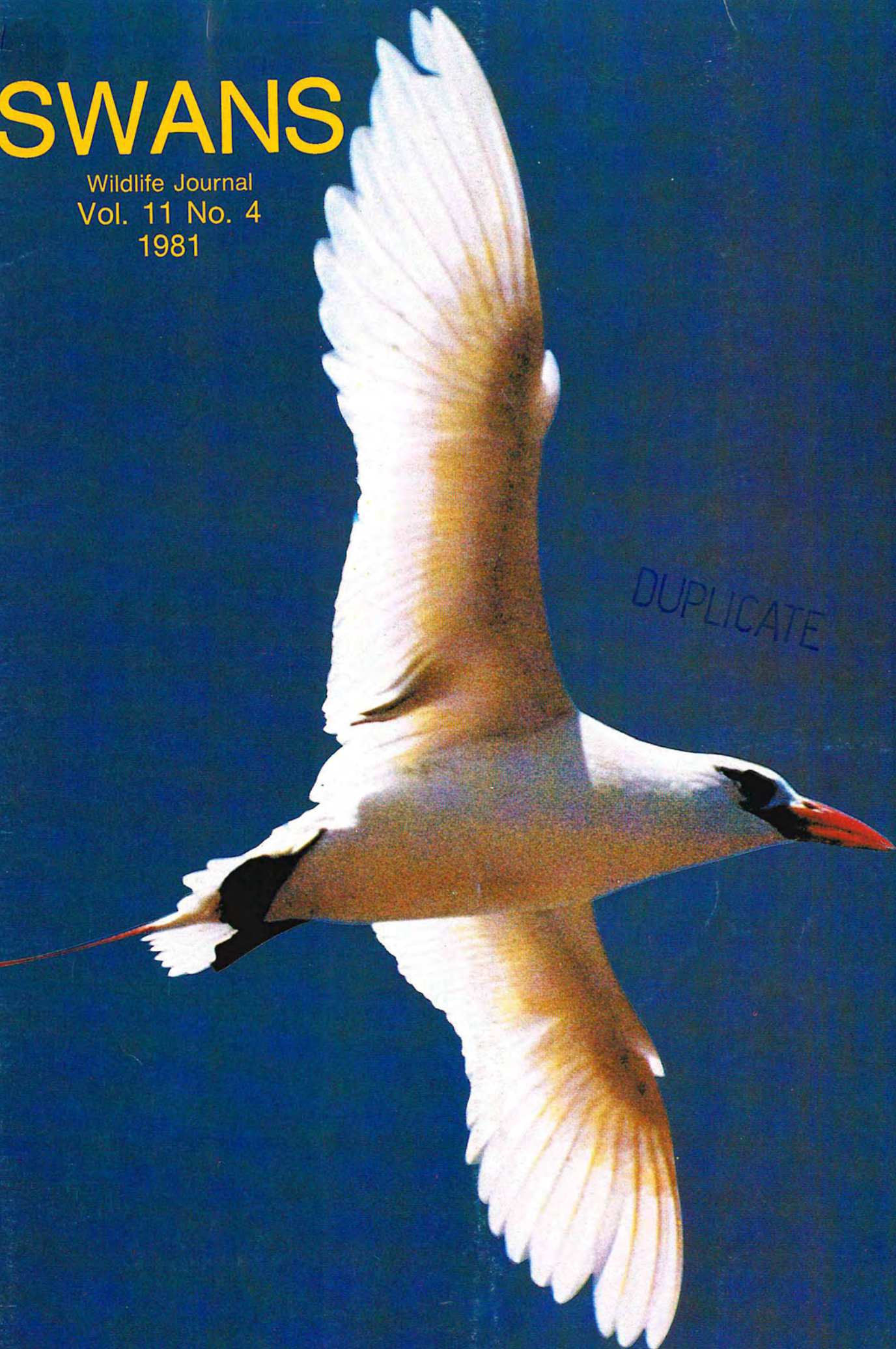


SWANS

Wildlife Journal
Vol. 11 No. 4
1981



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SWANS

Vol. 11 No. 4
1981

*The State Wildlife
Authority News
Service (SWANS)*
is

*issued by direction of the Hon.
Gordon Masters, M.L.C.
Minister for Fisheries
and Wildlife.*

*Director of Fisheries and Wildlife
B. K. Bowen, B.Sc.*

*The support of the public is an
essential component in any
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management*

*programme—but an informed,
educated public is needed to
ensure its continuing success.*

*This publication is designed as
a medium by which the various
organisations, individuals, and
wildlife management
personnel may be kept
informed of the work being
carried out by this department,
of departmental policies and
directions: and for promoting
a better understanding and
appreciation of Western
Australian wildlife and the
role it plays in maintaining a
suitable environment in which
man can live.*

*SWANS is published
quarterly by:*

**Extension and Publicity
Office,
Department of Fisheries
and Wildlife,
108 Adelaide Terrace,
Perth, Western
Australia 6000**

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ISSN 0155-9397

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COVER PHOTO

The Red-Tailed Tropic-bird (*Phaethon rubricuda*) is one of the more commonly occurring birds of Pelsart Island (see Page 3 for story) and has bred on the island as recently as 1956. (Photo—Copyright A. G. Wells).

WILLIAM C. BROWN, Government Printer, Western Australia

Pelsart Island—A Haven for Seabirds

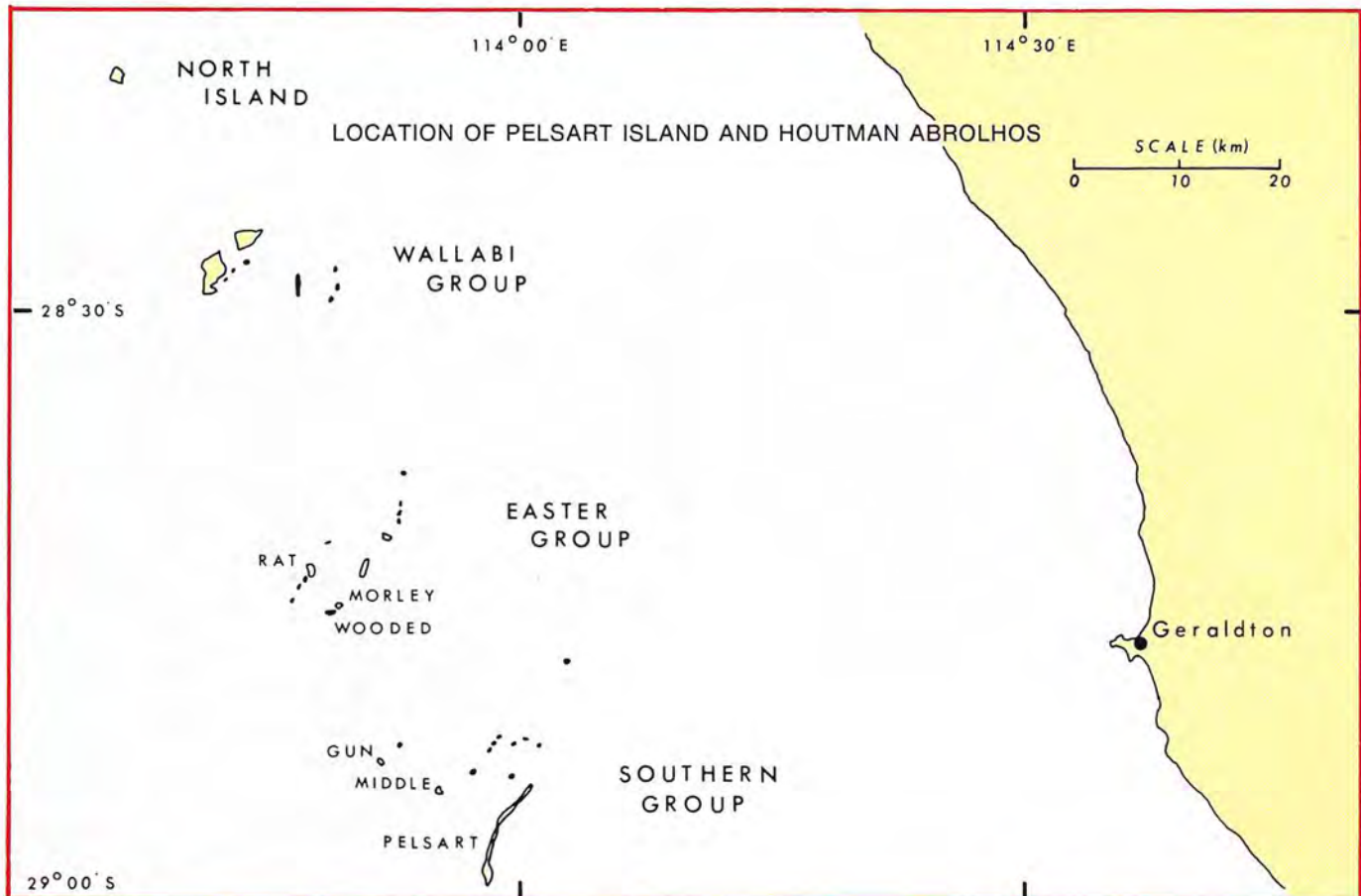
A survey of the birds of Pelsart Island carried out by a team from the Western Australian Department of Fisheries and Wildlife has confirmed that Pelsart Island is one of the world's most important breeding areas for seabirds.

Pelsart Island is the largest island in the southern Abrolhos group and it lies 60 km from the port of Geraldton, Western Australia (see map). The island itself is 12 km long and varies in width from 0.5 km to only 50 metres. It is composed of coral boulders, shingle, limestone and sand rising only a few metres above high water mark.

Areas composed of coral shingle are virtually bare or have very low perennial and annual herbs and grasses. On deeper soils, especially near the southern end, is a dense low heath of shrubs, notably *Nitraria schoberi* and *Atriplex cinerea*. Samphire (*Halosarcia* spp.) is found in salt marsh areas, while the white mangrove (*Avicennia marina*) forms



▲ Sooty Tern. (Photo Copyright A. G. Wells).





▲ Breeding colony of Crested Terns. (Photo A. A. Burbidge).

▼ White-breasted Sea-eagle and chick. (Photo Copyright A. G. Wells).



dense low forests along sheltered parts of the northern shore, around salt lakes and in some moist low lying areas.

The bird survey was carried out by Mr P. J. Fuller a Technical Officer and Dr A. A. Burbidge, Chief Research Officer of the Western Australian Wildlife Research Centre, between 1977 and 1981.

Survey Results

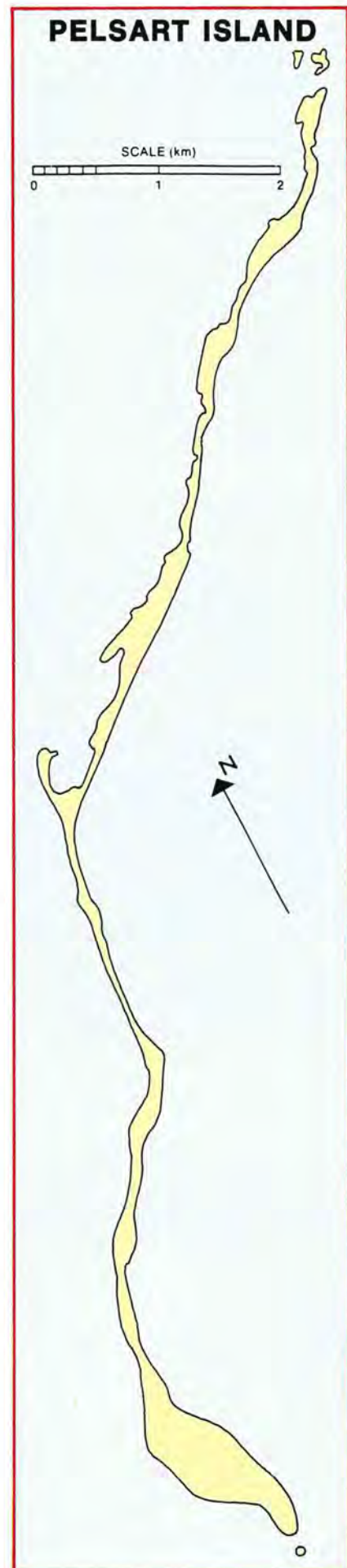
Fifty-eight species of birds were recorded during the survey. Of these, 21 were sea birds, 23 were shore birds, eight were water birds with a widespread distribution, and seven were land birds. Fifteen sea birds and one land bird were found to be breeding on the island.

These findings showed that more species of sea bird breed on Pelsart than on any other island off the Western Australian coast. The next most important Western Australian islands in terms of breeding species are Sandland and Buller, each with ten species, and both these islands are quite small.

Pelsart Island is the breeding place of some particularly important species of sea birds. The island's colony of Lesser Noddies, *Anous tenuirostris*, is one of only two in Australia—the other is 27 km to the north-west on Wooded Island and

Morley Island, both in the Easter Group of the Abrolhos. Elsewhere the Lesser Noddy breeds only in the Seychelle Islands. Because of its extremely restricted breeding range the Lesser Noddy has been placed on the Australian Official List of Endangered Species and is specially protected under Western Australian legislation. These colonies have suffered marked fluctuations in numbers and the species did not breed on Pelsart for many years in the early part of this century. Fortunately, the mangroves on Pelsart were recolonised some time between 1913 and 1936, presumably from Wooded Island, which for some time would have held the only breeding colony of this rare species in Australia. The mangroves, on which breeding depends, are of limited extent and any disturbance leading to death of mangroves would have a disastrous effect on the Lesser Noddy.

Pelsart Island also provides a breeding site for the more widespread Common Noddy, *Anous stolidus*, which has few other breeding stations in Western Australia. The closest to Pelsart is Bedout Island, off the northern Pilbara, and the only other colony in this State is in the Lacepede Islands, near Broome.

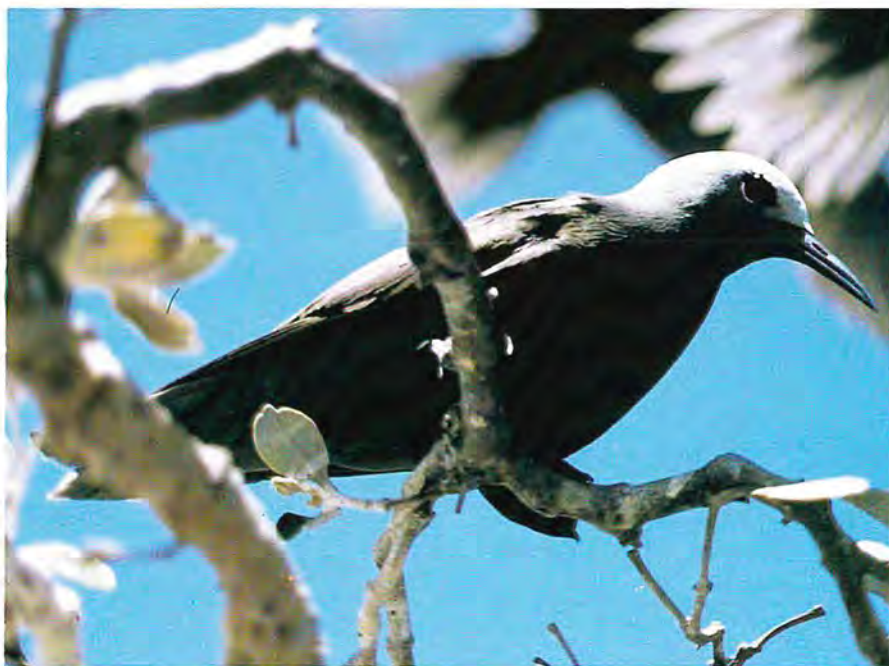


▼ Near centre of island showing coral shingle. Note narrowness of island. (Photo A. A. Burbidge).





▲ Salt marsh area in Common Noddy colony. (Photo Copyright A. G. Wells).



▲ Lesser Noddy (Photo C. Young)

▼ Lesser Noddy surrounded by nests in Mangrove Forest (Photo C. Young).



Also to be seen on the island is the Red-tailed Tropic-bird (*Phaethon rubricauda*). This species has been declared to be "rare or likely to become extinct or in need of special protection" under the Western Australian Wildlife Conservation Act. As far as is known it has only one breeding place in Western Australia, at Sugarloaf Rock, near Cape Naturaliste. Nests have not been found on Pelsart for several years. Tropic-birds are moderately common at Pelsart and there seems to be no reason why breeding cannot occur in the future. Red-tailed Tropic-birds have a widespread tropical distribution but there are few breeding colonies.

Also present is the Sooty Tern (*Sterna fuscata*). This species also has a wide tropical distribution but it has few Western Australian breeding places. It has bred on Wooded Island in Easter Group but the closest major colony to the Abrolhos is Bedout Island.

Pelsart Island was found to be a stronghold of the Osprey (*Pandion haliaetus*), with seven breeding pairs and a number of unoccupied nests recorded in 1977, making it the biggest concentration of these birds south of Shark Bay.

The White-breasted Sea Eagle (*Haliaeetus leugoster*), is common on the island and at least two pairs breed there most years. Outside the Abrolhos-sea eagles are scarce south of Shark Bay.

Island Management

The Houtman Abrolhos islands are classified as a multi-purpose reserve for flora and fauna, tourism and activities associated with the fishing industry.

Wildlife experts, supported by the survey results, say Pelsart Island is so important to nature conservation that it should be given the greatest protection from interference.

In particular the seabird colonies may suffer from increased human activity on the island.

Unfortunately, there are many examples of seabird colonies being adversely affected by man's activities, both direct and indirect. The best known local example of this is the extinction of the enormous colonies of Wedge-tailed Shearwater, Common Noddy and Sooty tern which formerly occurred on Rat Island in Easter Group. In 1907 it was reported that Sooty Terns "were breeding in countless numbers" and Common Noddies "were laying in hundreds of thousands". In 1889 the Common Noddy colony occupied 300 acres and averaged at least one bird per square yard or 1 452 000 birds. The last time the colonies were seen and reported by an ornithologist was 1913 but there is evidence they lingered on until the 1930s. Their disappearance has been attributed to human depredation, particularly the taking of eggs. However, there must be considerable doubt that this was the main cause since there were very few fishermen in the Abrolhos until the 1950s.

Rat Island suffered major disturbance from guano mining, which ended in 1915, and was left as a barren rocky area almost devoid of the vegetation required by the Common Noddy and Sooty Tern as nesting sites and the soil required by Wedge-tailed Shearwaters.

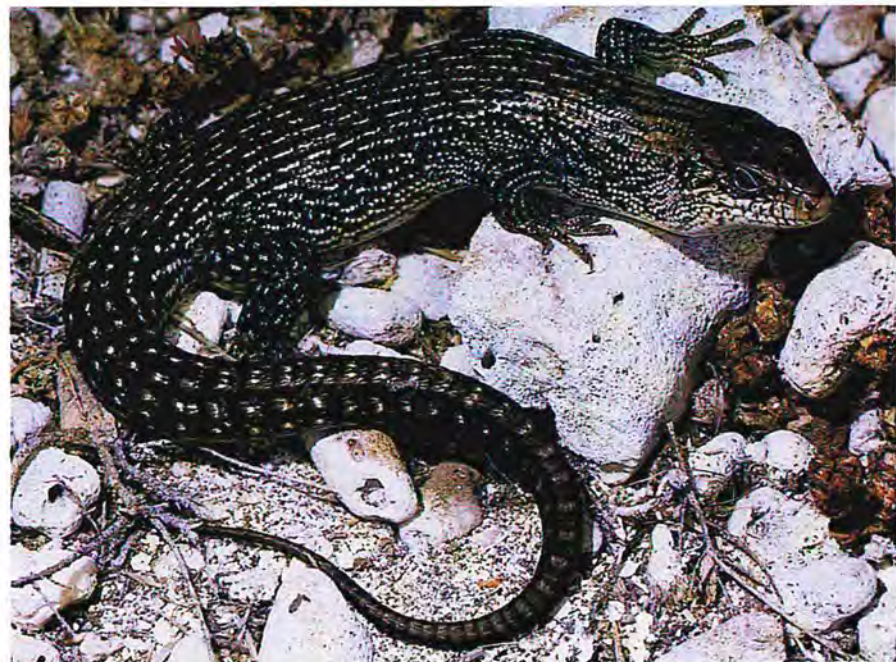
Added to this disturbance was the presence of rats (*Rattus rattus*), first noted in 1840, and cats (*Felis catus*) which were present during 1913.

Pelsart Island has also been subjected to guano mining and in this context it is notable that the disappearance of the Lesser Noddy from Pelsart Island also coincided with the peak of guano mining there. Although the guano mining would not have affected many mangrove areas directly, it is likely that there were indirect effects. A report of a visit in 1843 stated: "As an article of food it [the Lesser Noddy] was the favourite, several hundred being killed almost daily during our stay on the island."

Guano mining commenced in the Abrolhos in 1847. However, it did not reach any magnitude until 1885 and ended in 1915 after 56 900



▲ Wedge-tailed Shearwater at entrance of breeding burrow. (Photo Copyright A. G. Wells).



▲ King Skink (*Egernia Kingii*), a predator of bird eggs and chicks. (Photo Copyright A. G. Wells).

▼ Pied Oystercatcher. (Photo Copyright A. G. Wells).





▲ Red-necked Avocet. (Photo Copyright A. G. Wells).

▼ Pacific Gull. (Photo Copyright A. G. Wells).



tonnes had been shipped. Mining recommenced in 1943 and ceased again in 1946 after a further 10 900 tonnes had been extracted. Guano mining has had a major impact on several islands in the Abrolhos, including Rat, Gun, West Wallaby and several islets. On Pelsart, although the soil of some areas has been removed, there still remain extensive sand deposits which support the major colonies of Wedge-tailed Shearwater, Common Noddy and Sooty Tern.

Further human activities took place on Pelsart Island in the form of a small tourist camp which operated near the southern end of Pelsart Island between about 1946 and 1953. It used the buildings left by the guano diggers which were located just behind the beach on the western side of the island 1.0 km north of Wreck Point. The buildings were located among burrows of the Wedge-tailed Shearwater and nests of the Sooty Tern. Tourists walking near the camp could not avoid collapsing the breeding burrows of the Shearwaters.

Conservation Needs

The most important areas of Pelsart for sea bird conservation are the mangroves and the sandy southern four kilometres or so. The mangroves provide nesting sites for the Lesser Noddy. The large colonies of Common Noddy, Sooty Tern and wedge-tailed Shearwater overlap in the Southern area. No area could be said to be not used by sea birds for breeding because many species, e.g. Roseate Tern, Crested Tern, Fairy Tern, Osprey, Pacific Gull, do not have fixed breeding sites and may move their breeding place each year.

Because of its high nature conservation values Pelsart Island should be afforded the greatest protection from interference.

EDITOR'S NOTE:

This summary has been adapted by M. L. Taylor from Report No. 44 entitled, "The Birds of Pelsart Island, Western Australia" by P. J. Fuller and A. A. Burbidge which is available on request from the

**Extension and Publicity Officer
Department of Fisheries and Wildlife
108 Adelaide Terrace Perth, W.A. 6000**

A new dunnart from Australia's tropical sandy deserts

by N. L. McKenzie

The Australian genus *Sminthopsis* comprises mouse-sized marsupial predators known as dunnarts; they are nocturnal and most prey on ground-dwelling arthropods such as spiders, beetles and insect larvae.

About twelve species are currently recognised in the genus. One of the largest is the Long-tailed Dunnart reported in a previous issue, of *SWANS* (Vol. 11 No. 3) but most are somewhat smaller with shorter tails. *Sminthopsis* can be divided into two broad categories: species with thin tails and those having fat (incrassated) tails.

Specimens of a new species of dunnart were captured during the 1979 biological survey of the Great Sandy Desert. Superficially, they resemble another desert-dweller, the Hairy-footed Dunnart *Sminthopsis hirtipes*. Both species have golden brown backs contrasting with white undersides and a diffuse head stripe; both have a slightly incrassated tail, about the same length as their body, hairy foot pads, and similarities in one of the teeth characters generally used by zoologists to separate *Sminthopsis* species (no entoconids on their lower molar teeth). Even the preferred habitats are similar; both species live on the spinnifex covered sandplains and dunes of the Australian arid zone.

Although much smaller in size than *Sminthopsis hirtipes*, the Hairy-footed Dunnart, the Great Sandy Desert specimens were all sub-adults; it was conceivable that the size discrepancy and other differences noted in the hindfoot pads, fur colours, and skulls were due to a combination of age and geographic factors.

This uncertainty was eliminated in August 1981 when we captured adult specimens in the proposed Edgar Range Nature Reserve on the southern edge of the South-west Kimberley. The series included a female with pouch young and males with large scrotal testes. The adults showed the same anatomical



▲ Desert Dunnart *Sminthopsis* spp. (Photo N. L. McKenzie).

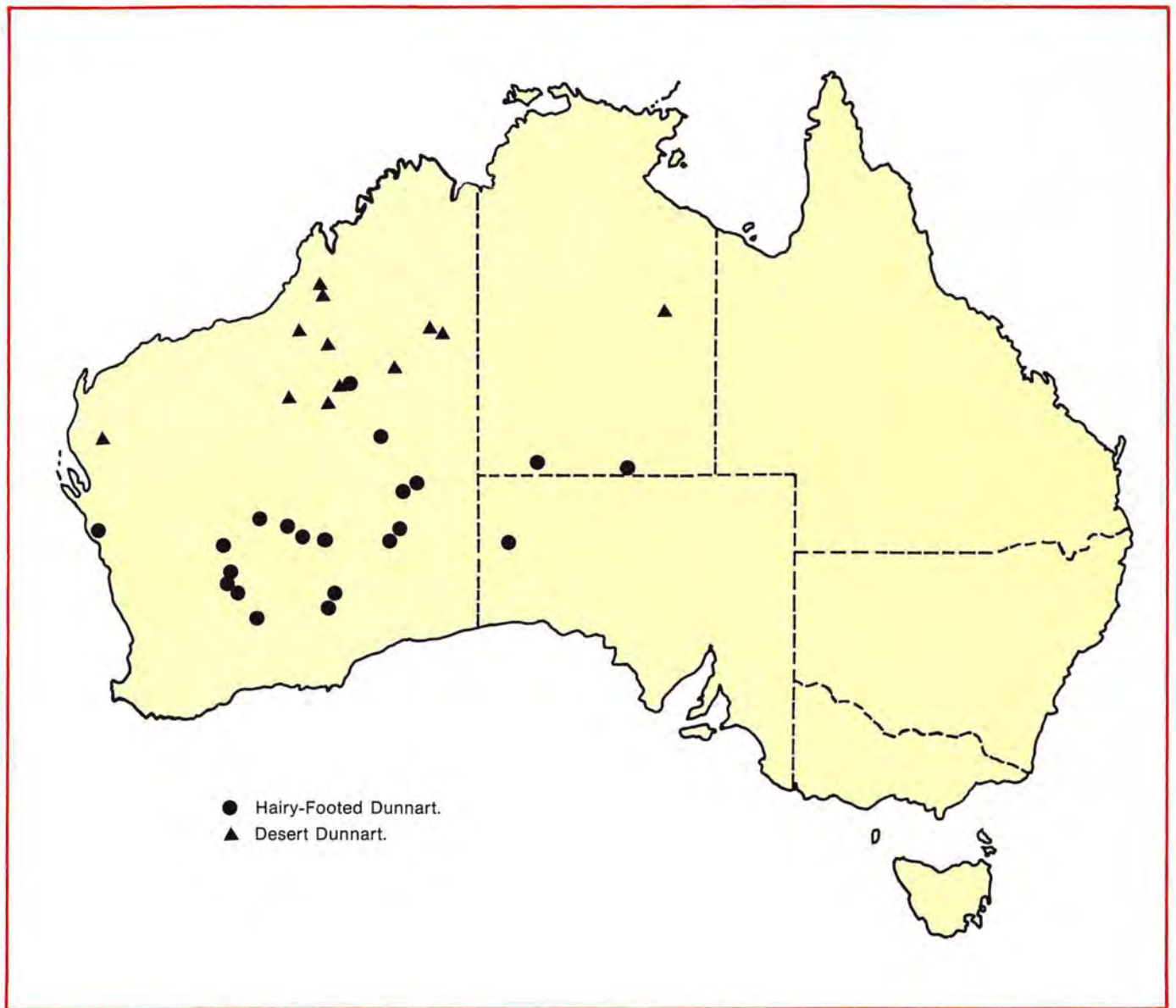
differences from *S. hirtipes* as had our sub-adults.

A description of the new species is currently submitted for publication in the *Australian Zoologist*. It is intended that the species will be named after Mr W. K. Youngson who was there when we caught the first specimen and who, for nine years, assisted me in biological survey work throughout Western Australia.

The published description of a new mammal species generally includes a careful anatomical account of the animal's skull and external characteristics. The description is mainly based upon one specimen which is thereafter called the

"Holotype" and stored in an especially secure cupboard in a museum. Several other specimens are nominated as "Paratypes" which are usually selected to encompass any anatomical variation noticed within the new species. "Topotypes" are specimens from the same locality as the "Type". Thus, a specimen may be both a Paratype and a Topotype.

The anatomical characteristics in which the new species is different from other related species must be discussed; comparative tables of external and skull measurements, and ratios of measurements, are usually included nowadays. In the published scientific description, a summary of these comparisons is



▲ Known distribution of the two species of Sand-Dwelling Dunnarts with hairy feet in 1981.

▼ Typical habitat of the Hairy-footed Dunnart in the Queen Victoria Spring Nature Reserve of the Great Victoria Desert. (Photo N. L. MacKenzie).



▼ Habitat of the Desert Dunnart in the proposed Edgar Range Nature Reserve. (Photo N. L. MacKenzie).





▲ Hairy-footed Dunnart (*Sminthopsis hirtipes*) foot-underside. (Photo Copyright A. G. Wells).



▲ Desert Dunnart foot-underside. (Photo Copyright A. G. Wells).

▼ Hairy-footed Dunnart (*Sminthopsis hirtipes*) foot-side view. (Photo Copyright A. G. Wells).



▼ Desert Dunnart foot-side view. (Photo Copyright A. G. Wells).



called the “diagnosis” and is a valuable aid in writing keys to separate all the species in that genus. Ideally, a search should be made of collections in museums elsewhere to see if further specimens of the newly

recognised species have previously been collected.

The hindfeet are the best distinguishing feature of the new species: *Sminthopsis hirtipes* has hindfeet 18 to 20mm long (excluding

the claws) whereas the hindfoot of adult (Desert Dunnarts) range from 13 to 14mm long. The soles and pads of the Desert Dunnart are clearly more granulated and less hairy than *S. hirtipes*; the large pads at the base of the toes are not nearly so completely fused as in *S. hirtipes*.

The Desert Dunnart is known throughout arid sandy habitats of tropical Western Australia; the Western Australian Museum has a single juvenile specimen from the eastern side of the Northern Territory (M15882; 19°51'S, 136°02'E). In Western Australia it has so far been collected in the Tanami and Great Sandy Deserts, northern parts of the Little Sandy Desert, the Gibson Desert, Carnarvon Basin, and the far southern edge of the South-west Kimberley (see map).

The animal favours sandplain and sand dune country supporting spinifex (*Triodia* and *Plectrachne*), shrubs and, sometimes, open low trees. Its closest relative, the Hairy-footed Dunnart, occupies structurally similar vegetations on sandplains and sand dunes in the southern (temperate) half of the Australian arid zone. It was described in 1898 from a Northern Territory specimen collected at Station Point, near Charlotte Waters, Northern Territory.

Both the supposed rarity of the Hair-footed Dunnart and the delayed discovery of the Desert Dunnart are a product of inappropriate collecting techniques. Today's clearer understanding of the species' distributions, habitats and survival status can be attributed to the gradual adoption of pit trapping techniques for biological survey work since 1975. Neither species should be considered rare or endangered.

In Western Australia, the Hairy-footed Dunnart is known from Kalbarri National Park and the Wanjarri, Neale Junction and Queen Victoria Spring Nature Reserves. Although the Desert Dunnart has not been collected in any existing conservation reserves, populations are known in the proposed Edgar Ranges Nature Reserve.



▲ Typical habitat of the Desert Dunnart in the Great Sandy and Little Sandy Desert. (Photo N. L. McKenzie).

▼ The Hairy-footed Dunnart *Sminthopsis hirtipes* (Photo Copyright A. G. Wells).



South-west duck shooting season *by Clifford Young*

Along with waterfowl, duck-shooters in Western Australia have to pay the penalty of living in one of the driest continents in the world and must learn to take the good seasons with the bad.

Very little of this state's inland water is permanent, it being mainly dependant on each year's rainfall for replenishment. This, together with the flat "salt-pan"—like nature of many of the lakes, means that in years of low rainfall the available water is concentrated in a few small areas. Likewise, waterfowl are also concentrated and therefore are particularly vulnerable to any hunting pressure. Consequently, in years of poor rainfall, duck-shooting is prohibited throughout the South-West and the Eucla Land Divisions. A continuous open season applies in the remainder of the state due to the vast areas and very small number of inhabitants involved, and to the difficulty of access to most breeding areas following rain.

In the South-West and Eucla areas duck-shooting seasons are held sometime between January and March, if at all, and are classified according to prevailing conditions. Full seasons are declared when conditions for breeding have been average or better-than-average,

restricted seasons when conditions have been poor and no seasons when conditions have been particularly poor for a number of years. A full season normally lasts 10 weeks and shooters may take 10 birds of any game species each day. However, a restricted season is limited to four weeks duration and a bag limit of only five birds a day per shooter.

Because of the recent interest shown by duck-shooters in this state and others concerned with the management of waterfowl and wetlands in Western Australia a report has been produced by the Department of Fisheries and Wildlife giving an account of the biological principles involved in decisions concerning duck-shooting seasons in the south-west. The following is based on extracts from the report which is titled *1980 Review of Rainfall and Wetlands in the South-West of Western Australia* by J. A. K. Lane and D. R. Munro of the Western Australian Wildlife Research Centre.

Rainfall, Wetlands and Waterfowl Breeding

Rainfall in the south-west of Western Australia is markedly seasonal. On average, about 70 percent of the total annual rainfall occurs during the months May to September, with half of this being recorded during June and July. As a result, wetlands throughout the south-west show marked seasonal variations in water levels with depths rising during the wetter months of winter and spring and then falling during summer and autumn when little rains falls and evaporation rates are high.

Waterfowl breed when conditions are most favourable, that is, when food and water are most abundant. In the south-west of W.A. this occurs during spring and early summer when water levels reach their peak and warm weather accelerates the growth of aquatic plants and animals.

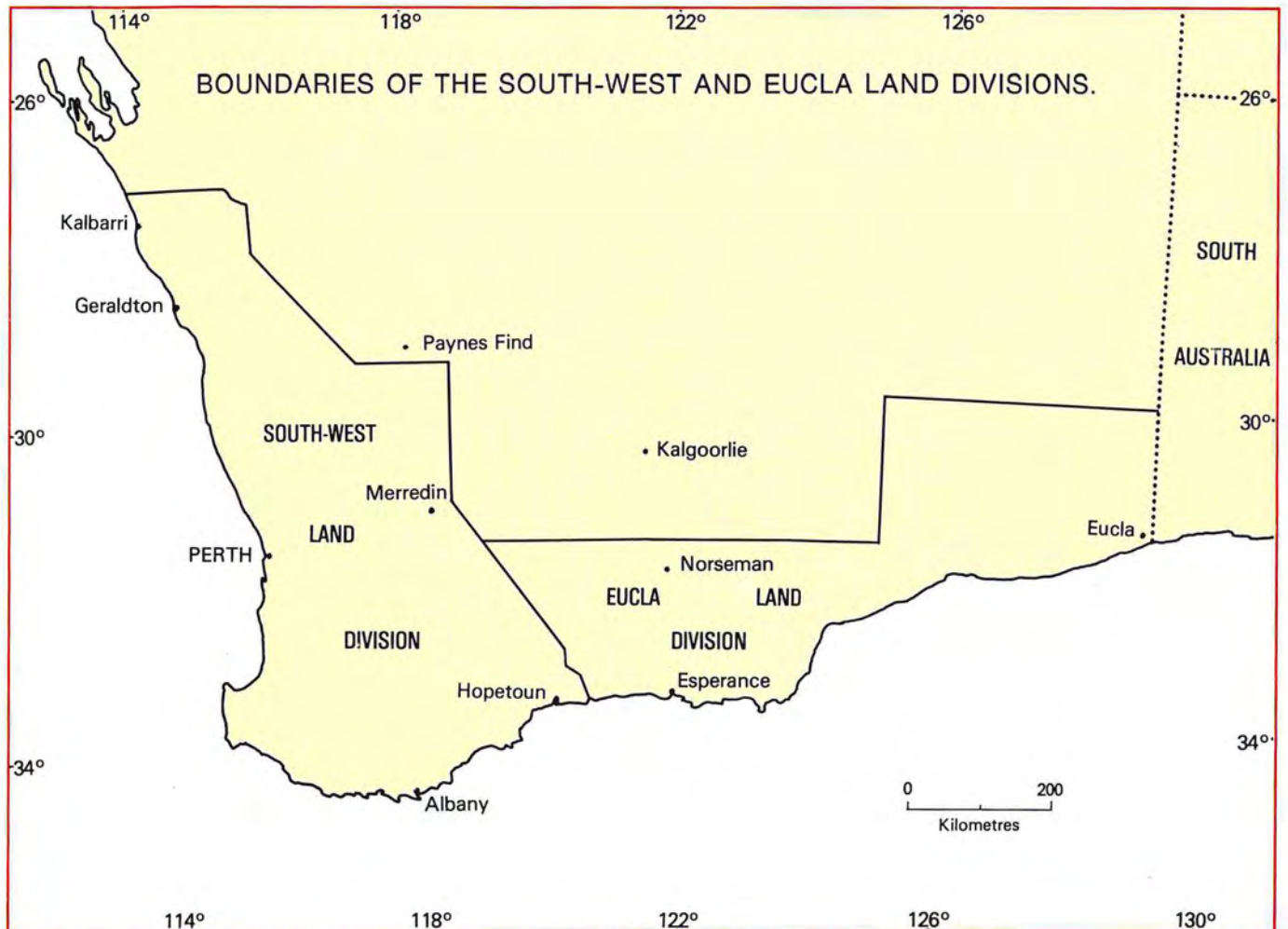
Nest construction and egg-laying may commence as early as June, and continue until November or even December. For most species

▼ Mountain Duck. (left) and Grey Teal are two of the more abundant game duck species found in Western Australia. (Photo Copyright A. G. Wells).





▲ Technical Officer, Don Munro, taking depth gauge readings and water samples from a lake in the wheatbelt. (Photo C. Young).



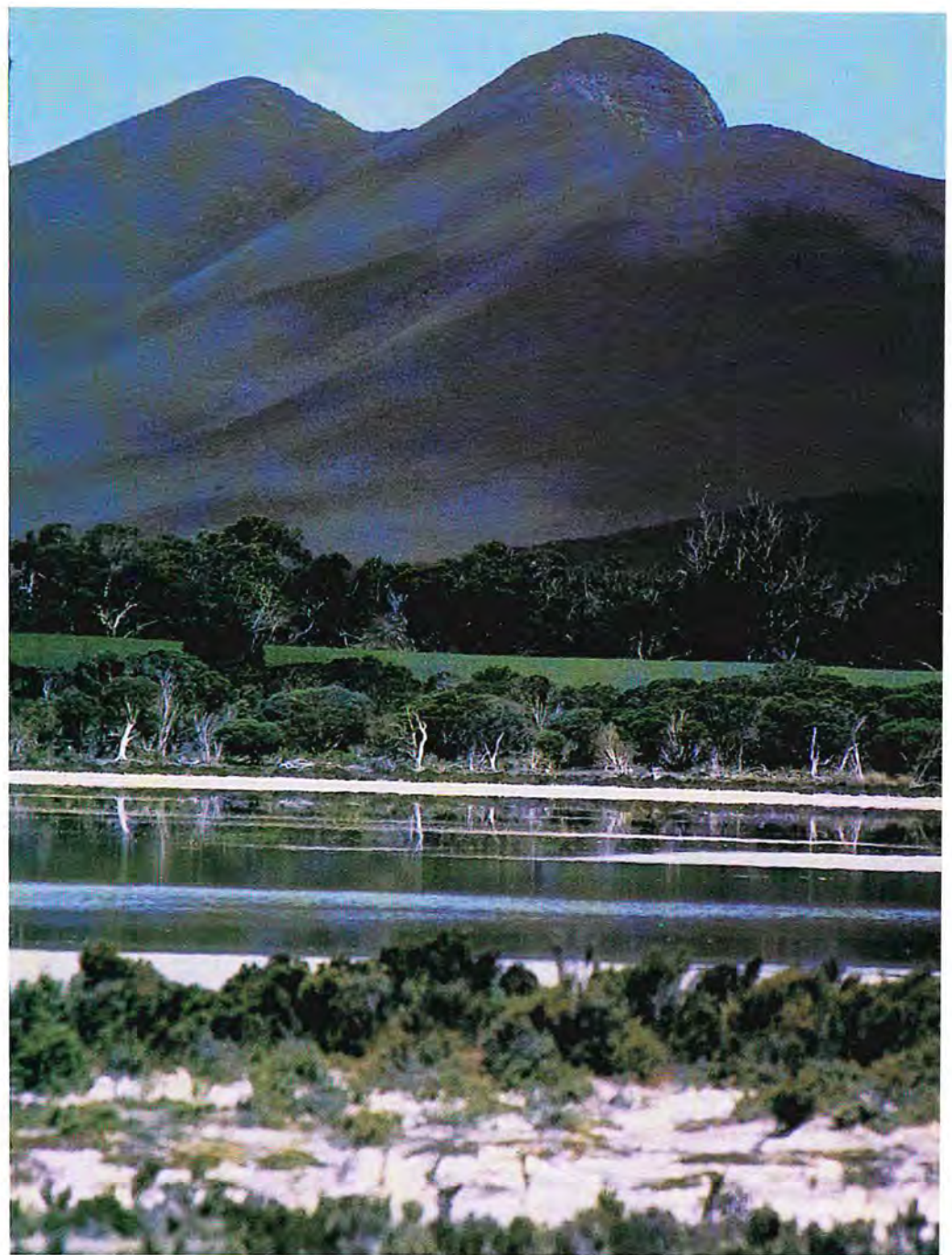
however, peak nesting activity appears to be during August and September. Broods of ducklings are most commonly seen from September to November and the great majority of young birds are flying by January. Waterfowl numbers are therefore at their peak in the New Year. This is when duck-shooting seasons are held.

Duck Shooting Seasons

Duck-shooting seasons are confined to January-March each year in order to minimise their impact on duck populations. This can be explained as follows: Game species of ducks are highly fecund, that is, they are capable of producing large numbers of offspring each year, provided conditions are favourable (single broods of five or more ducklings are a common sight during spring and early summer). Consequently, at the end of each successful breeding season, duck numbers are swollen by the addition of new birds. However, as the summer-autumn dry season progresses, and conditions for waterbirds deteriorate, many birds die due to a variety of natural causes such as lack of food or water, predation and disease.

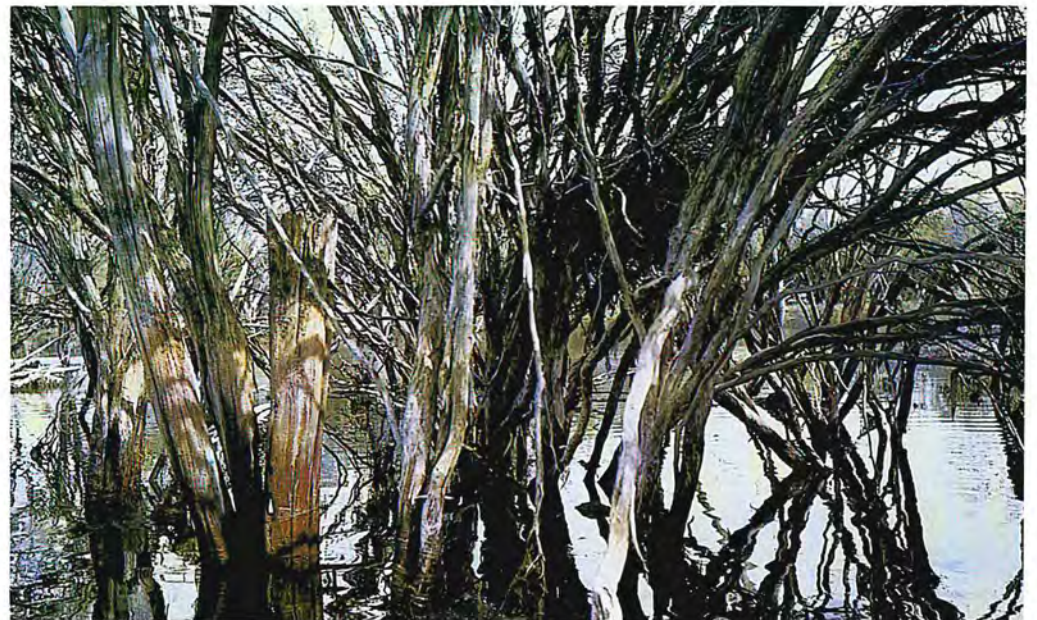
Such deaths are referred to collectively as "natural mortality". First-year birds in particular have a high rate of natural mortality, largely due to lack of experience in locating natural resources. By holding the shooting season early in the year one is able to minimise the impact on duck populations since a significant proportion of the ducks killed are birds which would normally die anyway before the next breeding season.

Thus, shooter-induced mortality is timed to replace natural mortality, rather than add to it. It follows that, upon completion of breeding, the sooner the shooting season is held, the less the effect on the number of birds surviving to the following breeding season. The later the season, or the longer it extends, the greater the effect on numbers surviving to breed.



▲ The northern face of the Stirling Ranges looms over this small lake in the lower South-West. (Photo C. Young).

▼ Flooded vegetation provides ideal nesting sites for several duck species as they are protected from predators. (Photo C. Young).





▲ In good seasons, W.A.'s wetlands provide sanctuary for many bird species besides ducks. A flight of Banded Stilt takes off from a wheatbelt lake. (Photo C. Young).



▲ Increasing water salinity in the State's South-West has killed vegetation bordering many wetlands. (Photo C. Young).

▼ Late afternoon reflections at a water monitoring site on the Coblinine River. (Photo C. Young).



Variations in Rainfall and Conditions for Breeding

Rainfall, of course, varies from year to year, and as a consequence so does the availability of water for breeding purposes. Thus, in conditions of average or better-than-average rainfall, conditions for waterfowl breeding are usually good and the number of young produced is high; whereas, in years of exceptionally low rainfall, little surface water is available and production is greatly reduced.

For example, in the past ten years, duck-shooting seasons have only been declared six times. For the remaining years, particularly dry conditions have been unfavourable for duck breeding and seasons have not been declared open. Although the last duck shooting season was in the summer of 1978-79, good rains throughout 1981 improved conditions greatly to the extent a season has been declared for 1981-82.

Obviously, waterlevels at wetlands throughout the south-west are crucial to any decision as to whether or not a duck-shooting season will be held. Prior to 1978 conditions for waterfowl breeding were assessed each year during ground and aerial surveys of important waterfowl sites. Water levels were recorded as dry, low, half-full, high or full.

Notes were also made of waterfowl numbers and, where possible, waterfowl breeding activity. However, in 1977 it was decided that a more precise system of evaluation was required and a programme of installation of depth gauges on selected wetlands was undertaken. Twenty-seven gauges were installed from November 1977 to December 1978, 29 in 1979 and a further 27 in 1980. Another 25 gauges were installed during 1981 and more are proposed for 1982.

The wetlands which have been gauged are distributed throughout the south-west of the state, mainly south of a line through Dongara, Merredin and Esperance. Most are



▲ A water sample and depth reading is taken at Poorginup Swamp in the lower South-west. (Photo C. Young).

Wetland Nature Reserves (including Game Reserves) vested in the Western Australian Wildlife Authority and managed by the Department of Fisheries and Wildlife (in fact, it is now policy to instal gauges only on wetland reserves so vested). The depth gauges permit precise monitoring of water levels and thus allow more meaningful comparisons of conditions to be made from one season to another. The gauges also make it possible to determine average rates of water loss during the annual dry season and thus enable researchers to forecast "dry-out" dates for individual wetlands or groups of wetlands each year.

Together with rainfall data this information assists any decision regarding declaring a duck-shooting season and enables better management of Western Australia's game bird species.

More Nest Robbing Reported

Photos R. Marshall.

Wildlife Officers with the Department of Fisheries and Wildlife have reported further evidence of nest-robbing involving the destruction of nesting hollows, this time in the extreme north-west of the State.

Although nest-robbing is a widespread problem which has threatened native birdlife for some time in other areas of the State, particularly in the Geraldton and Carnarvon regions, there has been little evidence of it further north. However, the latest finds are not thought to be the work of professional nest-robbers but amateurs intent on securing the birds as pets.

The nests destroyed, near Wyndham, had probably been occupied by either Cockatiels or Red-collared Lorikeets as both species are relatively common the area.

Nest-robbing, taking young birds or eggs from their nests, is not the only way of obtaining native birds illegally but is certainly one of the most destructive. Many species of parrots in Australia nest in hollow tree trunks or limbs and, for robbers to reach the nests, it is often necessary for them to damage the tree.

Nests are often up to 10-15m high and if the tree cannot easily be climbed it may be cut down. Also, access to a large percentage of nest hollows may be restricted either by the smallness of the existing entry hole, the depth of the hollow or an awkward entry angle. In these cases the trapper will determine the





location of the nestlings or eggs by tapping the trunk and listening for a change of note just as you would gauge the depth of water in a tank. Once their location is determined the trapper will use either an axe or a saw to cut a section out of the tree at the base of the nest and take the birds or eggs. The hollow is, of course, rendered useless for further nesting by this practise until time and deterioration causes the hollow to deepen once again. This destruction of the birds nesting habitat has far-reaching consequences to its population, in some cases even greater than the direct predation of the young birds.

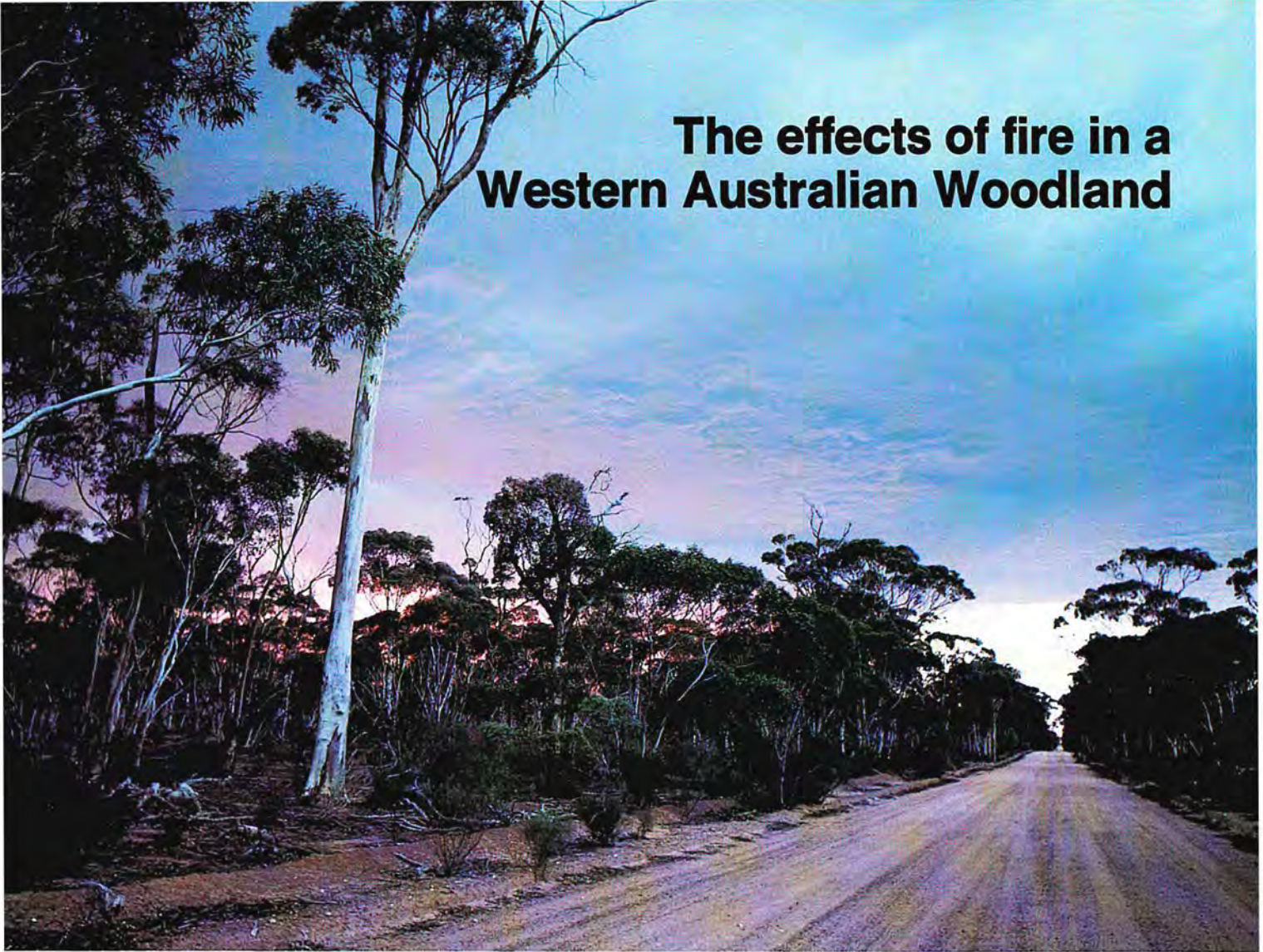
Generally, only young birds or eggs are taken by the nest-robbers because of the difficulty of training grown birds to adapt to captivity, to "talk" and to be docile pets. However, taking birds at a very early stage brings with it its own problems in terms of rearing. The nestlings require considerable care if they are to survive.

Nest-robbing of young birds is not a practice carried out for profit alone. Some aviculturists also play their part although they are usually more selective in the species that they take. The methods are generally the same but the motive is not. Aviculturists require "new blood" in their breeding stocks to prevent in-breeding or to produce better quality birds. More often than not, the birds sought are the less common or endangered species with resulting consequences to the species population. Together with the problems of natural mortality, introduced predators and poor food availability due to drought or changing land use, heavy nest predation by nest-robbers poses a serious threat to many native bird species.

Nest-robbers face substantial fines and wildlife officers throughout the state now conduct regular patrols through bird nesting areas during the breeding seasons. However, they have a large task ahead of them and the general public is asked to assist by contacting the Department or one of its district officers with any information which may lead to a nest-robber's apprehension.



The effects of fire in a Western Australian Woodland



▲ Woodland Vegetation between Lake King & Salmon Gums. (Photo A. J. M. Hopkins).

The hot dry summers experienced in south-western Australia are very conducive to a high incidence of bush fires, with resulting damage to vegetation. Many native plants are adapted to withstand the effects of fires—which suggests that fires may have occurred naturally, e.g. from lightning strikes, for a considerable period. Nowadays, it is generally agreed that fire has been a feature of the evolutionary environment in Australian sclerophyllous (hard-leaved, i.e. non-rain forest) vegetation types for thousands, if not millions, of years. Ancient sources of fire included such phenomena as lightning, spontaneous combustion, volcanic activity and friction. As a result, many native plant species appear well adapted to recover after fire.

Since the arrival of European man in Western Australia and the introduction of new techniques, such as prescribed burning and the use of fire by farmers for land clearing, the incidence of fire has increased greatly.

Because of the importance of fire in the management of our Nature Reserves, researchers at the W.A. Wildlife Research Centre, in collaboration with others, have been conducting studies on fire effects at a number of sites throughout the Western Australian wheatbelt from Shark Bay to Israelite Bay. Results of one of these studies have recently been published. This study was of the effects of a single fire on eucalypt woodland at a site east of Lake King, south-western Australia ($32^{\circ}41'S$, $120^{\circ}42'E$).

The study site is situated in a remote spot approximately 120 km east of the Lake King Townsite on the Lake King-Norseman Road (see map).

This fire, about 40 years ago, effectively converted the woodland into a mallee-heath.

The researchers measured the effects of the fire both in terms of what are called physiognomic factors (i.e. life forms and height) and floristic composition (i.e. variety of species present).

The area was relatively undisturbed except for a number of large fires which could be accurately mapped from aerial photography (March 1958, April 1971 and, in more recent cases, Landsat imagery, November 1976). It is possible that

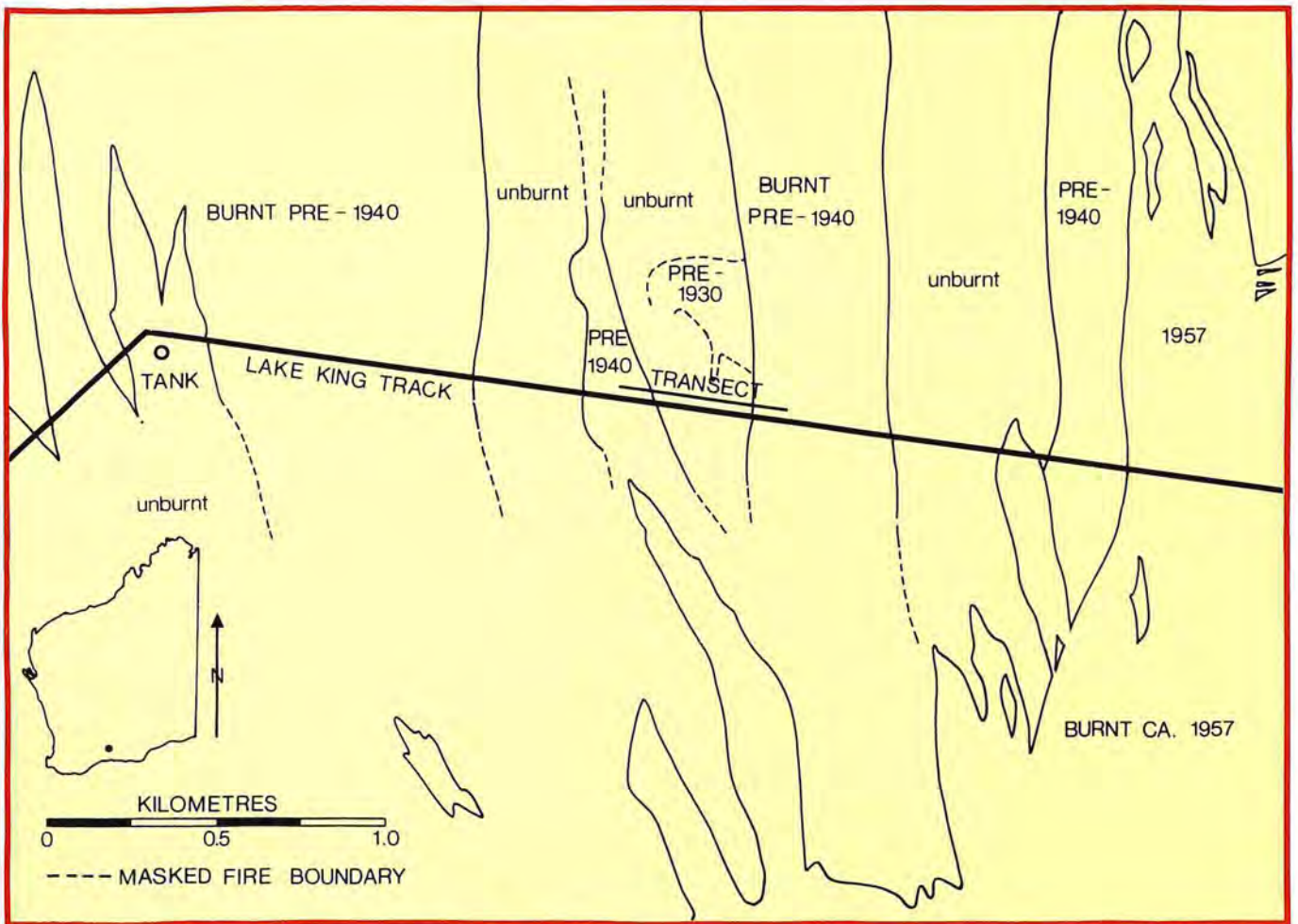
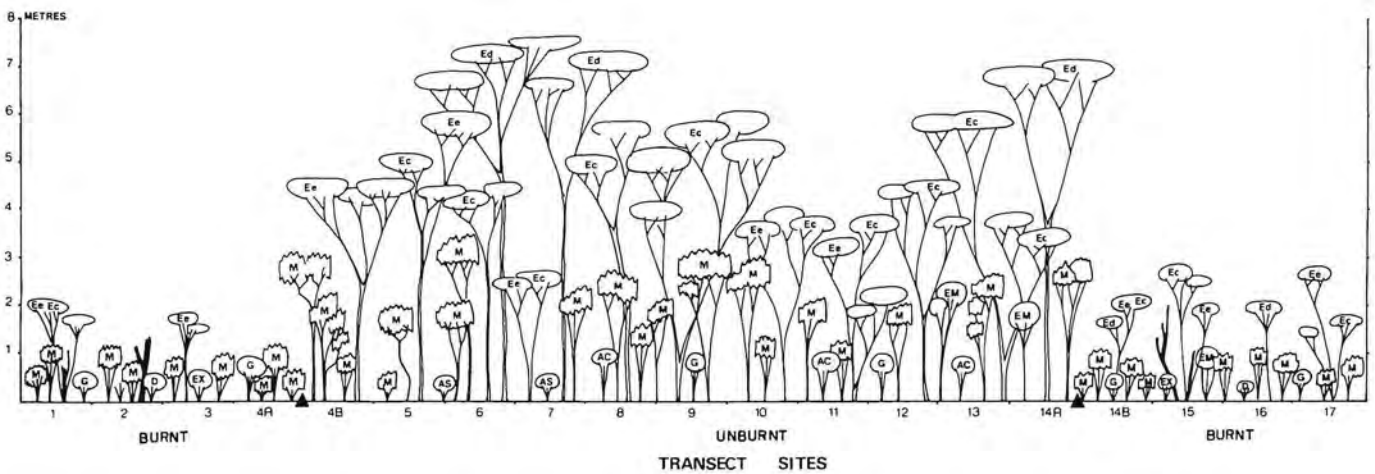


Fig. 1—Fire history map of study area showing study transect.



Profile diagram of the vegetation along the study transect. AC = *Acacia mackeyana*, AS = *Astartea ambigua*, Ec = *Eucalyptus cylindiflora*, Ed = *E. diptera*, Ee = *E. eremophila*, EM = *Eremophila pachyphylla*, EX = *Exocarpus aphyllus*, D = *Daviesia acanthoclona*, G = *Grevillea pinaster*, M = *Melaleuca* spp.

a number of these fires were of natural origin, but a greater number are likely to have a human cause resulting from development of roads, farms in the area, improved vehicular access and encroaching rural activity.

The fire history of the area was estimated from aerial photography and inspection of regeneration on the ground—this history is shown on Fig. 1.

It was estimated that a large fire burnt much of the study site about 40 years ago. This fire is labelled “pre-1940” on Fig. 1 while areas which escaped the effects are labelled “unburnt”.

The researchers sampled the vegetation at seventeen points (along the 400 metre long straight line shown on the map and known as a transect) at 25m intervals. At each sampling point a 10 m diameter circular plot was delineated. The height, habit and reproductive status of all species within each plot was recorded.

As the Figure shows, the transect passes from a 40 year old regeneration area through a long unburnt area and into the 40 year old area again. Soil samples were collected for later study and results from sampling of soils showed no change along the transect. Similarly there was a continuity of plant species present along the transect although there was a tendency for herbs and grasses to be more important in the long-unburnt woodland area. Three species of *Eucalyptus* were continuously distributed along the transect.

A total of fifty-one species of plants were encountered along the transect.

The structurally dominant shrub species of the woodland, *Melaleuca* spp. and *Eremophila pachyphylla*, were generally common to both the woodland and the mallee-heath. However, herbs and grasses were much more common in the woodland (ten species, fifty-two records) than in the mallee-heath (eight species, fifteen records), and this probably reflects the lack of disturbance in the woodland.



▲ Eucalypt growing in Mallee form. (Photo A. J. M. Hopkins).

▼ Close-up of the base of *Eucalyptus cylindriflora* in the mallee-heath showing the development of the mallee habit by resprouting. (Photo A. J. M. Hopkins).



Analysis of the species distribution data showed that the high degree of floristic continuity along the transect, regardless of structural variation is consistent with the properties of the soil along the transect.

However, the structure of the vegetation varied markedly along the transect. The substantial structural discontinuities in the vegetation which are illustrated in the profile diagram accord closely with the boundaries of the "pre-1940" fire. The long-unburnt area was comprised of a low *Eucalyptus* woodland with a well-developed shrub understorey. The 40 year old regenerated area was

dominated by shrubs of *Melaleuca* spp. with emergent mallee eucalypts. This formation is described as a mallee-heath.

The study revealed a very slow rate of regeneration of the vegetation in the area. These results, together with observations on the vegetation of nearby areas of known fire history suggest that complete post-fire regeneration to the structure of mature woodland may take as much as 100 years. However, since little is known of the fire ecology, biology and in particular, the growth rates of the species of this area, a more precise determination cannot be given.

Probably the effects of a single fire may be imprinted on the vegetation for a period much longer than this estimate. In particular, the eucalypts in the mallee-heath had developed a mallee habit with many thin stems, whereas the eucalypts in the woodland more commonly had a single vertical stem.

At least for the eucalypts, the pre-1940 fire appears to have favoured resprouting as a means of regeneration, over regeneration from seed. The potential for seed regeneration in the burnt formation at present is poor as the eucalypts in the mallee-heath had a very low seed store in the canopy (0-500 fruits per plant) relative to that of the woodland eucalypts (5 000-10 000 fruits per plant).

It was suggested that this changed appearance of the eucalypts would be reinforced by a second fire in the near future.

Some long-term successional processes are suggested as a result of this study. The development of the woodland formation is associated with a gradual thinning of shrub species and an increase in abundance of herbs and grasses.

The study graphically illustrates the extremely long term effects of a single fire on vegetation. Even after 40 years the effects on vegetation are easily discernable at this site, which suggests that considerable thought should go into the consequences of adding a man-made burning regime to areas of bushland before action is taken.

▼ The eucalypt woodland formation (Photo A. J. M. Hopkins)



EDITORS NOTE

This article is adapted by M. L. Taylor from a paper by A. J. M. Hopkins and C. J. Robinson entitled 'Fire induced structural changes in a Western Australian Woodland' published in the *Australian Journal of Ecology*—(vol. 6 p. 177-188 1981).

Dandaragan Nature Reserve Plans

The latest in a series of Nature Reserve Draft Management Plans being prepared by the Western Australian Department of Fisheries and Wildlife has been released. This document deals with Nature Reserves of the Shire of Dandaragan and, as with previous Draft Management Plans, will be open for public comment before a final Management Plan is prepared.

Excluding offshore islands there are 19 Nature Reserves wholly or partly within the Shire of Dandaragan. Together they cover an area of some 343 sq.km. or about five percent of the total area of the Shire. The reserves differ widely in size, the largest one wholly within the boundaries of the Shire being 10 854 ha. (Reserve No. 36053) and the smallest 3 ha. Five cover areas greater than 1 000 ha., and four are less than 100 ha.

This Plan deals with nine reserves in the southern half. The remaining mainland Nature Reserves and those on several small offshore islands within the Shire will be the subject of

later Draft Management Plans.

Dandaragan Shire covers an area of 6 754 sq.km. and lies roughly halfway between Perth and Geraldton on the coast. Its relatively small population of 1 960 persons is centred around the coastal towns of Jurien and Cervantes, and inland around Badgingarra and Dandaragan itself. The major industries of the Shire are broad-acre agriculture and fishing, particularly for rock lobster, based on Jurien and Cervantes. Tourism and recreation, bee keeping, the wildflower industry and mining are of lesser but variously developing importance.

Four physiographic units of major extent are represented in the Shire of Dandaragan: the Coastal Belt, the Bassendean Dune System, the Dissected Region and the Dandaragan Plateau. Each unit supports particular varieties of flora, vegetation types and fauna, each of which is contained within a representative Nature Reserve or Reserves.

A large proportion of land which has been developed for agricultural purposes in the Shire lies in the belt of the Dissected Region and the Dandaragan Plateau. On the other hand, most of the Bassendean Dune system and the Coastal region, remain undeveloped and are probably not suitable for agricultural purposes. As a result large areas of the Shire remain uncleared. Some parts of these areas are used by

▼ "Brown Honeyeater feeding on flowers of One-sided Bottlebrush *Calothamnus quadrifidus*, a spectacular sight awaiting the patient bird-watcher on such reserves as No. 23934 on Gillingarra Road." (Photo S. D. Hopper).



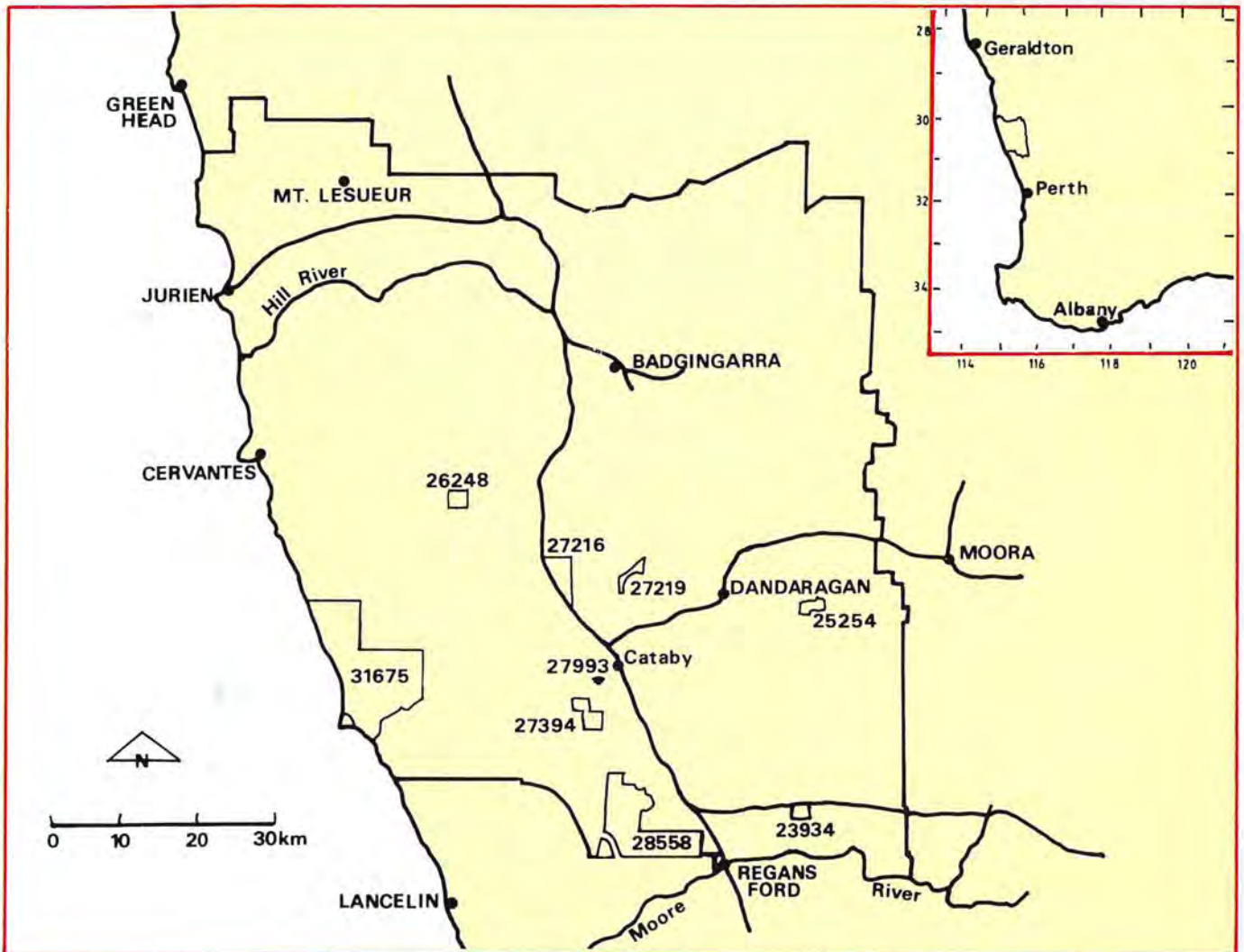


▲ "Grey Cottonhead *Conostylis condicans* growing with Spiny Cottonhead *Conostylis aculeata* at the inland junction of the coast region and the Bassendean Dune System east of Wanagarren Nature Reserve." (Photo S. D. Hopper).

apiarists and the wildflower industry as sources of nectar, plants, flowers and seeds. They also include three large and two smaller National Parks which are a focus for tourism and recreation in the Shire.

Vegetation in the Dandaragan Shire, when compared to near coastal areas to the north and south, can be seen to occupy a transitional position between areas of higher rainfall in which woodland vegetation predominates and that of lesser rainfall where heathlands are the predominant vegetation type (the northern heathlands).

These northern heathlands are floristically very rich. On one survey in the Mt. Lesueur area 67 different species of plants were recorded in an area of 500 sq.m. As well as their overall species-richness, the northern



heathlands support many endemic species (i.e. plants found nowhere else), plants which are rare and in need of special protection and many which are important to the State's wildflower industry.

The following are two examples of Nature Reserves found within the Shire and covered under the draft management plan:

Eneminga Nature Reserve

The Eneminga Nature Reserve (No. 27394) is an important refuge for waterfowl and is recognized as a key site in the W.A. Nature Reserve system, both as a freshwater wetland and as a breeding ground for waterbirds.

The Reserve, which has an area of 741 ha; lies near the northern end of a depression occupied by Eneminga Brook. The stream bed runs through the Reserve and is characterised by a series of long, narrow and shallow lakes which hold water in the winter, but are dry during the rest of the year. The remainder of the Reserve varies from heath-covered, winter-waterlogged lowlands to sandy ridges bearing stands of *Banksia* woodlands.

Although no formal survey of fauna has been carried out on the Reserve, 34 bird species have been recorded on various visits and inspections. This relatively large number and the range of species confirms that the Reserve supports a rich bird fauna. The reed beds and dense thickets of *Melaleuca* spp. found around the swamps provide ideal nesting sites for the wide range of waterfowl.

One of the primary objectives of management for the Reserve is the continuing maintenance of its values as a wetland and waterfowl habitat. Providing public use can be maintained without conflict with the major aims of conservation, the Reserve (which is open to duck hunting during open season) will continue to cater for the specialist interests of shooters and naturalists—the natural division of the seasons of their interest allowing for a minimum of conflict between the two uses.



▲ "The brilliant flowers of *Eremaea beaufortii* may be seen in the Dandaragan Shire during late spring and early summer." (Photo S. D. Hopper).

▼ "Posy triggerplant *Stylidium crosscephalum*. This common herb of the sandplains within the Dandaragan Shire has been studied in detail by botanists at the University of Western Australia because of its remarkable variation in chromosome form." (Photo S. D. Hopper.)



TABLE 1. The Nature Reserves of the Shire of Dandaragan (excluding islands).

Reserve No.	Name	Area (ha)	Purpose	Vesting
855		12	Camping and Flora	Local Authority
23934.		212	Flora and Fauna	W.A.W.A.*
24496†		70 013 (3 600)†	Flora	—
25254	Jam Hill	183	Flora	—
26248	Wongonderrah	439	Flora	—
27216		1 576	Rec'n Camping and Flora	Local Authority
27219	Minyulo	200	Flora and Fauna	W.A.W.A.
27277		131	Camping and Flora	—
27394	Eneminga	741	Flora and Fauna	W.A.W.A.
27871		206	Flora and Fauna	W.A.W.A.
27872		203	Flora and Fauna	W.A.W.A.
27993		21	Flora and Fauna	—
28558	Namming	5 411	Flora and Fauna	W.A.W.A.
31675	Wanagarren	11 138	Flora and Fauna	W.A.W.A.
33287	Hill River	293	Flora and Fauna	—
35191		3	Flora	—
35594		56	Flora and Fauna	—
36053		10 854	Agiculture and Flora	—
36093		882	Flora and Fauna	W.A.W.A.

*Western Australian Wildlife Authority.

†Reserve No. 24496 is mainly in the Shires of Carnamah, Coorow and Irwin. The area of the Reserve within the Shire of Dandaragan is given in parentheses.

The Reserve numbers (in blue) are dealt with in some detail in the Management Plan.

▼ "Copulating thynnid wasps on flowers of the paperbark *Melaleuca rhapsiophylla* at Minyulo Brook." (Photo S. D. Hopper).



Namming Nature Reserve

The Namming Nature Reserve (No. 28558) is also of great significance to the W.A. Nature Reserve system as a seasonal wetland and waterfowl breeding area because of the populations of uncommon species of animals and plants which it supports. Also valuable is its considerable expanse of *Banksia* woodlands and mixed species heathlands.

The Reserve is 5 411 ha. in area and is situated 4 km. north-west of Regans Ford. The southern boundary of the Reserve is also the southern boundary of the Shire of Dandaragan. Most of the Reserve is of gently undulating topography. There are several seasonal, fresh-water swamps on the Reserve and these are surrounded by varying successions of wetland to dry-land vegetation types. The system of wetlands of which this Nature Reserve forms a part (in conjunction with Eneminga Brook, Lake Guraga, Namming Lake and swamps further west) is a most significant one as a habitat for waterfowl. The values of the system as a whole are considerably greater than those of the individual wetland areas which are its parts.

The Draft Management Plan proposes an integrated scheme of management which provides for protection from fire, weeds and animal pests whilst permitting the controlled use of the Reserve by apiarists and professional and amateur environmentalists. The protection of the Reserve's flora and fauna is, of course, of paramount importance.

Namming Nature Reserve is perhaps most renown for the occurrence of the rare and endangered Rose Banksia (*Banksia laricina*) and the Freckled Duck (*Stictonetta naevosa*) (see S.W.A.N.S. Vol 10 No. 1).

The Freckled Duck shows primitive characteristics which link it with geese and swans as well as ducks and thus it is of great interest to the



▲ The northern heathlands of the Dandaragan Shire are floristically very rich. Botanists count the number of species within an area by systematically marking the areas off into small units. (Photo A. J. M. Hopkins).

scientific community.

The Rose Banksia is exceptional because it is the only known occurrence of the plant north of the Moore River. Small isolated patches of the Rose Banksia were located outside the bounds of Namming Nature Reserve in 1978, on unvested Crown Land. In May, 1979, two areas of this Crown Land containing the Rose Banksia were added to the Reserve.

The Namming and Eneminga Nature Reserves are the most noteworthy areas dealt with in this Draft Management Plan. A further seven Reserves are covered in some detail by the Plan.

Any individuals or organisations interested in commenting on the Department's Draft Management Plan for the Dandaragan Nature Reserves may obtain copies of the Plan (free of charge) from:-

**EXTENSION AND PUBLICITY
OFFICE
DEPARTMENT OF FISHERIES
AND WILDLIFE
108 ADELAIDE TERRACE,
PERTH W.A. 6000
PH. 325 5988.**

*Adapted for SWANS from draft
Management Plan No. 5 by I. G.
Crook, A. E. Williams and
G. R. Chatfield.*

Field Survey for Rare Eucalypt— The Bookleaf Mallee by Clifford Young



▲ Buds, flowers and fruits of *Eucalyptus kruseana*. (Photo B. Haberley).

Field officers from the Department of Fisheries and Wildlife have located several more populations of the rare eucalypt, *Eucalyptus kruseana* or Bookleaf Mallee, during a recent survey of country east of Kalgoorlie.

The latest finds bring the total known number of specimens of *E. kruseana* to 875 in six separate populations, all of which are located east of a line between Kalgoorlie and Norseman. Despite this, the species cannot be considered secure as the specimens are not located within any established Nature Reserves, but are growing in areas subject to grazing and mining—two adverse forces affecting native flora and fauna in Western Australia today. For example, the largest population of *E. kruseana*, a stand numbering about 400 specimens or almost half the total known number of the species, is located on the very edge of a rock quarry. Attempts are now being made to secure the land around

the quarry as a protected reserve but whether or not this move will be successful is still to be seen. Most of the other specimens are on station country.

The Bookleaf Mallee, a name which refers to the closeness of the leaves to one another on the stem, was first described by Ferdinand von Mueller in the *Australian Journal of Pharmacy* in 1895 from specimens collected in the Fraser Range which lies some distance eastwards from Norseman. However, the plant remained little known until it was again collected in 1909, this time east of Kalgoorlie, by Henry Dean, a consulting engineer for the Trans-Australian Railway. Unaware of Mueller's earlier description, Dean's specimen was named *Eucalyptus morrisonii* but its true name remained *E. kruseana* after John Kruse who was at one time Victorian Government Analyst and was involved in establishing the College of Pharmacy in Melbourne.

Despite its relative scarceness in the wild, the Bookleaf Mallee is widely cultivated as a decorative shrub, growing equally well in the light sand of the western coastal regions as in the clay soils of the interior. In the wild, however, it is usually found associated with granitic soils.

The plant is well suited to use as a decorative shrub having attractive yellow flowers which, with its small crowded grey leaves and unusual habit of growth, renders the species quite distinctive from all others.

In its natural occurrence the plant rarely grows higher than 2 to 3m, but under cultivation it can attain a height of 4-5m with usually a single stem and more or less horizontally spreading branches with dense foliage. In the wild it tends to be more shrubby, often having several thin stems in place of a single main stem.



▲ A large specimen (about 5m) of *Eucalyptus kruseana*.
(Photo B. Haberley).

▼ A Singing Honeyeater feeding on *E. kruseana* flowers.
(Photo B. Haberley).



▲ An example of *E. kruseana* regrowth after disturbance by a grader.
(Photo B. Haberley).





▲ Quarry wall with large stand of *E. kruseana* in the background. (Photo B. Haberley).

▼ *Eucalyptus kruseana* regrowth about 5m from the quarry edge. (Photo B. Haberley).



The wildlife officers who conducted the recent survey through the Goldfields also noted the importance of *E. kruseana* in relation to the local avian population. The officers, R. Piggott, B. Haberley and D. Coughran, noted seven species of birds feeding on the flowers of *E. kruseana*, and a further 10 species were seen alighting on the shrubs but not feeding. Those feeding were the White-eared Honey Eater, Yellow Throated miner, Yellow Plumed Honey Eater, Brown Honey Eater, Singing Honey Eater, Red Wattle Bird and Wee Bills (yellow form). Those birds sighted amongst *E. kruseana* but not feeding on the flowers included the Red Cap Robin, Crested Bell Bird, Chestnut Rump Thornbill, Little Wattle Bird, Blue Breasted Wren, Spiny Cheeked Honey Eater, Rufous Tree Creeper, Striated Pardalote,, Jacky Winter and Elegant Parrot.

While mapping the occurrence of *E. kruseana*, the field party made another interesting discovery. A small number of another rare eucalypt species, *E. brachyphylla*, were found sharing the same habitat as the Bookleaf Mallee at several locations. This eucalypt, which has been described and published as a separate taxa although some botanists consider it either a variety or a subspecies of *E. kruseana*, is not known to occur anywhere else in Western Australia. A total of 30 specimens of *E. brachyphylla* were found during the recent excursion. The name *brachyphylla* refers to the shortness of the leaves.

Although the Bookleaf Mallee is widely cultivated, its natural occurrence is very restricted. Under its gazetted status as a rare and endangered plant, *E. kruseana* is protected by law and cannot be taken by anyone except with the written permission of the Minister responsible for Fisheries and Wildlife. Anyone contravening the provisions of this law is liable on conviction to fines of up to \$1 000.

However, the ultimate role of protecting this and other rare species and ensuring their survival lies with the general public.

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