts wallaby
long-nosed potoroo
pademelon
brushtail possum
ringtail possum
burrowing crayfish
diversity of flying insects including butterflies, moths, lacewings, flies and native wasps
huge variety of ground invertebrates, many species are restricted to particular vegetation types, particularly amphipods, ground beetles, bugs, crickets, grasshoppers, spiders and specialised earthworms

Tasmanian velvet grasshopper or tallus hopper (Tasmanalpina clavata) lives in rocky areas.

RAINFOREST

Callidendrous rainforest, Ralph's Falls, Northeast Highlands

Extensive areas of cool temperate rainforest are found in western Tasmania, in the northeast highlands and in sheltered gullies subjected to frequent mist and fog.

The classification of the different types of rainforest in Tasmania is based on the structure and composition of the vegetation. Pencil pine (*Athrotaxis cupressoides*) rainforest is restricted to alpine areas; myrtle-beech rainforest (*Nothofagus cunninghamii*) is more widespread.

Myrtle-beech rainforest is subdivided into three main types. Callidendrous rainforest has tall canopy trees with very little woody understorey but abundant fern species; thamnic rainforest is dominated by well formed trees with a shrubby understorey; implicate rainforest has a low broken canopy of poorly formed dominant trees with a tangled understorey.

The Tarkine region of northwest Tasmania has the largest remaining contiguous area of cool temperate rainforest of Gondwanan origin in the country. On the Australian mainland myrtle-beech rainforest remains as small isolated pockets in sheltered gullies or along rivers.

Rainforests with simple vegetation structure and fewer plant species do not support the range of faunal species seen in nearby eucalypt forests. Much of the rainforest fauna is found on the forest floor in decomposing wood and the deep, friable leaf litter.

However, these rainforests are hotspots of fungal diversity with many fungal species only growing in association with myrtle-beech. Furthermore, there are numerous invertebrate species associated with the rich variety of bryophytes, lichens and fungi that are restricted to these high rainfall areas.

Hygrocybe astatogala

Tasmania's rainforests are extremely important for fungi. From left Hygrocybe sp, H. cheelii, Clavaria miniata, Cortinarius metallicus

SWAMP FOREST

Melaleuca swamp forest, Birralee

Swamp forest and scrub are widespread in Tasmania, but are most common in the northwest. They are dominated by paperbark (*Melaleuca* species) and blackwood (*Acacia melanoxylon*).

Swamp forest and scrub are found on water-logged soils, and are susceptible to inundation. They have little plant diversity, but provide unique habitat of mostly bare ground and low light levels. This is ideal for many amphipods and several species of burrowing crayfish. The flaking bark of paperbark is suitable for a variety of invertebrates adapted to living in the spaces between the layers.

The prolific flowering of paperbark and blackwood provides pollen and nectar for birds and insects from surrounding areas.

Sheep and cattle trample and compact swampy ground, which destroys the habitat of many ground invertebrates, especially burrowing crayfish.

The endemic scrubtit is found in wet forest and rainforest.

THREATENED SPECIES

The grey goshawk forages and nests in all types of wet forest including rainforest, mixed forest and blackwood swamps. However, swamp forest, especially those dominated by blackwood (*Acacia melanoxylon*), is its preferred breeding site.

The giant Tasmanian freshwater crayfish once occurred in all the waterways flowing into Bass Strait except those in the Tamar catchment.

The King Island scrubtit is only found on King Island, where it inhabits scrubland and swamp paperbark forest.

pink robin

SOME RAINFOREST AND SWAMP FOREST FAUNA

burrowing crayfish	Bassian thrush
Tasmanian thornbill	ringtail possum
Tasmanian scrubwren	amphipods, freshwater
pink robin	crabs, worms
olive whistler	spiders, moths, mayflies,
scrubtit	caddisflies

IMPORTANT HABITAT FEATURES

White-faced heron on dead eucalypt, Bruny Island

Some features of native vegetation have a major influence on the number and diversity of animals in an area. For instance, old-growth trees, also known as habitat trees, are very important, as is leaf litter and fallen logs on the forest floor. These features may be present in any vegetation type and should be protected.

masked owl

OLD TREES

Old trees are a remarkable three-dimensional world that provide food, hiding spots, escape routes and nesting sites for a wide range of animals. Huge old eucalypt trees, either dead or alive, are among the most valuable habitat features of Australian bush. In modified landscapes, such as much of Tasmania's grazing land, old paddock trees are not only of immense value to wildlife but they also provide shelter and shade for stock, help maintain the water table and reduce erosion. They also have other conservation values, which are often overlooked, such as producing locally adapted seed for revegetation and shelter belts.

Studies on isolated paddock trees in the sheep and wheat belts of Western Australia and New South Wales have found that their foliage is more nutritious than that of the trees in nearby remnants because the soil around them has been enriched by fertilisers and manure from domestic animals. Their nutritious leaves support large numbers of invertebrates, which, in turn, attract many birds, including magpies, ravens, parrots and large honeyeaters. Although small insectivorous birds, such as thornbills and fairy-wrens, seldom venture into open paddocks for fear of predation, old paddock trees provide important stepping stones for migrating species, such as the striated pardalote, dusky woodswallow and black-faced cuckoo-shrike. Paddock trees are also valuable as resting and nesting places for hollow-dependent birds, including owls and parrots, and they are especially favoured by bats. The brown falcon and other raptors use their elevated branches to survey the landscape for prey.

dusky woodswallow

NO WOODPECKERS!

Woodpeckers inhabit every continent on Earth except Anarctica and Australia. They have special shock absorbers in their heads designed to withstand the impact of drilling into tree trunks with their chisel-like bills. They can create a hollow in a matter of days or weeks.

In Australia hollows form over a much longer period. Fungal decay in the heartwood occurs in old trees, especially those already damaged by wind or fire. The heartwood is then excavated by fire or the activities of vertebrates and invertebrates.

It takes up to 80 to 100 years to form hollows for small species including striated pardalotes, pygmy possums and bats. It takes another 100 or more years to form cavities large enough for sulphur-crested cockatoos, yellow-tailed black-cockatoos, green rosellas, eastern rosellas and masked owls.

Guayaquil woodpecker of South America

Many spiders live in underground burrows, especially where there is abundant litter.

TREE HOLLOWS

Trees with hollows are important features of forests and woodlands, and they are crucial for the survival of many of our native animals. Many animals use hollows for shelter, feeding, nesting, rearing young and regulating temperature. Sometimes they provide a source of water for mammals.

Since European settlement logging has removed many large old trees for timber, fencing and firewood. Consequently, trees with hollows are scarce in many areas. Conserving hollow-dependent fauna is an increasingly important management issue.

The shortage of hollows is exacerbated by a number of factors. Introduced species or those that are favoured by current land management practices including brushtail possum, common starling, European bee, laughing kookaburra, little corella, galah and Australian wood duck use tree hollows. Their large populations mean that there are fewer hollows left for native species.

It is essential to preserve existing old-growth trees and paddock trees. It may take 300–400 years before today's revegetation creates a new home for a masked owl.

LITTER

Fallen trees and branches, large woody debris, bark and leaf litter are often regarded as waste or fuel. In fact, they are vital components of the structural complexity of ecosystems. They protect the soil and are important for the recycling of nutrients, particularly carbon and nitrogen.

The nutrients used by a plant during its lifetime are released back into the soil when it dies and decays. The break down is hastened by fungi, bacteria and invertebrates.

Most wood-boring insects are not able to digest cellulose, the main component of plants. As a result, many have developed symbiotic relationships with wood-decomposing fungi or bacteria, which break down the cellulose into digestible components. After the insects bore into wood and decay has been initiated, the site is colonised by fungi, which in turn become food for hundreds of species of insect. In Tasmania, over 500 beetle species are associated with decaying wood.

Rates of decay and the development of microhabitats for lichens, mosses, fungi and ferns vary with topography, aspect and soil. In wet forests, large logs support a diversity of bryophytes (mosses and liverworts) which have a remarkable ability to retain water. Bryophytes provide countless invertebrates with shelter, camouflage, protection from extreme temperatures, food and a place to deposit their eggs. These concentrations of invertebrates are important sources of food for mammals, reptiles and birds.

Logs provide habitat and basking sites for reptiles, small animals use them as pathways, and ground-foraging birds such as robins and cuckoos perch on them when scanning the ground for prey. Logs, especially large ones with hollows, protect ground-dwelling species, such as the spotted quail-thrush, eastern quoll, white-footed dunnart and Tasmanian bettong. The high moisture content of logs makes them desirable habitats for frogs especially during and after fires.

About 75% of arthropods (spiders and insects) spend some of their life in the leaf litter or the upper layers of the soil. Wolf spiders, named because of their great speed when running down prey, occupy cavities deserted by cicada nymphs or moth and beetle larvae, or use their fangs to dig underground burrows. Many predatory beetles, such as ground beetles, rove beetles and click beetles, are important in controlling insect populations. They rely on the abundant litter for protection. The litter layer of bark and leaves camouflages ground-dwelling animals.

Ants have several ecological roles. As well as being collectors of seed, and movers of huge amounts of soil, many ants are scavengers. They collect unhealthy, dead and exhausted fauna from the ground and foliage. They drag the animals back to their nests, where they feed the masticated bodies to their larvae. Ants are not able to live in areas where the ground has been overgrazed and compacted, or where their preferred nesting sites—logs and rocks —have been removed.

Messy bush with fallen logs, rocks and leaf litter is rich in fauna. In comparison, bush that has been cleaned up or subjected to frequent fuel-reduction burning supports fewer species.

WET AREAS IN DRY FOREST

Wetlands, streams or drainage lines that occur within dry forests increase the diversity of animals in an area. They produce abundant plant growth which makes them favoured feeding sites for herbivorous mammals. Populations of frogs, some reptiles and a variety of invertebrates focus on these sites, and spread out into the surrounding vegetation.

ROCKY AREAS

Areas with rock outcrops, boulder fields and rocky ground cover are important for some lizard species and many invertebrates, such as ants and beetles. Areas with larger rock features, such as cliffs, small caves and large boulders, are favoured as den sites by mammals such as the Tasmanian devil and spotted-tailed quoll.

A MOSAIC OF DIFFERENT VEGETATION TYPES

There is a greater diversity of animals in areas with a mosaic of vegetation types, such as dry sclerophyll forest interspersed with gullies of wet forest. Each vegetation community is favoured by certain species of animals, but many species use several vegetation types. Birds, in particular, use different vegetation communities at different times of the year.

This long-legged metallic fly (Arachnomya arborum) lays its eggs into a recently fallen eucalypt. Some landowners are uniquely placed to record natural occurrences and contribute to 'citizen science' projects.

SOIL

Tasmania has an extensive range of the geological, geomorphological and soil diversity that make up a landscape. It has representatives of the 12 major periods of Earth history from the Precambrian to the Holocene spanning some 4,600 million years. Landforms include rugged mountains, glacial and periglacial features, rivers and their catchments, extensive limestone and dolomite karstlands, inland dunefields and a variety of coastal features. Soil types vary across the island and are derived from the bedrock and a range of soil forming processes.

Soils are one of the most important living and dynamic ecosystems that support the production of much of the world's food. It is estimated that in one cup of healthy soil there are more than 6 billion living organisms and that in healthy ecosystems about 70–90% of the organisms live underground.

The formation of soil is influenced by temperature, the availability of water and the myriad of life forms it contains. Plants have an enormous influence on soil health by providing shade and shelter for soil microbes. Most of the biological activity and exchange of nutrients takes place in the top 20 centimetres of soil, particularly in the root zone. Micro-organisms (algae, viruses, protozoa, fungi and bacteria) obtain their nutrients from decaying leaves, roots and other organic matter, and from the faeces of plant-eating insects.

Fungi and bacteria are the main decomposers of organic matter. They convert it into humus and make the nutrients available to other organisms. Fungi are active decomposers of cellulose and lignin. Fungal hyphae form networks in the soil and although each individual thread is weak, collectively they form a framework for soil structure. As the by-products of decomposition are released they are used by other organisms, especially bacteria, that proliferate rapidly, especially in areas with a high organic content. Bacteria are the only organisms capable of fixing nitrogen in a form usable by plants. Bacteria and fungi produce different types of antibiotics that control plant pathogens. Microfauna such as nematodes and protozoa graze fungi and bacteria and release nutrients for plant growth.

Small invertebrates such as mites, collembola (springtails), ants, earthworms, millipedes, dung beetles, spiders, centipedes and cockroaches, burrow in the soil and mix organic with inorganic substances. They ingest dead roots, litter and other organic substances, combine them with digestive juices and excrete them. Many mites are predatory and control populations of plant-feeding insects thus eliminating the need for chemical insecticides.

Small native animals such as bandicoots, bettongs, wombats, echidnas and reptiles, burrow in the soil in search of food. Their burrowing mixes litter and surface soil, hastens decay and enhances soil structure and condition. Water percolates into the soil through the small depressions created by burrowing.

Australia's infertile soils have suffered considerably as a result of human activity that disrupts the interactions that have evolved over millennia between soil, micro-organisms, plants and animals. Clearing native vegetation removes the ground cover essential for retaining moisture and good biological functioning. It removes habitats leaving small mammals more vulnerable to predation. It also leads to saline soils.

Hard-hoofed domestic animals including sheep, cattle and feral deer, which have replaced soft-footed native herbivores, compact the soils and make them hard and impervious to water. Pesticides, herbicides and fungicides destroy soil micro-organisms.

Fire damages soil by exposing the soil surface making it less permeable and more vulnerable to erosion. It converts the organic litter layer and soil surface to a thin bed of ash, which reduces nutrients, moisture and litter fauna.

Soils are also damaged by machinery that compact them or reshape the topography; irrigation raises the water table making soils saline. Fertilisers increase nutrients, radically changing soil chemistry.

John Simmons

eastern barred bandicoot

BRYOPHYTES: MOSSES, LIVERWORTS & HORNWORTS

A variety of thallose and leafy liverworts cover a 'mossy' log in a rainforest gully.

The dark damp conditions of Tasmania's rainforests and wet eucalypt forests are ideal for the proliferation of cryptogams; plants such as algae, ferns, bryophytes, fungi and lichens that reproduce by spores rather than seeds.

'Bryophytes' is a term used for three unrelated groups of plants: mosses, liverworts and hornworts. They are thought to have evolved from a group of green algae about 400 million years ago and although they represent separate evolutionary lines, they are lumped together because they developed similar adaptations to increase their reproductive success and to overcome the problems of desiccation.

To do this they produce their sperms and eggs in separate sacs called antheridia (male) and archegonia (female). Then they retain the fertilized eggs inside the archegonia where the embryos grow into spore-bearing structures called sporophytes. And, most importantly, they enclose their spores in a rot resistant, waterproof, UV shielding carotenoid polymer called sporopollenin. It was this last adaptation that enabled them to colonise the land.

Unlike flowering plants, most bryophytes do not have a transport system for conducting water. In addition, the leaves of most bryophytes lack a thick waxy covering that in flowering plants reduces water loss. They lack true roots but attach to the substrate (e.g. logs, trees, rocks or soil) by hair-like rhizoids through which they can take in water and minerals.

Bryophytes usually reach peak abundance in wet habitats where exposed roots, trunks, rocks and soil are blanketed in a rich variety of leafy liverworts and mosses that in some areas can number over two hundred species.

Bryophytes become desiccated during prolonged dry periods but they have a remarkable ability to absorb water through their leaves which means they can transform quickly from a crisp to a photosynthesizing green plant as soon as water becomes available. This ability, along with the

A fly (Ceratolauxania atrimana) laying eggs into liverwort.

A fly (Hybitodae sp.) on moss sporophytes.

A parasitic wasp laying eggs in to a mossy log.

relatively large amount of water they can hold on their leaves by surface tension, makes them crucial in maintaining a stable humid atmosphere. Soil colonising species help to reduce evaporation and prevent soil erosion.

Bryophytes do not contain lignin, the substance that gives structural strength to the cells in ferns and flowering plants. Consequently, most bryophytes are small.

THALLOID (OR THALLOSE) LIVERWORTS AND LEAFY LIVERWORTS

Thallose liverworts dominate the northern hemisphere flora and there are relatively few species in Tasmania. One familiar species, *Marchantia berteroana*, often grows with potted plants. It has thick leathery leaves that lie flat on the surface (usually soil) from where it can access water and nutrients. Leafy liverworts have small thin leaves and superficially resemble mosses. They evolved in Gondwana and dominate the southern hemisphere liverwort flora. New Zealand is the centre of southern hemisphere liverwort diversity with Tasmania a close second. The liverworts that occur in Tasmania and New Zealand include primitive endemic families that inhabited Gondwana before it fragmented, as well as genera that evolved after the fragmentation. These primitive families are believed to hold the key to the understanding of the evolution of liverworts - the first plants on Earth.

MOSS

There are three main groups of mosses. The 'true' mosses are the most widespread and species-rich with about 9000 species; the approximately 100 species of granite mosses are restricted to granite; and the third group, the sphagnum mosses, have a cosmopolitan distribution and are usually associated with bogs.

leafy liverwort sporophytes

moss sporophytes

hornwort sporophytes

thallose liverwort sporphyte

The most obvious (visible) difference between mosses, leafy and thallose liverworts and hornworts can be seen in their fertile structures called sporophytes.

Leafy liverwort sporophytes have dark spherical capsules containing the spores which mature close to the plant and before the translucent stalks begin to lengthen. When the stalks lengthen they lift the capsule above the plant. The capsule splits into a star-shaped structure and the spores are ejected. The stalk is unable to make its own food and it therefore lasts for hours or several days at the most.

Moss sporophytes have a stalk (seta) that is usually brown and solid with long lasting capsules. As the stalks slowly lengthen they raise the capsules above the plant. The capsules mature only once the stalk has stopped growing.

Hornwort sporophytes are needle-shaped structures that open by one or two vertical slits. They continue to grow if conditions are favourable and shed mature spores from the tip and produce new spores at the base.

The sporophytes of thallose liverworts resemble small green umbrellas.

FUNGI

Australian honey fungus (Armillaria luteobubalina)

The fruiting bodies of fungi display a stunning variety of colours, shapes and textures. Although their network of mycelial threads spreading through the substrate is usually not seen, fungi are ever-present in the environment where they perform crucial ecological roles as decomposers; as symbiotic partners with most plants; and as parasites, weeding out the weak.

pixie's parasol (Mycena interrupta)

SAPROTROPHIC FUNGI

Saprotrophic fungi get nutrients from decaying organic matter found in soil, litter, dung and wood. Fungi, along with bacteria, are the principal decomposers in the environment. They play a crucial role in hastening the decay of organic matter. During the process fungi transport, store, recycle and release nutrients for use by other organisms.

MYCORRHIZAL FUNGI

The mycorrhizal (fungus-rooted) fungi are a specialist but widespread and important group of fungi that have symbiotic (mutually beneficial) relationships with approximately 90% of plant species. The fungus modifies the roots of the host plant by forming sheaths around the non-woody rootlets, which effectively extends the root zone, and allows nutrients to be exchanged between the two organisms. The fungus supplies the plant with water and soil nutrients (particularly phosphorus). In return, it obtains carbohydrates and sugars from the plant. Mycorrhizal fungi help plants in poor soils take up nutrients more effectively, which enables them to grow faster, withstand droughts and resist pathogens. This, in turn, enables the plant community to be more diverse, resist weed invasion, and provide better habitat for small animals.

earthstar (Geastrum sp.)

forest cup (Plectania campylospora)

beech orange (Cyttaria gunnii)

Boletellus obscurecoccineus

Russula lenkunya

Tom Thekathyil

Vegetable caterpillar (Cordyceps gunnii)

purple jellydisc (Ascoryne sarcoides)

PARASITIC FUNGI

Parasitic fungi extract nutrients from living plants and animals. They invade trees, insects and other fungi, sometimes killing them. The honey fungus is a widespread parasitic fungus that several decades ago contributed to the death of many trees in the Tasmanian Botanic Gardens. It is a native species found in native forests where it spreads by dark, string-like roots known as rhizomorphs.

Vegetable caterpillars are a group of fungi that parasitise insects. In Tasmania, the fungus *Cordyceps gunnii* is often found under silver wattles (*Acacia dealbata*). It parasitises the larvae of moths over-wintering underground. The fungal hyphae invade and gradually replace the insect's tissues. The fruiting body then appears above the ground.

FUNGAL HABITATS AND MANAGEMENT

There is much to learn about the habitat needs of fungi, and how best to maintain or increase their diversity and biomass. It is not known if conservation reserves based on plant communities conserve fungi adequately, or if any species are more or less important for the stability and conservation of ecosystems. However, it is known that some species specialise in breaking down dead wood, and that the type of wood, size of the log, and degree of decomposition determine the species present.

Studies in the Northern Hemisphere have shown that some wood-decomposing fungi are now rare, except in areas of undisturbed forest where large logs have been left to rot. It is likely that burning, firewood harvesting and "cleaning up" the bush have had a negative effect on wood-rotting fungi in Tasmania. Leaving a diverse array of woody debris of various sizes and stages of decomposition should encourage a diversity of fungi.

A FIRST FOR TASMANIA

In 1792, the French naturalist Jacques-Julien Houtou de Labillardiere was the first European to document a fungus in Australia after finding the starfish fungus or anemone stinkhorn (*Aseroe rubra*) at Recherche Bay in southern Tasmania. The starfish fungus is a red, star-shaped fungus that expands from an egg-like sac. It belongs to a bizarre groups of fungi known as the phalloids or stinkhorns. The spores of this group are a mass of foul-smelling, brown slime. They are spread by flies and other insects that are attracted to the fungus by the disgusting smell of rotting flesh. The spores adhere to the feet and other parts of insects and are dispersed when they fly away.

LICHENS

A carpet of lichens of various species covers the ground at the Blue Tier.

Few organisms can survive and flourish in the most inhospitable places on earth, and even fewer are composite structures that comprise members of two and sometimes three life forms.

Lichens are a remarkable partnership between at least two organisms: a fungus and a green alga, or blue-green alga, or both. The alga contains chlorophyll and provides the fungus with food in the form of sugars through photosynthesis. The fungus, which usually makes up the bulk of the lichen, provides the alga with some nutrients and protection from harsh conditions. Lichens that have a blue-green algal component are able to capture and fix atmospheric nitrogen. This symbiotic (i.e. mutually beneficial) partnership allows lichens to live in habitats that the components could not colonise independently. For example, fungi usually inhabit areas rich in organic matter, while algae are usually found in aquatic and moist environments. As lichens, they are able to colonise areas of extreme humidity, aridity and light intensity.

Cladonia sp.

REPRODUCTION AND DISTRIBUTION

Lichens reproduce by spores or by small vegetative parts that break off from the main body of the lichen. As these are transported by wind, rain, insects and birds, numerous species have a worldwide distribution. Many Tasmanian lichens, especially rainforest species, originated in the ancient supercontinent, Gondwana, and have closely related species in similar habitats in New Zealand and South America.

Numerous species of crustose lichens form on rocks.

Lichens are not restricted to natural surfaces; they also colonise footpaths, windows, rubber tyres and roofing tiles. Most do not obtain nutrients from the surface on which they grow. However, some species are restricted to particular host plants and rock types and some have particular climatic requirements, such as a high rainfall.

This tiny spider is well camouflaged on a leafy lichen.

HABITATS

Lichens are found almost everywhere from rocky coasts, where bright yellow and orange crust-like lichens cover the rocks like paint, to high rainfall rainforests, where they reach their greatest diversity. Extensive colonies cover the ground in alpine and subalpine areas where they prevent the soil from drying out. In

Coenogonium implexum grows on smooth barked trees such as dogwood and sassafras.

Peltigera dolochoriza is common on rocks, soil and logs in wet forests.

dry forests, where the shedding bark of eucalypts does not provide a stable substrate for lichens, many crustose (crust-like) and leafy species live on rocks and soil and on the bark of understorey plants.

In most areas, the number of lichen species far exceeds the number of flowering plant species. In rainforest, for example, there are usually four times more lichen species than flowering plants. One large, old tree with many microhabitats can support up to 70 different lichen species.

WATER AND NUTRITION

Lichens obtain all their needs, including carbon dioxide, oxygen and inorganic nutrients, from air and water. They are extremely efficient at absorbing water—and the substances dissolved in it, including mineral nutrients—from mist, fog, dew and run-off. However, their efficiency means that they also absorb atmospheric pollutants, so they cannot survive in some highly polluted urban areas. They are extremely sensitive to air pollution, and are used extensively in environmental monitoring programs, especially in the Northern Hemisphere.

ECOLOGICAL ROLES

Lichens quickly colonise bare soil. When they cover the ground, they aid moisture retention and prevent erosion. They physically and chemically break down rocks and thus contribute to soil formation.

Lichens contribute to the nutrients in rainforests. Species are blown from the trees by wind and their decomposition adds nutrients to the soil. Some species fix atmospheric nitrogen, others trap nutrients from rain and mist.

Many birds use lichens in their nests. The pink robin disguises its nest with flakes of leafy lichens. Some invertebrates have colours and patterns that make them almost invisible when they rest on lichens.

Lichens contain many unique chemicals. Usnic acid, a commonly occurring compound in lichen, has antibiotic properties. The perfume industry has long used lichen compounds as fixatives and base odours in its products. Lichens have been used to dye woollen fabrics since the early fourteenth century. Even today, Harris Tweed, manufactured in Scotland, is dyed with lichens. Further research will no doubt find other important chemicals.

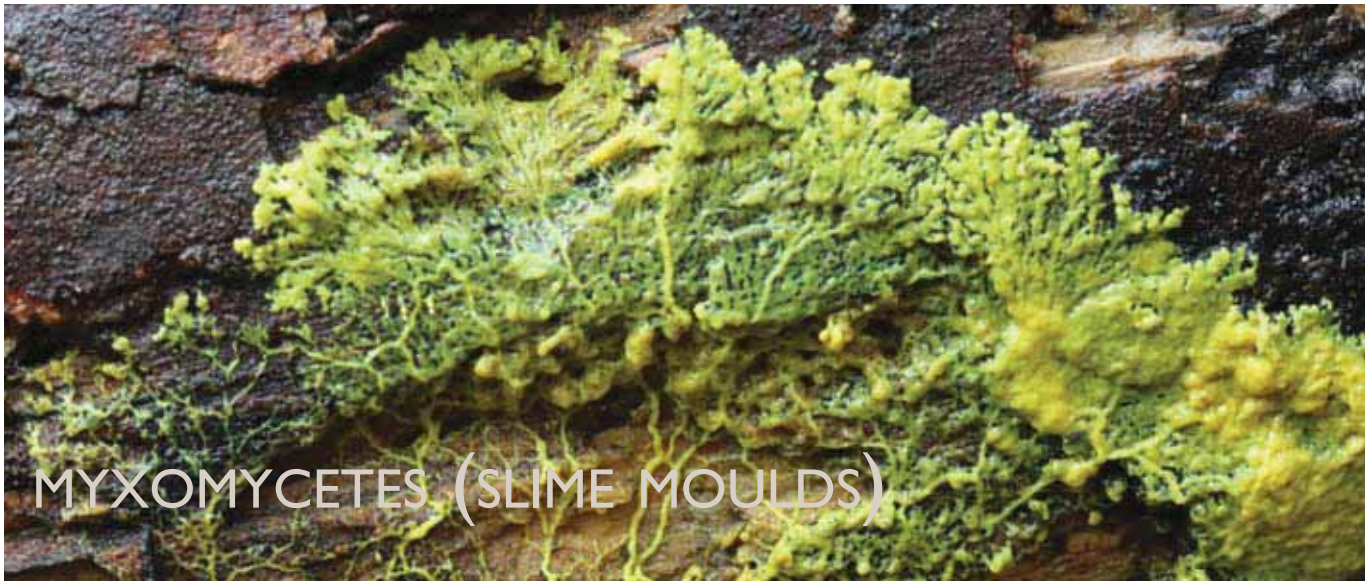
CONSERVATION

Like many organisms, lichens are sensitive to disturbance of their natural habitat. The species most at risk are those confined to particular substrates and vegetation types. Very old trees support a high diversity of lichens, because of the many microhabitats they provide. Disturbances in forest change the light intensity and microclimates and adversely affect many lichens. Trampling by stock destroys ground lichens and bushfires can eliminate all lichens. Air pollution, especially near urban and industrial areas, can wipe out the local lichen flora. Several lichen species in Tasmania are listed as rare, vulnerable or endangered, and at least one is considered extinct.

IRRADIATED REINDEERS

The ability of lichens to absorb atmospheric pollutants was unexpectedly highlighted in 1965. At that time, blood samples were taken from people throughout the world to ascertain the effects of radioactive fallout from above-ground nuclear tests. The Sami, who live in the far north of Norway, Sweden and Finland, were used as a control group because of their presumed remoteness from pollutants. But they had 55 times more radioactivity in their tissues than the Finns, who live further south.

It transpired that lichens absorbed and concentrated the radioactive caesium and strontium fallout. Reindeer ate the lichens and stored the radioactive elements in their bodies. The Sami, in turn, ate the reindeer, which are one of their main sources of protein.



MYXOMYCETES (SLIME MOULDS)

slime mould plasmodium

Slime moulds are really remarkable organisms! Except at a certain stage of their lives, or if they remain in the field too long, slime moulds are neither slimy nor mouldy – or even smelly. Rather, they are fascinating organisms with qualities of both animals and fungi. They have two trophic (feeding) stages that remain hidden within the soil and dead organic matter where they move in search of food and thus are akin to animals; then they transform into spore-bearing fruiting bodies more akin to fungi. This duality has befuddled classifiers for centuries and although slime moulds have at different times been placed alongside plants, animals and fungi, they are now included with amoebae and other single-celled organism in the Kingdom Protista.

There are three types of slime moulds. The dictyostelids, also known as cellular slime moulds, the very obscure protostelids, and the acellular slime moulds, also known as plasmodial slime moulds or myxomycetes. The cellular slime moulds are mostly microscopic; the acellular slime moulds are the ones we see.

Myxomycetes start life when microscopic spores released from the fruiting bodies germinate into one or several amoebae. The amoebae take one of two different forms: myxamoebae or flagellated amoebae called swarm cells. The latter have two thread-like structures (one short and one long) called flagella which assist in locomotion. Amazingly, each form is capable of converting to the other form depending on conditions: they're flagellated swarm cells when it's wet and myxamoebae when it's dry. The myxamoebae and flagellated swarm cells feed by engulfing other micro-organisms such as bacteria, yeasts and small protozoans. They multiply by division and their populations can reach extraordinary numbers measuring between 10 and 1000 and sometimes more than 10000 per gram of soil. They require moist conditions to function but should dry conditions persist they can change to a dormant stage, a microcyst, and revert to functioning normally when favourable conditions return.

Two or more compatible myxamoebae combine to form the second feeding stage, the plasmodium, a single-celled organism with numerous nuclei — sometimes numbering in the thousands. The plasmodium is enclosed in a slime sheath, a membrane believed to prevent desiccation. It feeds in the soil and decaying organic material on various kinds of bacteria; fungal hyphae, fruiting bodies and spores; algae (which may remain alive and impart a greenish tinge to a plasmodium) and possibly lichens. They are also known to parasitise and predate plasmodia of other myxomycetes.

There are three main types of plasmodia. The most primitive and smallest, the

Acyria sp.

Badhamia utricularis

Colloderma sp.

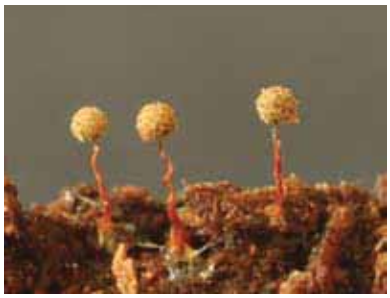
Stemonitopsis typhina

Diderma sp.

Lamproderma sp.

Metatrichia floriformis

Physarum viride



Cribraria sp.

dog's vomit slime mould (Fuligo septica)

protoplasmodia, are tiny structures 100-300 microns in diameter that give rise to one minute fruiting body.

The most common type is the often large and conspicuous phaneroplasmodium whose simple external appearance belies a complex internal structure. Phaneroplasmodia can attain sizes of up to one metre; they pulsate over substrates such as logs, tree trunks and leaf litter, sometimes travelling several metres within days. They eventually produce several to several thousand tiny usually stalked fruiting bodies, often dotted equidistantly along a log or other substrate.

The third type of plasmodia characteristic of the order Stemonitales are the large, almost invisible aphanoplasmodia (aphano = invisible) whose thin plasmodial strands can invade the micropores in hard woody substrates. Like the first feeding stage, plasmodia are able to revert to a hard dormant structure, a sclerotium, during adverse conditions and return to function normally when favourable conditions return.

Eventually plasmodia transform into the spore-bearing stage, also known as fruiting bodies or fructifications. What activates the transformation is difficult to determine but in the laboratory changes in ambient conditions such as pH, moisture and temperature or exhaustion of the food supply seem to act as triggers.

Fruiting bodies take a number of different forms. The most common type, the sporangium (plural: sporangia), found in approximately 75% of species, is a tiny stalked or sessile structure usually between 0.5 mm and 3 mm tall. Their spore mass, known as sporotheca, are encased in a membrane, the peridium (pl: peridia), which can be multilayered, iridescent, lime encrusted, wholly or partly persistent or fugacious (i.e. short lived) depending on the genera or species.

Less common but more conspicuous are the large amorphous blobs called either aethalium (plural aethalia) or pseudoaethalium. Aethalium result from most or all of the plasmodium and are characteristic of the widely occurring *Fuligo septica* also known as "dog's vomit" or "scrambled egg" that are often seen atop tree stumps or logs where their spores are dispersed by water droplets. Pseudoaethalia look similar to aethalia, but close examination reveals that they are composed of individual closely packed sporangia. The plasmodiocarp, the fourth type, take the form of the veins in the plasmodium.

Slime moulds are considered to be one of the most important regulators of bacteria because they inhabit and feed in all types of decaying organic matter such as logs, leaf litter and faeces. More recent research shows that they may play an important role in the bioremediation of heavy metals such as lead and zinc.

Australia's slime moulds are the least studied in the world. In 1995 one hundred and five species were documented from Australia, including only 29 species from Tasmania. Given that Tasmania has considerable areas of potential habitat, and that species inventories from temperate regions of the world usually number approximately 150 species, this number is clearly a gross underestimation. An ongoing study in northern Tasmania has already documented 90 species.

The identification of most slime moulds involves examination of their spores and other structures with a good quality compound microscope, or even a scanning electronic microscope. Although this equipment is not readily available, interested people (equipped with hand lens and head lamp) can find a range of species in their local area, especially if there is an abundance of decaying organic material such as rotting logs, leaf litter and other coarse woody debris.

CONCLUSION: GOOD ECOLOGICAL PRACTICES

The aim of good ecological management is to sustain viable populations and ensure the long-term survival of the multitide of species that are found in different habitats.

Protecting geodiversity (the rocks, landforms and soils that are the basic building blocks of our landscapes and the foundation for ecosystems) is integral to the maintenance of biodiversity.

Any patch of native bush, regardless of size, will provide habitat for some native animals. Large areas of remnant vegetation are more likely to maintain viable populations than small areas, and management priority should be given to patches of 10 hectares and over. Ideally patches should be linked with corridors at least 50m wide. Streams and waterways are important for wildlife. Riparian vegetation provides shelter for fauna and stabalises streambanks. It also keeps the water cool and shaded and provides nutrients for fish and other wildlife. A coordinated management approach with neighbours will be more effective than an individual approach.

A mixture of local native plant species—preferably of various ages—will have the structural complexity to provide many different places to forage, nest sites and places to shelter. A greater variety of plants supports a higher diversity of insects, as many insects require specific plants for food or habitat. Seasonal variations in flowering and fruiting times ensure a continuous supply of food for many species including insects, birds, mammals and reptiles.

Large old trees – dead or alive – provide hollows, nest sites and places to forage for birds, insectivorous bats and climbing mammals. Trees take over 100 years to form hollows so are essentially irreplaceable in our lifetime. They provide larger areas for foraging and flower more profusely than young trees. Many birds require a high vantage point to survey the landscape for potential predators or a high perch from which to sing to attract a mate.

Rocks and logs provide microhabitats for mosses, liverworts and lichens and shelter for insects and seedlings. Logs are used by countless animals for feeding, basking, breeding and as lookout sites. They provide important habitat for reptiles, travel routes for small animals and are a concentrated source of invertebrate food for other wildlife. They offer nest protection for ground-nesting birds and their high moisture content make them particularly desirable habitats for frogs – especially during fires.

Leaf litter, fallen branches and logs release a bounty of nutrients if left on the ground to break down. Hundreds of species of insects feed on the fungi that speed up this process, and they in turn are food for mammals and birds.

THREATS TO FAUNA

Cats and dogs do untold damage to Tasmania's fauna. Uncontrolled dogs can frighten or kill small native animals such as echidnas or possums, flush animals from their nests or harass snakes and other reptiles.

Cats should be de-sexed, well-fed and kept indoors as much as possible, especially at night. An active programme of trapping and humanely destroying feral cats can prevent the decimation of local populations of small animals and birds. Feral cats pose not only a risk to wildlife by hunting and killing, but also by spreading potentially fatal diseases such as toxoplasmosis. Toxoplasmosis can adversely affect native animals especially bandicoots. Toxoplasmosis infection during pregnancy in humans can lead to eye disease, hydrocephalus (enlarged head) and convulsions. In sheep and goats it can lead them to abort.

Under the 2009 Cat Management Act only registered breeders are permitted to breed cats. Cats sold or given away must be more than eight weeks old, desexed and microchipped.

Excessive livestock grazing seriously degrades natural habitats. Stock such as sheep and cattle disturb native animals. Trampling endangers ground-nesting birds, frogs and many invertebrates. Pollution and nutrient enrichment of land and water diminishes populations of native wildlife, favouring some species while disadvantaging others. Prevent overgrazing and fence out stock from water sources.

Speed kills. To prevent road mortality, take care and slow down especially when driving at night, dusk or dawn in bushland fringe areas. Many animals become dazzled by lights and will often cross or stop on roads. Moving carcasses off the road will ensure that carrion feeders such as quolls, devils and raptors will not be put at risk of being hit when feeding on road kills.

Poisons such as pesticides, insecticides or meat baits kill native animals. Toxic chemicals and sprays affect animals and their food source. Many poisons are indiscriminate. Insecticides kill target pest species as well as useful predatory insects. Once in the environment, persistent chemicals can pollute water supplies and enter the food chain, adversely affecting a wide range of animals including birds of prey and people.

FIRE AND FAUNA

2013 was the hottest year on record over the whole of the Australian continent. 'Catastrophic' wildfires such as those experienced on the east coast in 2006/07 and at Dunally in early 2013 are predicted to become more frequent events in Tasmania. With more people living surrounded by bush this scenario puts additional pressure on landowners, local councils and other authorities to undertake fuel reduction burns to reduce the risk to human life and property. But what impact will this have on the native wildlife?

Fire is a frequent event in Australian ecosystems. It plays a major role in determining the species composition and structure of vegetation, which in turn influences the distribution and abundance of animals. Fire is frequently used to manage different vegetation communities or to stimulate the growth or provide ideal conditions for threatened plant species, particularly orchids. However, some plant species such as bracken fern are pyrophytic. Pyrophytic plants are adapted to withstand or achieve a competitive advantage from fire. The impact of fires on plant communities is relatively easy to assess; the impact on faunal species is much more difficult to determine. And while there have been numerous studies on the impacts on fauna after wildfires, there have been very few long-term studies on the whole biota.

Since European settlement vast tracts of land have been cleared for housing, agriculture and forestry. In many areas, remaining isolated and fragmented habitats have been further degraded by frequent fires. High intensity wildfires and repeated low intensity control burns are catastrophic events—albeit on a different scale. Studies are now showing that frequent low intensity burns that have been used for decades to reduce fuel loads and stimulate the growth of grass for stock are also removing the food, nesting sites and nesting materials of many birds. Individuals that cannot escape the flames die in the fire. Fires during spring and summer disrupt the breeding cycles of many animals.

Birds, mammals and invertebrates all respond differently to fire. The impact of fire on different species will depend on a number of factors including the vegetation type, intensity of the fire, the frequency of fire events, the season of the burn and what is occurring in the surrounding landscape. The following examples illustrate how complex these responses can be.

GRASSLANDS

Woody shrubs such as *Leptospermum* and *Hakea* species can eventually take over some native grasslands if they are left unburnt. If grasslands turn to shrubby heathlands they no longer provide habitat for grassland fauna including the threatened Ptunarra brown butterfly. This endemic species occurs in fragmented populations in the midlands and some high altitude areas where it depends on *Poa* tussocks for food and shelter. To manage the habitat for the species it is recommended that the grasslands be subjected to cool burns in a mosaic pattern; burning different patches each year on a cycle of approximately 4 to 7 years. This reduces fuel loads but maintains grassy features without damaging the *Poa* tussocks. Cool winter and autumn burns are recommended as they are less likely to kill the caterpillars living in the base of the tussocks. However, fires when the adults are flying in February to April (i.e. late summer to early autumn) should be avoided completely.

The burning regime will depend on the purpose of the fire.

The orange-bellied parrot is a critically endangered species that breeds only in southwest Tasmania where it feeds on the seeds of low shrubs and sedges in buttongrass plains, sedgelands and heathlands. The availability of food is related to the fire history of the feeding sites and one study suggests that they prefer to feed on relatively young vegetation in a seasonally rotating order: in October and November they fed mainly in 7 to 8 year old regrowth, in December they fed mainly in 1 to 4 year old regrowth, in January and February they mainly fed in regrowth more than 8 years after fire. However, because they breed in tree hollows that often fringe the plains where they feed, they are constantly at risk from wildfires that destroy their nests, eggs and chicks.

On the other hand, ground parrots and southern emu-wrens occur in the same vegetation communities as the orange-bellied parrot. Both are weak flyers so they have limited dispersal abilities and are particularly vulnerable to wildfires or controlled burns that escape. Frequent burning of intervals of less than 5 years has led to the decline and/or local extinction of these heathland dependent birds.

Burning the buttongrass also affects mammals in different ways. Within a year of burning the regrowth provides succulent shoots for herbivorous animals such as Bennett's wallaby, wombat and grasshoppers. However, wallabies and wombats need unburnt areas of vegetation nearby for shelter.

Small mammals such as swamp rat, broad-toothed mouse and swamp antechinus need a thick vegetation cover to protect them from predators and are unable to survive in recently burnt areas. It may take five or more years before the vegetation becomes dense enough to provide adequate protection. Studies have shown that they probably recolonise areas at a different rate: the broad-toothed mouse is an herbivorous species and can feed on regrowth as soon as there is adequate cover. The omnivorous swamp rat is slower to recolonise probably because there is an insufficient range of foods and the vegetation cover is not adequate to protect it or its nest sites from predators.

Fires in buttongrass moorlands that are intense enough to burn the underlying peat may threaten the long term survival of the rare Hickman's pygmy mountain shrimp (*Allanaspides hickmani)* which lives in pools in the moorlands.

INVERTEBRATES

The dry eucalypt forests of eastern Tasmania dominated by ironbark (*Eucalyptus sieberi*) have been used intensively since early European settlement. The timber is hard, durable and splits easily making it ideal for fence posts, firewood and high quality timber products. Since the 1970s Forestry Tasmania has advocated the use of fuel reduction burning on a 7 year cycle to protect forestry assets. Studies have been undertaken to establish the impact of this frequent fire regime on vegetation structure and fuel loads. At only one of the 54 sites studied did researchers find an active and diverse invertebrate fauna. The site had not been burnt for at least 15 years and had a 15 cm litter layer of mostly *Allocasuarina* needles.

Studies on the impact of frequent, low intensity hazard or fuel reduction burning on forest invertebrate fauna in New South Wales found a range of different impacts depending on the species.

Frequent burning results in the simplification of the forest litter (leaves, twigs, bark etc) which is of course the desired outcome of fuel reduction burns. The moisture in the topsoil was considerably lower (18%) following 20 years of frequent burning and the amount of light reaching the ground increased by 125%. Results showed a statistically significant decreases in species associated with leaf litter including ticks and mites (down 31%), insect larvae (down 35%), flies (down 58%), and beetles (down 31%). There was an increase in abundance of some groups including bugs (up 77%), ants (up 250%), and spiders (up 33%), a response that could be attributed to more suitable habitat or increased ease of capture by researchers in the simplified environment.

Although the overall species richness did not change the composition of species assemblages did change. Species that are naturally uncommon or rare or with particular habitat requirements such as a deep litter layer and stable moist conditions were eliminated and those species adapted to drier more open environments increased. The researchers concluded that fuel reduction burning could potentially reduce terrestrial invertebrate populations by as much as 50% at a regional scale. They also conjecture that the loss of particular species could change the dynamics of nutrient recycling in the forests.

Terrestrial animals, including echidna, Tasmanian scrubwren, superb fairy-wren and dusky antechinus that feed almost exclusively on invertebrates in the litter layer, are likely to be impacted by these changes.

CONCLUSION

Burning in small patches (mosaic burning) gives animals a chance to escape the flames during the fire and enables them to find suitable unburnt habitat after the fire. Patch burning will enable small vertebrates and invertebrates to recolonise the area.

Fires should be kept away from old-growth trees to preserve their vital habitat for hollow-dependent fauna. Even though eucalypt species are adapted to fire they will die if exposed to repeated burning. An initial fire hollows out the base of the tree and subsequent fires burn out a little more of the heart each time. Eventually the trunk cannot support the weight of the tree and it falls over.

Fire management for the conservation of biodiversity is extremely complex. Responses to fire vary considerably depending on the species, vegetation type, the type and intensity of the fire and what is occurring at the landscape scale. The best approach it to ensure that the same fire regime is not uniformly applied across the landscape. Variation in timing, intensity and frequency should ensure that there is minimal loss of species from inappropriate fire regimes.

It is extremely important that there are good reasons to burn and that when fire is used to conserve particular vegetation communities or plant species long-term monitoring is undertaken to determine if the desired outcomes are being achieved. Monitoring should also assess the impact of the fire on the fauna as well as non target plant species.

Fire can be an effective management tool in the right circumstance, or it can be indiscriminate and destructive.

It is vitally important to consult a fire ecologist and the local fire authorities if burning is to be used as a management tool.

CASE STUDY: FIRE AT RUBICON SANCTUARY

Rubicon Sanctuary at Port Sorell has 50 orchid species making it one of the richest sites for orchids in Tasmania. Many of the species are rare or threatened and in some cases, Rubicon Sanctuary is the only place in Tasmania where they occur.

Fire is used as a management tool to stimulate the growth of the orchids.

Patch burning is carefully managed. All debris is raked from below mature eucalypts to eliminate the risk of the trees catching fire; seedling eucalypts are also protected. Fire breaks are constructed around the patches to be burnt and the weather is carefully assessed to determine if conditions are safe to burn. Landowners burn in consultation with local fire authorities and neighbours are notified. All necessary precautions are taken to eliminate the possibility of the fires escaping.

Landowners conduct extensive monitoring to assess the impact of the fires on threatened orchids and other species and to determine the optimal interval between successive fires.

Phil Collier

rainbow sun orchid (Thelymitra polychroma) at Rubicon Sanctuary

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RESOURCES FOR IDENTIFYING FAUNA

Frogs

Frogs of Tasmania by Murray Littlejohn (2003) has excellent general information and species accounts. It also has identification keys to eggs, tadpoles, adult frogs and the advertisement calls of male frogs.

The Tasmanian Frogs CD, produced by the Central North Field Naturalists, contains descriptions and recordings of the calls of Tasmania's 11 frog species. It can be ordered through the website: http://www.disjunctnaturalists.com/

Birds

Australian Bird Call: Tasmania CD by Nature Sound and David Stewart.

There are numerous field guides to Australian birds and some specific to Tasmania including *Field Guide to Tasmanian Birds* by Dave Watts and R.H. (Bob) Green's *The Fauna of Tasmania: Birds*.

The Bird Finder allows you to search, browse or find information about individual Australian birds.
http://www.birdsinbackyards.net/finder

Mammals

Tracks, Scats and Other Traces: A Field Guide to Australian Mammals by Barbara Triggs is one of the best reference books on identifying the signs of Australian mammals. It provides comprehensive illustrations.

Skulls of the Mammals in Tasmania, written by R H Green and illustrated by J L Rainbird, has illustrations of the skulls of all of Tasmania's mammals. It is now out of print but available through local libraries

Tasmanian Mammals: A Field Guide by Dave Watts is a useful photographic guide to Tasmania's mammals.

Reptiles

Snakes and Lizards of Tasmania by Hutchinson et al is a good photographic guide to the reptiles of Tasmania with excellent information. It is Number 9 in the Fauna of Tasmania series.

Reptile rescue—emergency call from anywhere in Tasmania Phone: 0407 565181

Invertebrates

Butterflies of Tasmania published by the Tasmanian Field Naturalists Clubs is a pictorial guide to butterflies.

Wings, an introduction to Tasmania's winged insects by Elizabeth Daley depicts a wide variety of insect.

This website has lots of photos that aids in the identification of insect species.
https://sites.google.com/site/insectsoftasmania/home

Fungi

Fungi down under, the Fungimap guide to Australian Fungi includes 100 easily recognisable fungal species.

A field guide to Australian fungi by Bruce Fuhrer covers more than 500 species.

http://www.bluetier.org/nature/fungi.htm & http://fungimap.org.au/

Bryophytes

http://www.bluetier.org/nature/mosses.htm

Slime moulds

http://disjunctnaturalists.com/slime-mould-log

Fire management

Planned burning in tasmania Operational Guidelines and Review of Current Knowledge September 2009 by Jon Marsden-Smedley http://www.stors.tas.gov.au/item/stors/0cf0e8e8-b12e-d70f-ac75-d032ddecd922/1/web1/file.pdf

Threatened species

http://www.dpiw.tas.gov.au/inter.nsf/WebPages/RLIG-5446TS?open

Other websites:

www.dpipwe.tas.gov.au/landforwildlife

www.gardensforwildlife.dpipwe.tas.gov.au

www.dpipiwe.tas.gov.au/plcp

SPECIES INDEX

Numbers underlined indicate photographs; * indicate endemic species

PRIVATE LAND CONSERVATION IN TASMANIA

'Bugs, birds, bettongs and bush' beautifully describes the fascinating and wonderful features of our Tasmanian wildlife and their habitats. A large proportion of Tasmania's wildlife species and habitats considered essential for biodiversity conservation occurs on privately owned land outside of National Parks or Reserves. The survival of our wildlife (plants and animals) and natural diversity depends on the conservation or restoration of suitable habitat as a means of protecting our land, waterways and wildlife. Protection of a diverse range of wildlife species and habitat today will assist in reducing the risk of species becoming threatened.

The Department of Primary Industries, Parks, Water and Environment's Private Land Conservation Program (PLCP) offers a number of options for private landowners to conserve wildlife species and habitat. It also supports and recognises landowners who are taking a positive approach to the integration of property land management with nature conservation. The aims of these programs include conserving species and habitat outside of National Parks and Reserves, providing continuity of habitat across landscapes, contributing to ecologically sustainable long-term viability of agricultural systems and promoting community participation in nature conservation.

Conservation covenants - landowners may enter into a covenant to manage defined areas specifically for nature conservation. Covenants are voluntary but legally binding and are registered on the land title in perpetuity. A Covenant in perpetuity gives peace of mind that the natural values, like native flora and fauna, wetlands and geoconservation areas will persist for generations. While retained in private ownership, they also contribute to Australia's network of protected areas, the National Reserve System.

The key partners in the delivery of conservation covenant agreements in Tasmanian are the PLCP, Tasmanian Land Conservancy (TLC) and Australian Government.

Land for Wildlife is a voluntary, non-binding nature conservation scheme that aims to encourage, support and recognise landowners taking a positive approach to the integration of property land management with nature conservation. The Land for Wildlife scheme was first established in 1981 in Victoria. It has since grown into a national program with the Land for Wildlife scheme established in Tasmania in 1998.

Membership of the Land for Wildlife scheme is entirely voluntary and free. Landowners with more than 2 ha, who wish to conserve existing native habitat or restore degraded habitat on their land are welcome to apply.

Gardens for Wildlife is a voluntary scheme that supports, encourages and recognises people who wish to make their urban or suburban garden friendly for local wildlife and the environment. It is an initiative of the PLCP and was officially launched in 2008. It was developed to provide the opportunity for broader community participation and support in nature conservation and to increase awareness of biodiversity conservation more broadly and to encourage people to think beyond their backyards. There is a growing recognition of the importance of urban wildlife and gardens can play a valuable role in providing and protecting wildlife.

For more information visit www.gardensforwildlife.dpipwe.tas.gov.au or www.dpipwe.tas.gov.au/plcp

Biodiversity is defined as: the variety of all life forms on earth – the different plants, animals and micro-organisms, their habitats and their genes ... Biodiversity is the foundation of life on Earth. It underpins the functioning of ecosystems from which we derive essential products and services such as oxygen, food, fresh water, fertile soils, shelter, medicines and recreation. (www.iucn.org/what/tpas/biodiversity/about/)