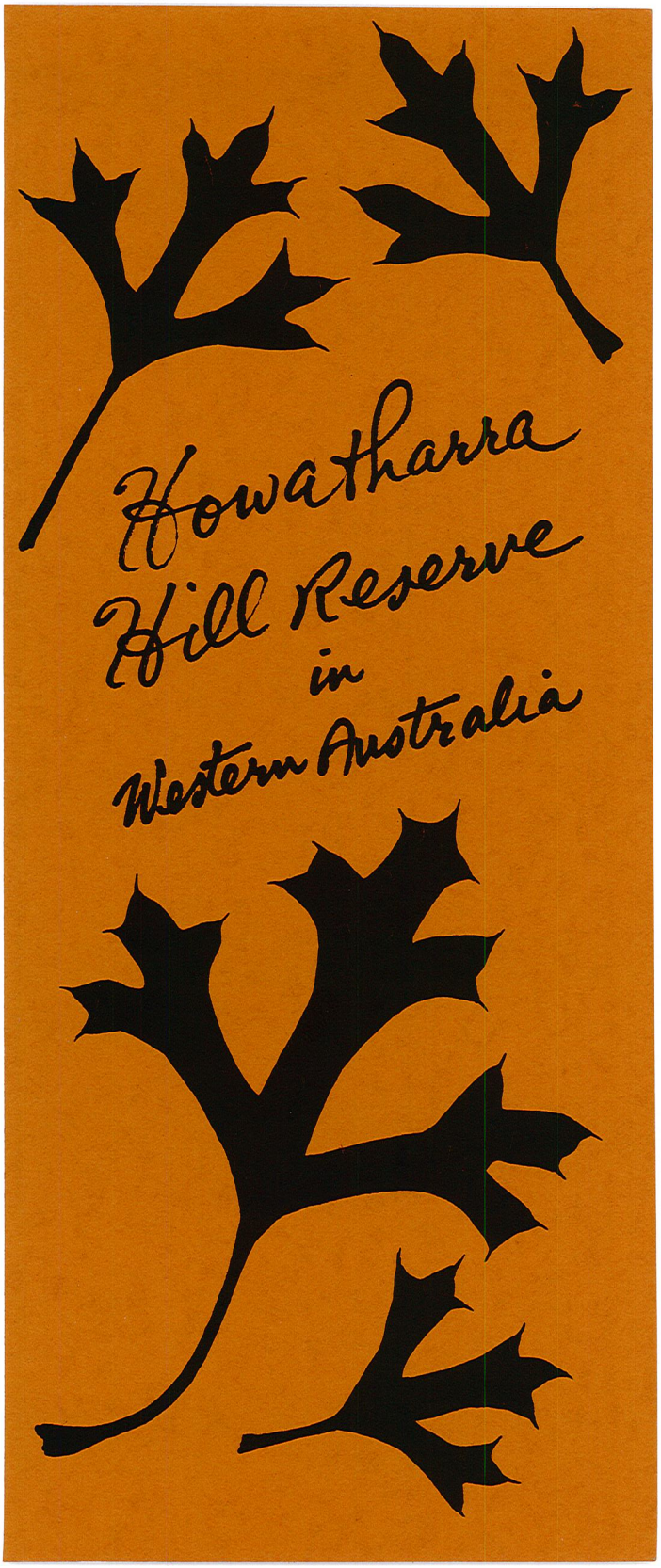
Howatharra
Hill Reserve
in
Western Australia

CHANGE IN RESERVE OWNERSHIP

In January 1988 the State Government of Western Australia purchased the Howatharra Hill Reserve from the McFarlands with the aim of having it managed as a Nature Reserve. The Reserve is now public land administered by the Department of Conservation and Land Management. As a consequence of this purchase some of the restrictions outlined in pages 26 to 28 of this publication are no longer appropriate. For further information on the reserve please contact:

Regional Manager, Greenough Region
Department of Conservation and Land Management
Cathedral Avenue
Geraldton, Western Australia 6530.
Telephone: (099) 215 955

INTRODUCTION

to

Howatharra Hill Reserve Ecological Research Area

in the

MORESBY RANGES

near

GERALDTON, WESTERN AUSTRALIA

by

D. & N. McFARLAND

(written July, 1977)

~~**PLEASE NOTE: This reserve is privately owned land and is NOT open to the general public.**~~

This guide-book was written primarily to provide a foundation for future natural history studies on the reserve, and to answer the initial questions of scientists and naturalists intending to visit or undertake research here, but it is available for sale to anyone who is interested in its contents (see next page).

Limitations: We make NO claims of "complete" coverage for any topic discussed in this booklet, nor is it intended as a guide to plant or animal identification in the district. However, it does give a (limited) general picture of the local environment, including mention of many typical native flowering plants ("wildflowers") that grow in the Moresby Range, but all details are drawn **only** from observations made in and around the Howatharra Hill Reserve locality. At best, probably not more than about 20-30% of the several hundred plant species, native to the Geraldton-Nabawa-Northampton district, have received even a brief mention in this booklet.

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THE ENVIRONMENT

GEOGRAPHIC LOCATION

This privately-owned flora & fauna reserve is in the northern wheatbelt of Western Australia, between the towns of Geraldton (pop. 18,000 in 1976) and Northampton which are 52 km. (32 road-miles) apart. It is located 30 km. (about 19 rd-mi.) NNE. of the central Geraldton Post Office, at about LATITUDE 28° 33' S. and LONGITUDE 114° 40' E., and is about 9 km. (6 mi.) inland from the Indian Ocean coastline (E. of Coronation Beach), amidst the steep, rocky flat-topped hills and scattered mesas known as the Moresby Range (which extends from SE. of Geraldton to W. of Northampton), at a point about 3.7 km. (2¼ mi.) E. of the Northwest Coastal Highway (Hwy. 1), on BOTH SIDES of the Howatharra-Nanson road, which runs E.-W. in the SW. end of Chapman Valley Shire. Howatharra-Nanson Road divides the reserve into two major sections (40 acres on the N. and 66 acres on the S. side of the road); its total area is 106 acres (43 hectares).

As a matter of possible interest, our **latitude** here corresponds closely to the following other localities: Hermosillo, Mexico; San Antonio, Texas, and Orlando, Florida, U.S.A.; Canary Islands; Delhi, India; Orange River (mouth), SW. Africa; Lake Eyre, S. Australia and about 100 mi. S. of Brisbane, Queensland.

ZONING OF THE RESERVE

To facilitate research projects (to enable more accurate recording of specific study areas or individual plants under observation, etc.), we have divided the reserve into ten numbered **zones,** roughly rectangular to triangular in outline. These are highly variable in size, ranging in area from about 5 acres (Zone 6, the smallest) to around 10 or more acres (Zones 1-5). This great variation in sizes and shapes derives, in part, from an attempt to follow or enclose certain natural features, such as soil types, or very steep and irregular slopes, etc. Zones 1-5 comprise the 66-acre section S. of Howatharra Rd., and Zones 6-10 comprise the 40-acre section N. of the road. The triangular Zone 6 is entirely cut off from Zones 7-10 by a secondary farm road (locally known as the Bella Vista road) that branches off Howatharra Rd. to the NE., at a point nearly opposite the main entry-gate into the S. section. A small **MAP** has been prepared to define the zones and their subdivisions. Copies of this map can be made available to individuals seriously contemplating research here.

The 10 zones can be made more useful by further dividing each one into about 6 to 9 **subsections,** depending on the size and shape of the zone. Taking the nearly square Zone 5 as an example, it can be subdivided as follows: NW, NC, NE, WC, C, EC, SW, SC, SE. The "C" refers to central, and all other letters indicate the standard compass directions. As many of our plant specimens (deposited in the W.A. Herbarium) already

carry numbered zone citations, **it would be greatly appreciated if researchers would co-operate** by adhering to the zoning concept already in use here, if they wish to refer to specific locations within the reserve. PLEASE WRITE ZONE REFERENCES in this style: Z.1(SE), Z.4(C), Z.6(SC), Z.10 (NW), etc. Please capitalise the "Z" and follow it with a period or full stop (or a hyphen), and then follow with the zone-number; if desired, finish it with the sub-section written in parentheses. This eliminates any possible confusion between numbers and letters which could arise from a sloppy handwriting. For example, a quickly-scribbled "S" can easily turn out looking like "5" (or vice versa); "1" followed directly by "S" can look like "15"; "Z1SE" (all handwritten and unseparated) could appear to be "Z15E", whereas it was intended to imply Z.1(SE). (There are many examples, but one illustration should suffice to make the point!) Throughout this booklet zone references are abbreviated to "Z", as in Z.1(SE) or Z.5(NC), etc.

We hope to eventually have the zone boundaries defined on the reserve itself: Zone corners will probably be marked with tall poles or rods, capped by inverted white plastic containers (or flags) conspicuous at a distance. Sub-sectional lines could be indicated by shorter poles with smaller caps or flags, as these need not be seen from great distances in order to serve their purpose. The approximate **centre** of each zone will be marked by a conspicuous yellow sign attached to a 5-foot steel post.

TRAILS AND CLEARINGS

Narrow, meandering TRAILS are planned, to give relatively noiseless access to various parts of the reserve, but these may take a long time to complete as we are doing all trail-making (and other maintenance) entirely ourselves. Wherever possible our trails will follow pre-existing kangaroo trails, many of which are already well defined. In trail construction, our two foremost considerations are always minimal disturbance to the habitat coupled with avoidance of all rare plants. Peripheral access to all of the zones already exists. This is due to the relatively small size of the reserve, plus the long-established roads that cut across it 3 ways, the old firebreaks at the N. & S. ends, and the cleared paddocks along all the NE., E., and SE. boundaries. Only the W. side is relatively inaccessible due to the steep slopes and dense scrub on that side.

One small CLEARING in the scrub (approx. 25' x 15') is planned for Z.1(SE), where a cement slab will be poured to securely anchor a large picnic table with benches and a covered rubbish bin, etc. — again, with minimal disturbance to the habitat in mind. Some form of shelter may also be erected over this picnic area to give protection from hot sun or rain, in order to make the area more pleasant (and less tiring!) for elderly visitors, and also to facilitate the field-pinning of insects, the writing of notes, or the eating of meals in comfort. NO fires for cooking (or any other purpose) will be permitted here, or **anywhere else** on the reserve, however.

It is hoped that a permanent water-source can also be established SW. of the picnic area, in order to increase the bird activity there. Aside from these minor local disturbances, no other alterations to the original habitat are contemplated, except for the maintenance of a few narrow trails in certain places.

RECENT PAST HISTORY

Sheep have always been kept out of the entire area that now forms the reserve due to the great abundance of several kinds of poisonous native plants, particularly 2 **Gastrolobium** spp.; the most abundant of these is the Champion Bay poison bush (FABACEAE: **G. oxylobioides** — NM.1010). Aside from the steep slopes and rocky terrain, the numerous poison bushes were primarily responsible for saving this unique habitat from being "used" (**i.e.,** destroyed)! Over the years there have been a few localised disturbances of the vegetation, and there is one access-road (still maintained), which crosses the S. section (through Zones 1 & 4) to reach a lateritic gravel quarry S. of Zone 3. (THIS IS NOT A PUBLIC ROAD!) Some localised or partial rolling and clearing of the scrub in parts of Zones 3, 4(S), 5(EC-NC), 6(SC-W), and clearing in 7(S to C), plus the firebreaks in Zones 3(S), 5, and 10 (N & W), were apparently the only other major disturbances that have taken place (in recent decades) within this otherwise relatively untouched habitat, aside from occasional kangaroo shooting by big-brave "sportsmen". [5, 16] However, right up to our fence on the E. and SE., the land has long been cleared (for at least 30 years) of nearly all its original vegetation, and has been in constant use for wheat and sheep-raising in the manner of most farms throughout this part of the state [12,13.14,]. (NOTE: Bracketed [ ] numbers refer to the "Quotations" section, starting on p. 30.)

FIRES

The potential fire season is from about late Oct. through April. The previous owner (Mr. R. Starling) has informed me that, within his memory, no fire has ever burned through the SOUTH side (Z.1-5), except for a small one (about 1969-70), which only penetrated about halfway into Z.1(SW-SC) from the west and then died out. Another small fire (about 1974) penetrated a short distance into Z.5(NE). There could be some interesting **longevity-records** (possibly more than 40 years) among the oldest woody shrubs still alive on the south side of this reserve. However, the NORTH side (Zones 6-10) was burned by a major fire on 8th March, 1964, which nearly destroyed the residence of Mr. and Mrs. C. H. Royce. (This is recorded in Mr. Starling's diary.) These **known** past fire records could add considerable value to botanical-ecological studies undertaken on this reserve.

We now have on file numerous photographs (made between 1971-77) of the area in general, plus file cards on most of the plants (including comparisons of relative abundance). The existence of this information could increase the potential value of future observations, on any changes that might occur in species-composition within the various plant associations, should another fire ever

burn through this reserve in the future . . . (If that should occur, observations on plant successions and growth rates, etc., could be initiated immediately.) This is a fire-adapted flora, in MANY ways strikingly reminiscent of the chaparral and certain other sclerophyll shrub associations in coastal southern California. Regrowth after fires is generally rapid and soon becomes dense again.

CLIMATE AND SEASONS

The climate at this latitude could be described as "dry subtropical-Mediterranean", with a short growing season (about 5 months) of almost entirely cool weather rainfall (peak in winter), followed by a long summer drought. Humidity is relatively low throughout most of the year. WIND (often strong) is particularly evident during the first half of the dry season (about mid Oct. to Dec. or Jan.), and periodically (for brief spells) throughout the winter. Late in the dry season (late Jan. or Feb. to about early April) there can be relatively longer spells of windless days, high temperatures, and often somewhat higher humidity. The **rains** normally **begin** sometime between mid April and the end of May. About 75% of the total annual precipitation (around 350 mm. or 14") falls between early May and late August. June and July are normally the wettest months. "Winter" is very short and mild at this latitude, rather quickly fading into spring about mid August (even earlier some years), accompanied by a tremendous show of wildflowers.

The **FLOWERING-SEASON** begins with the early epacrids (see **Astroloma** — p.13), very soon after the first soaking rains of April or May, and reaches a **PEAK** sometime **between early Aug. and early September.** Around early to mid Oct., mild summer conditions are usually beginning and most of the ephemerals are drying up, although some reach their peaks still later in Oct., and certain myrtaceous shrubs are still in bloom (or just starting) in October. The majority of plants are producing mature seeds between late Sep. and early Dec. here. In most years the **dry season** lasts for 6 or 7 months, from about mid Oct. to (or through) mid April, and it sometimes extends well into May. Fog (at ground level) is rarely seen here, but it does occasionally form in low blankets over the hills and mesas for **brief** periods early on warm and windless mornings during the dry season. An early morning low cloud-cover is frequent along the coast (and up to about 15 mi. inland), during warm and windless spells between Oct and April, but it is usually dissipated by 1100 hrs. (or earlier); these clouds never bring rain.

RAINFALL

The annual average for Geraldton (based on 95 years of records) has been 474 mm. (18.75 in). For Northampton, the 95-year average is 504 mm. (20 in.). The Howatharra district lies among the hills about halfway between these two towns; we have no records for this exact locality. The mean (average) monthly rainfall totals for **Geraldton,** based on records kept between 1877-1972, have been as follows: APR. - 24 mm; MAY - 70 mm; **JUNE** - 120 mm; **JULY** - 97 mm; AUG. - 69 mm; SEP. - 31 mm;

OCT. - 19 mm; NOV. - 7 mm; DEC. - 4 mm; JAN. - 6 mm; FEB. - 9 mm; MAR. - 14 mm. It is worth noting that **nearly half the total** annual rain falls in the 2 winter months of June and July (in "normal" years). By late August the rains rapidly begin to taper off. Most of the rain falls **at night** here, and winter-spring days are usually sunny, or only semi-cloudy with scattered showers. Summer thunderstorms can occur between Nov. and March, but near the coast they are extremely uncommon.

TEMPERATURES

It rarely drops below 3-4 degrees C. (about 38 degrees F.) at night in winter, and is usually much warmer. Daytime highs in winter usually range between 16-26 degrees C. (60-80 degrees F.), but can be even higher. Summer diurnal highs rarely exceed 40 degrees C. (104 degrees F.), and are typically in the 24-35 degrees C. (75-95 degrees F.) range. From about mid Sep. to Jan. a strong and cooling S. or SW. wind springs up along the coast on many days between noon and 1400 hrs., generally dying down again at night. Between Oct. and Feb. or March, **hot** and drying E. winds (from the interior) are frequent in the mornings up to about noon or later. In winter-spring, these same morning winds are **cold** and dry. Spells of these desiccating E. winds (usually several consecutive mornings) generally alternate with quiet spells of slightly increased humidity (also usually several consecutive days), off and on from about July to Jan. or February. Major winter rain storms are often preceded and followed by strong W. to NW. winds along the coast. (Note: More detailed information, on the Geraldton district climate and geology, is given by Beard & Burns, 1976, pp.4-10; see also Playford, 1959.)

GEOLOGICAL NOTES

(from K. Wyrwoll and G. Strong)

The whole area was under the sea before the Jurassic Period. The present flat-topped Moresby Ranges are the remnants of the much-dissected Victoria Plateau. They are mesa formations composed of flat-lying sedimentary rocks, which dip slightly to the E. at Howatharra Hill Reserve. These rocks lap against the underlying igneous and metamorphic Proterozoic basement rocks of the Northampton Block. The boulders and rocky outcrops ("breakaways", etc.) are mainly Jurassic **sandstones** (about 135 to 190 million years old), with some silt-stones, shales and occasional conglomerates, primarily of the Champion Bay and Chapman Groups. They are highly-weathered and are capped by laterite with a ferricrete duricrust — some parts have a massive structure; others are composed of pisolitic pebbles or gravel. The latter are the rounded, light brown pebbles typical of Z.3(SW), and are of more recent (Cainozoic) origin. The duricrust which caps the rough sandstone "cliffs" or breakaways (mainly in Z.2 & 10) is an iron-impregnated layer, which has formed through the upward-leaching of iron-saturated ground water; the hollows or small "caves" beneath these hardened caps resulted

from a gradual weathering-out of the softer sandstone inside. Soil types range from fine whitish sands (typical sandplain types) to heavier gray or gray-brown to reddish clays (weathering products of the rocks). The fine sands and sandy-gravels (laterite) carry distinctive plant associations, differing greatly in species-composition from those occurring on the heavier soils or clays among the boulders and massive rocky outcrops. Certain low-lying areas, as seen in Z.5 (NE.-NC) and 6 (SW), have accumulated their fine sand by a gradual downhill erosion from the lateritic flat-tops, which are typically overlain by sand. There are many steep, boulder-strewn slopes, the predominant **exposures** being to the N. (in Z.1, 2, 3 & 10) and to the S. (Z.1, 6 and 9); some E. and W.-facing slopes are also represented.

Elevations on the reserve range from a maximum of about 180-210 metres (about 600 to 700 feet) above sea-level on the flat-tops (in Z.1-3 & 10), down to about 120-150 metres (400-500 feet) in the low lying areas.

A rather large **fossilized tree trunk** fragment (about 18 in. x 6 in. diam.), probably of the Colalura Sandstones (Champion Bay Group), was recently discovered N. of Howatharra Rd., partially-embedded in the base of a termitarium on Crown Grant 3, on the W. boundary of our reserve, about 15 feet W. of the Z.9(C) fence-line, at a point about 140 metres (460 ft.) N. of the Z.8(SW) corner. Some pieces of this petrified wood were given to the Geological Survey of W.A., Perth (G.S.W.A. regis. No. F9788). I quote A. E. Cockbain's (unpublished) Palaeontological Report 58/77 on this material: "The wood is silicified and the internal structure is beautifully preserved. In places the wood fibres flake off, much as in modern wood, although each individual fibre is silicified. The gross structure of the wood indicates that it is softwood (gymnosperm), most probably podocarp wood. There are no growth rings and this suggests that the climate in which the wood grew was tropical or subtropical. Judging by the locality data the wood comes from rocks of Jurassic age." An accompanying letter from J. H. Lord, Director of the G.S.W.A., stated that this specimen was "quite the best-preserved fossil wood that Dr. Cockbain has seen."

FLORA

MISCELLANEOUS REMARKS

Space here permits only the most superficial outline of Howatharra Hill's immense botanical richness and diversity. Within this 106-acre reserve — less than one ninth the size of Kings Park (996 acres) — we have already collected or observed **over 300 SPECIES** of flowering plants and ferns, representing about 180 **GENERA** and 66 **FAMILIES**! Probably **at least** 2 more families, and undoubtedly more small ephemerals, grasses and sedges, etc., still await discovery on the reserve; the lower plants (fungi, lichens, and mosses, etc.) have not even been tackled as yet. About 280 spp. have actually been collected and pressed to date; of these, about 260 have been partially or completely identified by various plant taxonomists.

It is hoped that a fairly complete plant list can eventually be prepared for Howatharra Hill Reserve, but more collecting (and identification) still remains to be done before this would be possible . . . Also, a more detailed account of the flora could perhaps be published someday, reporting such things as the usual flowering seasons and peak periods for most of the species, and including all other observations or phenological data of possible interest, but several more years of observation would be a minimum requirement.

We have already (in only 5 years) noticed considerable variation in the duration and "peaks" of blooming for many plants here; this appears to relate to annual variation in onset, continuity, duration, and quantity of winter rainfall. A heavy rain in the summer or early autumn can cause out-of-season or "early" flowering in **many** plants here. Such results can be expected from any unusually heavy (cyclonic) rainfall between Nov. and March, as this 5-month period is normally almost 100% dry in the Geraldton district.

In 1974 we began a small reference collection ("mini-herbarium") of pressed and code-numbered plants, along with a card file containing phenological data and other miscellaneous notes on each species. Numbered duplicate specimens of these plants are being deposited periodically in the W.A. Herbarium (South Perth). Identically-numbered colour slides are also being made, with the objective of eventually recording every Howatharra Hill species on film; this project is already well advanced.

The various plant associations enclosed by our small reserve are typical of many other areas in the Moresby Range, although by no means are all of the species or associations occurring in this district represented within our boundaries (unfortunately!). Other superb and botanically **irreplaceable** remnant patches of native flora still exist nearby on adjoining properties. In these other undisturbed areas grow numerous additional species not present within our reserve; of particular importance are Crown Grant 3 and Victoria Location 2862 (SE. corner only).

GENERAL APPEARANCE OF THE VEGETATION: Over most of the reserve numerous species of small to large woody, evergreen shrubs form a dense, blanket-like cover (with openings here and there), which varies in height from about one to seven feet, and looks startlingly like certain chaparral formations of COASTAL southern California (particularly in San Diego County), but entirely different plants are involved, of course. Many of the species are endemic to this region of W.A. — see Beard (1969) and Marchant (1973). This dense natural **blanket** of shrubs forms an important watershed for nearby farms; it is **vital** in reducing salinity and maintaining the level of underground water upon which the farmers here depend. (It is a tragedy that most landowners do **not** understand this ecological fact; see Wood, 1924.)

The plant formations covering most of the reserve are dense heath associations (on the laterite), and somewhat taller mixed shrub-thickets dominated by various Myrtaceae (esp. **Melaleuca megacephala**), with 2 **Hakea** spp. and various woody legumes (esp. acacias) as co-dominants (see Beard, 1976: pp. 11, 18, 19). SMALL trees also arise here

and there above the shrub blanket, but they are not common on the reserve; these "trees" are mostly leguminous (2 **Acacia** spp., **Jacksonia sternbergiana,** and **Viminaria juncea**), but a few **Nuytsia** trees are also present (see Fam. Loranthaceae, p. 15). There is a mallee thicket (primarily **Eucalyptus redunca**) in a low-lying area W. of Z.8, and nearly pure stands of **M. megacephala** (one of the larger shrubs) cover large areas. Around the breakaway "cliffs", on poor and shallow rocky soils, exposed to strong winds, some of the myrtaceous shrubs grow very slowly into gnarled and contorted woody forms, giving these areas a unique character. The primary contributors to this knee-high "bonsai forest" effect are **Melaleuca "scabra"** (NM.1078) and one other common **Melaleuca** sp. (NM.1142); also **M. cardiophylla** var. **longistaminea** (NM.1075), **Calytrix tenuifolia, Verticordia penicillaris,** and **M. megacephala** growing under conditions of deprivation.

Like the coastal Californian chaparral, these mixed thickets and heath associations are composed of numerous evergreen-sclerophyll woody shrubs, which appear to be relatively uniform when viewed from a distance. But there are, in fact, dozens of genera and species present in these rich patchwork formations. Typical of similar plant associations in other coastal regions having a Mediterranean climate (**i.e.** — South Australia, South Africa, Central Chile, California, and S. Europe - N. Africa), very few of these shrubs have STEM spines or thorns (the only 3 local exceptions being the legumes, **Mirbelia microphylla, M. spinosa,** and **Acacia ulicina**), although spiny or spine-tipped LEAVES are common; the latter involve about 10 families (many spp.) on our reserve. Dark green to yellowish-, olive- or gray-green leaf colours predominate among the shrubs. Most of the leaves range in size from small to medium, with linear, terete, or ovate to obovate and elliptic shapes predominating; revolute margins, resinous coatings, and many kinds of pubescence are common. **Deciduous** pubescence, present only on **new** growth (presumably to protect tender young lvs. and stems from the frequent drying winds), is also seen in about 15 of the shrubs here, the 3 most notable examples being a **Dampiera** sp. (NM.1040), **Melaleuca uncinata** (NM 1073), and **M. megacephala** (NM. 1074); others are **M. "scabra"** (NM.1078 & 1072), **Hakea pycnoneura** (NM.1025), **H. trifurcata** (NM. 1026), **Grevillea pinaster** (NM.1022), **Synaphea** (NM.1021), **Bossiaea biloba** (NM.1013), and **Acacia ericifolia** (NM.1003); Many of the shrubs are fire-adapted, having thick woody fruits that remain on the plants for years (**Hakea, Calothamnus, Melaleuca,** etc.), and/or lignotubers capable of rapid crown-sprouting after fires (or cutting).

NATIVE EPHEMERALS, particularly small species, are a major and conspicuous element of the winter-spring flora here. By "ephemerals" I mean not only all the annual plants, but also those perennials (from bulbs, etc.) which are only visible above ground for part of the year — primarily between June and late Oct. in this district. The **annual** ephemerals are predominately Asteraceae (Compositae): Several of these are very tiny with obscure flowers; others, like **Waitzia acuminata,** are gaudy and conspicuous in certain areas. Another

important family contributing to the annual ephemerals (4 abundant small spp.) is the Apiaceae (Umbelliferae), the carrot family. The monotypic **Brunonia australis** (blue pincushion or native "cornflower"—Fam. **BRUNONIACEAE**) deserves special mention because of the superb display it makes in Z.5(NC), with the onset of really warm, dry days (about mid to late Oct.), by which time most of the other annuals are nearly dead. **Waitzia** is also colourful (in the same place) at this time. The **perennial** ephemerals are mostly Stylidiaceae (trigger-plants), Liliaceae, Orchidaceae, and Droseraceae (sundews). These are extremely abundant, and much in evidence from June to mid Sep. throughout the reserve, particularly in boggy or slow-draining (clay) soils, in sunny glades or openings between the shrubs. Some, like tiny orchids of the genus **Pterostylis,** grow hidden under the shrubs in semi-shade; these can be abundant in suitable microhabitats but are quite inconspicuous, remaining visible for only a very brief period between late June and early August.

INTRODUCED WEEDS: Of the 66 plant FAMILIES recorded for Howatharra Hill Reserve to date, only 15 include some introduced (naturalized) species not originally native here (**i.e.**- "weeds"); of these 15 families, the following 5 are represented solely by introduced spp. on the reserve: Brassicaceae (2 spp.), Caryophyllaceae (3), Plantaginaceae (1), Primulaceae (1), and Scrophulariaceae (3). The remaining 51 families are represented entirely by native plants here. Of the approx. 300 SPECIES known to be growing on the reserve, about 31 (around 10% of the total) are almost certainly naturalized weeds. I have been told that the comparable figures for Kings Park, Perth (excluding the formal plantings and those Australian natives intentionally introduced from other districts) are as follows: A total of 318 species, of which 58 (about 18%) are introduced weeds, and 260 were originally native to Kings Park and vicinity.

As long as the ground remains undisturbed, **most** of the local weeds appear unable to penetrate the dense native plant associations growing at Howatharra Hill, even though numerous weedy annuals do approach right up to the fence along all of our borders except the western side. Most of the weeds are far more abundant in nearby paddocks (cleared fields), or along roadsides outside the reserve. Within the reserve they are primarily confined to trails and firebreaks, or to areas recently plowed up by echidnas (disturbed soils). Dead animal bodies or concentrations of droppings (rich nitrogen sources) also encourage weeds, temporarily.

The most persistent weeds **inside** the reserve are various grasses and composites, the 4 most abundant of the latter family being **Ursinia anthemoides** (NM.1280), **Arctotheca calendula** (cape dandelion or cape weed — NM.1245), **Hypochoeris ?glabra** (NM.1287), and **Inula graveolens** (NM. 1229), all of which have wind-dispersed seeds. **Briza maxima** (rattle grass) is also abundant in certain areas (esp. in Z.5), and the conspicuous **Bellardia (Bartsia) trixago** (Fam. Scrophulariaceae — NM. 1201), with cream-white fls., is fairly common in and around Zones 4-7.

FLOWER COLOURS of the native plants on the reserve are predominantly **whites** and **creams** (82 spp. or slightly over 35%), followed by all shades of **yellow** (25%); white through yellows combined equal about 60% of the total. The various percentages work out roughly as follows, based on a synopsis of the known flower colours of 232 NATIVE Howatharra Hill Plants (excluding introduced weeds and also omitting those native spp. that **lack** a corolla — or a colourful calyx in its place — such as the grasses and sedges, **Casuarina** and **Dodonaea,** etc.): Pure **whites** — 26% (60 spp); **creams** — 9.5% (22 spp.); various shades of **greenish-white** — 3.8% (9 spp.); **pure greenish** — 1.7% (3 orchids and **1 Melaleuca**); all **yellows** (including 6 Fabaceae partially-tinged with orange in the corolla) — 25% (58 spp); pale to deep **oranges** — only 1.3% (3 spp.); true **reds** — 3% (7 spp., of which only 5 are common); **pinks** — scant 14% (32 spp); **mauves** or lavenders — 5.2% (12 spp.); **blues** — 6.5% (15 spp.); all **violet** shades (grading to purplish) — scant 4% (10 spp.). There are a few native spp. (probably less than 10) not included in the above synopsis, only because their flower colours have not yet been observed.

PLANT FAMILIES

COMMENTARIES on **some** of the more abundant, colourful, ususual or noteworthy genera and species of **NATIVE FLOWERING PLANTS** growing on Howatharra Hill Reserve follow. They are arranged in alphabetical order by FAMILY:

Family **AMARANTHACEAE** — 5 spp., all of the genus **Ptilotus,** of which the distinctive **P. declinatus** (NM.1219) is the most abundant, and **P. manglesii** (NM.1222) is the most colourful, with vivid fls. in Oct.-Nov., esp. in Z.10(NW).

Fam. AMARYLLIDACEAE — see HYPOXIDACEAE.

Fam. **APIACEAE** — 7 spp., of which about 3 are **Trachymene** (abundant native ephemerals), and one is an undescribed perennial **Platysace** (NM.1183).

Fam. **ASTERACEAE** (COMPOSITAE) — at least 28 (+) spp. (18 genera); a major element in the ephemeral flora here. About 9 spp. (at least 6 genera) are introduced weeds (see p. 11). Among the abundant native spp. is a **Brachyscome** with mauve fls. (NM.1155); also common is the deep pink everlasting, **Helichrysum lindleyi** (NM.1098), and at least 5 **Helipterum** spp. of 3 colours (all ephemerals). One common **Olearia** sp. (NM.1121) is the only woody composite on the reserve (a shrub with inconspicuous fls. in autumn). The yellow "buttons" of **Podolepis lessonii** (NM.1223), on their thin and wiry red-brown stems, are abundant in late Aug.-Sep., at which time the great majority of other composites are also blooming. **Podotheca angustifolia** (NM.1162) and **P. gnaphalioides** (NM. 1295) are scattered throughout. The most conspicuous and abundant larger composite in some parts of the reserve is **Waitzia acuminata** (NM. 1202 & 1203), which is present in two colour forms here (rich yellow tinged with orange and white tinged with pink); both forms are about equally common and grow side by side. See Grieve & Blackall (1976, Plates XI-XVI), for colour photos of 8 of the composites occurring here.

Fam. **CONVOLVULACEAE** — see after Lauraceae.

Fam. **CYPERACEAE** — 4 spp. (in 4 genera) have been identified to date; the tussock-forming **Lepidosperma scabrum** (NM.1164) is abundant, dominating some areas. I suspect the larvae of our locally common castniid moth (**S. leucospila**) may feed underground within these clumps.

Fam. **DICRASTYLIDACEAE** (CHLOANTHACEAE) — 3 spp., all of the endemic genus **Pityrodia,** of which only **P. verbascina** (NM.1062) is common in Z.5(NE); it is a peculiar sprawling, tomentose shrub, with large woolly leaves which vary from deep rust-brown to pale yellowish in the colour of the pubescence. **P. atriplicina** (NM.1238) is present only in the gravel quarry area of Z.3, and in other areas S. of there outside our boundary; it is a tall, erect shrub with felty-whitish lvs. and beautiful pinkish mauve fls. in Sep.-October.

Fam. **DILLENIACEAE** — 3 spp., all **Hibbertia,** of which the largest, **H. hypericoides** (NM.1051), is a common and conspicuous shrub throughout; it can begin flowering as early as May, carrying on with its vivid buttercup-yellow fls. steadily for at least 5 months.

Fam. **DIOSCOREACEAE** — 1 sp., **Dioscorea hastifolia** (NM.1033), the native "yam", is common here; it is a slender twiner which arises from a large, underground tuber soon after the first rains, thereafter rapidly scrambling over nearby shrubs or boulders, etc. It has bright green, narrow-hastate lvs. and small, bright yellow fls. borne on upright spikes (May - July). The leaves die by about Sep., but the conspicious winged fruits remain on the drying stems for several months, gradually turning from green to pale tan as summer advances.

Fam. **DROSERACEAE** — 7 spp. (all **Drosera**) have been collected within the reserve; several of them are very abundant. (This is about one sixth of all described W. Australian sundews!) In winters of poor rainfall (less than about 10 in.) many of them fail to reach full size, or even to bloom. In a wet winter they are a most conspicious element of the flora from June-Aug. The robust climbing **D. macrantha** (NM.1063) is extremely common among low, dense shrubs on the heavy soils, bearing its large, pure white fls. (on the tops of supporting shrubs) from early July - early August most years. **D. neesii** (NM.1129) produces a rigidly erect stem and stands on its own; large vivid pink fls. appear in early spring. 2 of the other sundews form compact rosettes, closely-appressed to the ground.

Fam. **EPACRIDACEAE** — 4 spp. (3 genera); the low-dense shrub, **Astroloma serratifolium** (NM. 1045), is the most spectacular, with its incredibly profuse (but brief) display of translucent red to red-pink fls. between late Apr.-June.

Fam. **EUPHORBIACEAE** — only 3 spp. (2 genera) collected so far (all natives), of which **Ricinocarpos psilocladus** (NM.1036) is a fairly common slender shrub throughout Z.1-3; its relatively large, pure white fls. appear in June & July.

Fam **FABACEAE,** s.s. — 22 spp. (representing 12 genera) have been identified, of which only 2 are not native. All but one of the native legumes here are woody perennials, varying in size from tiny dwarf shrubs to small trees (the "weeping" **Jacksonia sternbergiana** — NM.1014, and the broom-like **Viminaria juncea** — NM.1187). One of the

most unusual is the abundant **Brachysema aphyllum** (NM.1156), with strap-like leafless, prostrate stems forming large, circular mats; the fl. buds are always cream-white, but as the corolla emerges red comes in as speckles at first, gradually intensifying to a very deep red; the fls. are peculiarly modified for pollination by birds (honeyeaters). The importance of the 2 **Gastrolobium** spp. here (poison bushes) has been mentioned earlier (see "Recent Past History" and "Dedication" sections); their fls. are deep yellow tinged with orange. One of our 3 **Gompholobium** spp. (NM.1199) has a brilliantly clear yellow corolla; another (NM.1260) has a pinkish-violet corolla marked with white, and most distinctive pinnate lvs. having narrow parallel leaflets that gradually increase in length from the leaf base to tip. (Two of its leaf-prints are on the back cover.)

Fam. **GOODENIACEAE** — 10 spp., 7 genera (all natives), of which the **Dampiera** spp. (NM.1040 and 1041) are the most colourful in bloom, having a profusion of intensely deep blue fls. in winter-spring.

Fam. GRAMINEAE — see POACEAE.

Fam. **HAEMODORACEAE** — 6 spp., of which **Anigozanthos humilis** (cat's paw — NM.1090) is the most colourful; it is common in Z.5 (NE) & Z.10(N). A small **Tribonanthes** sp. (NM. 1110) is not uncommon on mud, in winters of good rainfall; it favours areas similar to those described under Fam. Philydraceae. **Conostylis androstemma** (NM.1262), quite unlike any other member of the genus, can be seen among the rocks in Z.2(E); when not in bloom these plants could be mistaken for sedges or small grass clumps, and the large tubular fls. are deeply-buried within the clumps. 2 **Haemodorum** spp. are peculiar for black and dark brownish, glabrous fls. borne on tall scapes (NM. 1089 & 1301); the taller sp. is common in Z.5(NC).

Fam. **HYPOXIDACEAE** — The bright yellow "stars" of our one abundant sp., **Hypoxis leptantha** (NM.1111 — a small monocot), appear in profusion throughout much of the reserve (on heavier soils) in winter-spring; they are small plants, mostly around 2"-5" tall. This genus has been treated as a member of the Fam. Amaryllidaceae by some authors.

Fam. **IRIDACEAE** — 2 spp., **Orthrosanthus laxus** (NM.1113), with pale blue fls., and **Patersonia** sp. (NM.1114), with deep violet fls., are common and add much colour to the late winter-spring show.

Fam. **LAURACEAE** — represented by at least 3 **Cassytha** spp. (Devil's twine, dodder-laurel, or "dodder"), of which 2 (NM.1258 & 1259) are very common tough, twining **perennial** parasites on numerous shrubs in this locality. **C. glabella** (1258) shows a distinct preference for **Melaleuca uncinata** here. The least abundant (NM.1296) uses **Nuytsia floribunda** (Loranthaceae) as its host and grows rampantly; it is apparently an undescribed species. It is worth noting that there is an introduced thread-like **annual** parasite here (NM.1146), also known as dodder, which belongs to the same genus as the American parasites of that name (**Cuscuta** — Fam. CONVOLVULACEAE). It mostly attacks annuals such as clover and capeweed, etc., and is often very abundant in paddocks bordering the reserve (Aug.-Sep.).

Fam. LEGUMINOSAE — see FABACEAE and MIMOSACEAE.

Fam. **LILIACEAE** — at least 14 spp. representing 10 genera (**all** natives), of which many are abundant and colourful elements of the winter-spring flora in years of good rainfall. Especially conspicuous are the following: **Arthropodium** (NM. 1291 — blooms late, from Sep.-Nov.), **Burchardia umbellata** (NM.1105), **Chamaescilla** sp. (NM.1106), **Sowerbaea laxiflora** (NM.1104), the superb **Thysanotus patersonii** (twining fringe lily — NM.1108), and 2 **Wurmbea** spp. (NM.1107 & 1272). An interesting southernmost range-extension is the pink-flowered **W. densiflora** (1272), which blooms very early in winter (mid May-June), well ahead of all other Liliaceae in this locality. The **Sowerbaea** flower (but not the large clumps) is superficially reminiscent of the Californian native, **Brodiaea pulchella.**

Fam. **LOBELIACEAE** — 3 spp. (3 genera), of which one is an uncommon weed; the 2 natives become conspicuous in late spring - early summer (Oct.-Nov.), **after** most of the Liliaceae have finished blooming. These are a cream-white fl. form of **Isotoma hypocrateriformis** (NM.1220), and a deep blue **Lobelia** sp. (NM.1190), both abundant.

Fam. **LORANTHACEAE** — 3 spp., of which the most spectacular is the endemic and monotypic **Nuytsia floribunda** (the W.A. Christmas Tree); it is covered with masses of intensely rich golden-orange fls., from about late Oct. to mid Dec. at this latitude. The contrast of these fls. with the dark green foliage, against a brilliant blue, crystal-clear summer sky, cannot be adequately described!

Fam. **MIMOSACEAE** — 11 or 12 **Acacia** spp. (all native), varying in size from compact shrubs to small trees; a dominant element in the shrub cover here. Although the soil here is mostly heavy, this is **not** "Jam Country", but scattered individuals of **A. acuminata** (the jam tree) are present on the reserve. The little-known **A. oldfieldii** (NM.1000) is well-represented here. **A. blakelyi** (NM.1008), **ericifolia** (NM.1003), **lasiocarpa** var. **villosa** (NM. 1005), and **ulicina** (NM.1001) are the 4 most abundant acacias on the reserve.

Fam. **MYRTACEAE** (see also "Dominant Fams." - p. 18) — 31 spp. representing 9 genera (all natives), of which 9 are **Melaleuca** spp.; various myrtaceous plants (other than **Eucalyptus**) dominate large areas of the reserve, contributing many of our commonest **woody shrubs** to the heath and thicket associations. The lvs. of **all** genera are pleasantly and distinctively sweet-fragrant when crushed. In Z.5(NC), **Calytrix ?strigosa** (NM.1139) is an unbelievably dense mass of rich purple fls. from late Aug. to early Oct.; the low and spreading **C. tenuifolia** (NM.1086) is often abundant near **Verticordia penicillaris** colonies, blooming profusely for several weeks during the winter-spring; its bright fls. have pale yellow centres, the petals tipped with purplish-pink to pale violet. The genus **Eucalyptus** is only represented by 2 mallees (shrubby eucalypts) here, **E. redunca** (NM.1087) and another unidentified sp. (NM.1088); these grow in small stands or as scattered individuals. Of the **Melaleucas,** the abundant **M. "scabra"** (NM.1072 & 1078) is perhaps the most beautiful Howatharra sp. when in flower, ranging from intense dark pink to pale pink to pinkish-white; the dark pink form predominates here. The **scabra** flowering season is relatively brief, usually

starting about early to mid July and finishing by about mid August (on our reserve); in other nearby areas they usually bloom later (Aug.-Sep.). Also spectacular (but not as colourful) are the myriad cream-white inflorescences of the abundant **M. megacephala** (NM.1074) during Aug. of a wet winter (like 1974); in drier years (like 1976) its flowering is only patchy at best. Scattered individuals will continue blooming into Oct., well past the normal peak period. It appears that **M. scabra** may (?) be hybridizing with **megacephala** in Z.10 (SE), or else **"scabra"**(s.l.) is extremely variable here . . . **M. cardiophylla** var. **longistaminea** (NM. 1075) deserves special mention for its prostrate growth-habit and striking pale **green** fls. (late Sep.-mid Nov.); the new lvs. are red. Other spectacular myrtaceous shrubs abundant here are 2 **Calothamnus** spp. (red fls.), **Thryptomene** sp. (NM.1080), and **Scholtzia** sp. (NM.1079); both the latter are covered with masses of pale pink to mauve fls. (heather-like effect) from about late June or early July to mid Sep., and usually swarming with insect life. A rare and most peculiar dwarf shrub, **Verticordia penicillaris** (NM.1083), is very well represented (about 700 plants) within our reserve; most of these are concentrated in 5 major "colonies" on shallow clay soil over rock, in association with **Borya, Drosera,** and other plants that prefer boggy conditions during winter. These same locations are baked hard and dry from about Oct.-March. Four other **Verticordia** spp. ("feather flowers") are common here (NM. 1081, 1082, 1196, and 1214); these are all spectacular in bloom and 3 of them are highly attractive to insects; their colours are rich yellow, pink-tinged white, pale pink, and deep pink.

Fam. **ORCHIDACEAE**—13 terrestrial spp. (representing 9 genera) have been identified to date, and many of them are abundant here. All bloom between May and Oct.; the most colourful or noticeable spp. are the cowslip orchid, **Caladenia flava** (NM.1115), **C. gemmata** (NM.1134), **C. patersonii** (spider orchid — NM.1117), 2 donkey orchids, **Diuris** spp. (NM.1143 & 1194), **Prasophyllum fimbria** (leek orchid — NM.1135), and a sun orchid, **Thelymitra antennifera** (NM.1116).

Fam. **OROBANCHACEAE** — 1 sp., **Orobanche australiana** (NM. 1068) is sometimes exceedingly abundant in fallow wheat paddocks (among previous year's stubble) around our borders; they also appear here and there throughout the reserve.

Fam. **PHILYDRACEAE** — 1 sp., the monotypic and endemic **Philydrella (Pritzelia) pygmaea** (NM.1132), noteworthy as a northernmost range extension, is represented here by some small colonies in shallow clay soil, on certain rocky areas that remain constantly wet in winter.

Fam. **PITTOSPORACEAE** — 2 spp., **Billardiera bicolor** var. **lineata** (NM.1158) and **Bursaria spinosa** var.? (NM.1179); the former (a shrubby twiner) is unique in this locality for its profuse blooming in mid to late summer, at the height of the dry season (from about Dec. or Jan. to Mar.).

Fam. **POACEAE** — The grasses have not been carefully collected as yet, so the total is uncertain; various spp. (both native and introduced) occur throughout, but none really predominate anywhere on the reserve. Two conspicuous native grasses are **Neurachne alopecuroides** (NM.1168) and

Stipa elegantissima (NM.1283). (See also **Briza** under "Introduced Weeds".)

Fam. **PROTEACEAE** — 18 spp., representing 8 genera (all sclerophyll shrubs); a very important family throughout the reserve, particularly the genus **Hakea** (represented here by 7 spp.), of which **H. lissocarpha** (NM.1024), **pycnoneura** (NM.1025), and **trifurcata** (NM.1026) are the most abundant. A peculiarity of the latter is its strikingly-different leaf forms: linear-terete, trifurcate lvs. usually predominate, with a variable scattering of entire, broad leaves on most (but not all!) of the bushes. When in bloom (Aug.-Sep.) they are swarming with insect life, as are many of the myrtaceous shrubs, particularly the Scholtzias (NM.1079 & 1188) and **Verticordia ?densiflora** (NM.1196). **Banksia** is conspicuously absent on the reserve, although 3 spp. are common in a sandy area less than a mile to the northeast. **Grevillea pinaster** (NM.1022) is abundant all over the reserve and blooms profusely (red fls.) from June-Oct.; the rare **G. bracteosa** (NM. 1131) is locally abundant on lateritic gravel in 2 places, unfortunately both just **outside** the reserve boundaries in adjoining paddocks (SE. of Z.4 and NE. of Z.6). These striking shrubs come back vigorously after repeated bulldozing, but the sheep avidly defoliate them. In 1976, Mr. Starling kindly allowed us to enclose a 30' x 40' rectangle containing over 75 young and vigorous **G. bracteosa** plants (about 100 yards SE. of Z.4), in order to permanently protect a sample of this rarity from the sheep. (Incidentally, within this same enclosure are some fine specimens of a new **Platysace,** NM.1183.) Although heavily-grazed, **G. bracteosa** is still (7/77) surviving along the roadside NE. of Z.6. Among the most beautiful and peculiar plants on the reserve are **Isopogon divergens** (NM.1028), with large mauve fl. heads, and our common **Synaphea** (NM.1021), a southwestern endemic with rich yellow fl. spikes. The latter blooms primarily from late June-Aug.; four of its variable leaf shapes are depicted on the **front** cover (natural size).

Fam. **RUTACEAE**—5 spp., of which 4 are **Boronia** spp. and the other is **Diplolaena microcephala** (NM. 1060). The latter is fairly common among the boulders along the rim of the south-facing breakaways that run through Z.6 to 9(NE), and along the edge of 10(S). The most abundant Boronias are **B. cymosa** (NM.1049) and **scabra** (NM.1198), both dwarf shrubs with pale to deep pink fls.; the latter occurs primarily in Z.6(N).

Fam. **SAPINDACEAE**—2 spp., **Diplopeltis huegelii** (NM.1034) and **Dodonaea ericoides** (NM.1043). The former (an open shrub) has an abundance of showy mauve fls. about Aug.-Sep.; scattered throughout and common in Z.6(SW).

Fam. **STACKHOUSIACEAE** — 2 spp.; the small cream fls. of **Stackhousia brunonis** (NM.1096) are worth mentioning for their intensely sweet and penetrating perfume, which is ONLY released at night (moth-pollinated?); by day the fls. are essentially odorless. It is common in Z.6(SW), and also elsewhere.

Fam. **STERCULIACEAE** — 4 spp., of which 3 are in the endemic genus **Guichenotia;** the most spectacular is **G. macrantha** (or **angustifolia** ?) (NM. 1057), scattered widely over the reserve; the others are **G. micrantha** (NM.1058), **G. sarotes** (NM.1056),

and **Keraudrenia hermanniaefolia** (NM.1059).
Fam. **STYLIDIACEAE** — at least 10 or 11 spp. (2 genera), of which 8 are the unique trigger-plants **(Stylidium).** The largest on the reserve keys out to **S. elongatum** (NM.1101), with spectacular tall spikes of bright pink fls. (highly variable in shade), arising from large, grass-like clumps with light green, glabrous leaves. Most of the others are tiny plants with relatively large and distinctive fls.; they contribute a unique charm to the clay "bogs" and other openings in the scrub, where they often spring up (from tiny bulbs) in the hundreds during wet winters. In winters of poor rainfall many fail to bloom or reach full size. In the opinion of this writer, the white-flowered **S. emarginatum** (NM. 1102) has the most "personality"! [15]
Fam. UMBELLIFERAE — see APIACEAE.
Fam. **VIOLACEAE** — 1 sp., **Hybanthus floribundus** (NM.1044) is common, starting to bloom **early** in the winter and finishing about July.
Fam. **VITACEAE** (VITIDACEAE) — **1** sp., the monotypic and endemic **Clematicissus angustissima** (NM.1182); this is a semi-woody vine that spreads over the ground and through shrubs. It is in full leaf only during winter-spring; the fls. appear on nearly bare branches in mid to late summer, and are followed by small clusters of grape-like fruits.
Fam. **XANTHORRHOEACEAE**—4 spp. (3 genera), of which a small **Borya** (NM.1093) is by far the most abundant, usually in shallow clay soil over rocks (boggy in winter); it often dominates these areas. During the dry season its sharply-pointed lvs. turn from orange to pale tan but with the first soaking rains of autumn the **same** lvs. turn back to dark green again and growth continues. The slow-growing black boy, grass tree, or yakka — a **Xanthorrhoea** sp. (NM.1092) — is conspicuous among the rocky outcrops on south-facing slopes (esp. Z.6-9); old individuals develop a thick trunk several feet tall.

In NO way should the above discussions be interpreted as a complete inventory of the Howatharra Hill Reserve flora. In this booklet, we have mentioned only about **one-third** of the plant SPECIES recorded from the reserve up to the time of this writing (7/77). Of the 180 GENERA so far recorded, only 75 were even mentioned; of the 66 FAMILIES only 37 were briefly discussed above.

DOMINANT PLANT FAMILIES

The **top four families** (in numbers of species on the reserve) are the MYRTACEAE (31 spp. — all natives), ASTERACEAE (28), FABACEAE, s.s. (22), and PROTEACEAE (18 — all natives). If all the legumes are combined in the broad sense (to include **Labichea lanceolata** of the Fam. Caesalpiniaceae and 11 **Acacia** spp. of the Fam. Mimosaceae), this brings the total for LEGUMINOSAE (s.l.) to 34 species, placing it at the head of the list. A few additional composites (Fam. Asteraceae) almost certainly still await discovery on the reserve; therefore, they could eventually hold position number one or two among the top four families. (However, at least 9 of the composites and 2 of the Fabaceae are **not** natives.) The totals given for the **other** three dominant families are probably accurate (or very nearly so) as reported above.

FAUNA

INSECTS, etc.

Since 1972, we have been gradually building up a collection to document the incredibly rich and diverse insect fauna of this reserve, but probably **less** than 25 per cent of the species have been collected to date. (It is quite impossible even to estimate numbers of insect spp. at this stage.) The most conspicuous orders, represented here by countless numbers of spp., are the Diptera (flies), Hymenoptera (ants, wasps, bees), Orthoptera, s.l. (grasshoppers and relatives), Coleoptera (beetles), and Hemiptera (true bugs). **The entomological research potential on this reserve is stupendous!** Most of the insects we collected here between 1972-77 went to the Australian National Insect Collection (Canberra) and the Dept. of Agriculture — Entomology Section (South Perth); others were sent to the Univ. of California Ent. Dept. (Riverside, c/- Dr. S. Frommer) and the British Museum of Nat. Hist. (London, c/- D. S. Fletcher and others).

The Lepidoptera are poorly represented (as in all of SW. Aust.) by only about 15 butterflies and skippers, and an unknown but vastly greater number of moths, including that spectacular southwestern endemic, **Carthaea saturnioides** of the monotypic Fam. Carthaeidae (Aug.-Sep.), and one common diurnal castniid **(Synemon leucospila)**, on the wing from about mid Oct. to mid Nov. (see also FLORA: CYPERACEAE). An abundant limacodid, **Calcarifera ordinata,** deserves special mention because of its conspicuous, colourful larvae (rich **blue**-green, marked dorsolaterally with 4 strong yellow lines running along the 4 rows of soft-fleshy "horns"). These slug-like larvae sometimes nearly defoliate our two most common low-growing acacias **(A. ericifolia** and **A. ulicina)** between mid Aug. and late Sep.; in the Oakajee district (1-2 mi. further S.), they commonly feed on **A. oxyclada** (another low-growing species). The adult moths emerge from late Feb. to early April. **(Lm.7** in McFarland larval collection.)

As might be expected, Neuroptera are not nearly as numerous here as they are in more arid localities further inland. The Isoptera (termites or so-called white "ants") are conspicuous because of their massive earth nests (about 2-3 feet tall) constructed on the clay soils of this locality. Native cockroaches (Order Blattodea), of which there are several, are conspicuously represented by two large wingless spp.; the more abundant species is dorsally banded with rich red-brown and cream. It is gregarious and the numerous young are closely-brooded by the adults. Daily sunning (esp. in the morning) is a regular habit. When alarmed they quickly vanish into crevices between rocks or under fallen branches; if annoyed they will eject a fine spray with a foul odour. They are much in evidence (esp. in the rocky areas) during the winter-spring season here.

MILLIPEDES (2 or 3 spp.) are often seen crawling in the daytime during cool-wet weather. **SPIDERS** abound in all conceivable niches and their diversity is notable. There are at least 2 spp. of small native land **SNAILS.**

AMPHIBIANS AND REPTILES

Amphibians and reptiles are represented by an unknown number of spp.; there are at least 4 or 5 frogs (**Crinia** sp., **Heleioporus** sp., and **Limnodynastes dorsalis** identified), and probably close to a dozen (+) spp. of snakes and lizards, of which the latter by far predominate, and these are mostly skinks and geckos. The diurnal **Trachydorsaurus rugosus** (bob-tail, stump-tail, or sleepy lizard) is often seen, due to its large size (10"-15") and slow locomotion. It is most active from Aug.-Oct. on sunny days. This massive skink is approaching the northern limits of its range in this part of the State. The equally large but smoother and contrastingly-banded blue-tongued skink (**Tiliqua o. occidentalis**) is also present here; it is more alert and secretive, thus rarely seen. Geckos are represented by at least 3 or 4 species on the reserve; to date we have identified **Diplodactylus vittatus, Heteronotia binoei,** and **Phyllurus** or **Underwoodisaurus milii** (the barking gecko). The relatively large (about 24 in.), snake-like, flap-footed lizards (Fam. Pygopodidae) are represented here by at least one variable sp. (**Pygopus lepidopodus** twice identified). They are occasionally seen in the daytime (between May and Oct.), usually in dense scrub or rapidly crossing roads, or sunning in openings when the sun is weak. They are probably abundant in this habitat, but are shy and secretive. Most supposed "snakes" observed here have proven to be these peculiar lizards upon closer inspection. (They even enact an extremely realistic snake-like display or "bluff" if cornered.) The only true snake identified here so far has been one (harmless) rock-inhabiting python, seen slowly crossing the road in Zone 4(S), early on a warm, humid and overcast summer morning.

BIRDS

Birds are abundant on the reserve, but most spp. are more often heard (particularly early or late in the day) than seen. Many of the birds in this habitat are relatively drab and secretive, although the intensely-colourful males of the Australian warblers or fairy "wrens" (Maluridae), "robins" (Muscicapidae), the bee-eater or rainbow-bird (Meropidae), and the mistletoe bird (Dicaeidae) are anything but drab. To date we have identified about 55 species; most of these were seen on the reserve, but 3 spp. have been recorded only from around the borders (in nearby open-weedy paddocks or wheat fields). Bird-watching is one of several continuing projects here; undoubtedly a number of additional spp. still await identification.

The hawks & allies are represented by at least 6 spp. (probably more), of which only the Australian goshawk, little eagle, wedge-tailed eagle, & nankeen kestrel have been positively identified. Summarizing the other bird families, we have roughly the following list to date (families according to Serventy & Whittell, 1976): quails (1 sp.); plovers (1); pigeons (2); parrots & allies (4+?); cuckoos (2); owls (2?); frogmouths (1); owlet nightjars (1?); nightjars (1?); kingfishers (1); bee-eaters (1), from late Sep.-Mar. only; swallows (2+?); pipits (1); cuckoo-shrikes & trillers (2); thrushes (1?); babblers (1?); Old World warblers (1); Australian warblers or "wrens" (3); thornbills & allies

(4+?); Old World flycatchers (1+?); fantails (2); whistlers & shrike-thrushes (2); flower-peckers (1); silver-eyes (1); honeyeaters & allies (8+?); Australian chats (1); grass finches (1); wood swallows (1); magpie-larks (1); "magpies" & allies (2+?); crows & ravens (2+?). The western shrike-thrush deserves a special mention because it is one of our most vigorous and melodious songsters, and an amusing coincidence is the fact that its **call-note** is nearly identical to that of the phainopepla (a silky flycatcher) of the southwestern U.S.A.! The songs and various other calls of the brown honeyeater, the singing honeyeater, and the western shrike-thrush (in that order) are perhaps the most characteristic **louder** bird voices of Howatharra Hill.

Eventually we hope to publish a list of all birds identified on the reserve, along with notes on their abundance, local status (resident, nomadic, or migratory), habitat and feeding preferences, or other observations that might be of interest.

We also have plans for establishing one or two permanent watering-places, which could increase the numbers of certain birds and mammals induced to remain constantly inside the reserve; there is no permanent surface water available here. (See third paragraph under "Trails and Clearings".)

MAMMALS

Mammals occurring on the reserve are only known to us very superficially at present (only the few larger and more conspicuous spp.), due to the following factors: (1) that most of the smaller or more secretive spp. would be only or primarily nocturnal, and we have not, as yet, undertaken any live-trapping studies or nocturnal observations here; (2) that they would remain under or near dense cover most or all of the time. As dense shrub-thickets and heath formations (in some places essentially impenetrable) cover most of the reserve, and trails that permit silent walking and observation in these places are not yet completed, it is logical to assume that some interesting small or secretive mammals could in fact be fairly common here . . .

The largest mammal occurring in this brushy-rocky habitat is the EURO—also known as the hill kangaroo or wallaroo (**Macropus robustus** — Fam. Macropodidae); it is conspicuous and fairly often seen within the reserve, either alone or in small groups. This relatively large and heavy-set kangaroo is most often sighted among the rocky outcrops (breakaways) and **Melaleuca** thickets, early in the morning (esp. in Zones 2, 3, and 10). They do much browsing on the native plants, and normally keep to well-used trails when in the denser scrub areas. Their droppings, footprints, and tail drag-marks are constantly encountered throughout the area. Euros are among the primary "natural pruners" of the native shrubs here and certainly must have a major effect upon the vegetation. Also present, but less abundant and far less conspicuous, is the much smaller western brush wallaby (**Macropus irma**), with black hands and feet and white facial stripes. It is occasionally encountered by day, hiding or at rest in dense thickets. It takes off suddenly at high speed, bounding low to the ground

with neck and tail outstretched almost horizontally, and (unlike the euro) it rarely stops to look back when fleeing.

The other important larger native mammal here is an egg-laying monotreme, the ECHIDNA or spiny ant-eater (**Tachyglossus aculeatus** — Fam. Tachyglossidae), common in this habitat but rarely seen, as it is primarily nocturnal and very secretive. Abundant evidence of its recent digging or "rooting" (in search of soil insects) is seen nearly everywhere on the reserve, from about April or May to November. Echidna diggings are easily distinguished from those of other mammals, such as rabbits or feral pigs, by the distinctive "nose-prints", which are holes that appear to have been made by a small finger repeatedly poked into the (damp) soil in and around the excavations; if the soil is dry, these holes won't be visible. These excavations are often very destructive to the smaller plants (annuals, bulbs, and small bushes or seedlings, etc.), but they are undoubtedly of GREAT importance as a natural form of soil cultivation in an otherwise undisturbed habitat. Primarily through the activities of echidnas, annual native plants that require or "prefer" (or grow better on) disturbed soil are constantly being provided with many ideal and constantly shifting **new** locations upon which to germinate each year; without echidnas in this habitat, such plants (and there are many natives on the reserve that fit this category) would probably decline, both in size and numbers, over a period of years.◆ . . . The distinctive echidna droppings are often seen here and cannot be mistaken for anything else. It is worth noting that, in addition to much soil and fine surface litter, the scats sometimes contain the remains of insects other than ants or termites (**i.e.,** scarab beetle elytra, etc.), indicating possibly a wider range of soil insects in the diet than might be suspected. I have several times seen echidnas moving about in the daytime (any hour) at Howatharra Hill, in cloudy or semi-cloudy weather between April and August. They **may** aestivate for at least the hottest part of the dry season here (about Dec.-March). They are occasionally seen as road-kills in the district.

OTHER MAMMALS that **might** be on reserve (none seen as yet), are the southwestern pigmy possum or mundara (**Cercartetus concinnus** — Fam. Burramyidae), the honey possum (**Tarsipes spencerae** — Fam. Tarsipedidae), a bandicoot (**Isoodon** sp.—Fam. Peramelidae), dunnarts (**Sminthopsis** spp. — Fam. Dasyuridae), and one or two native rats or mice (Order Rodentia: Fam. Muridae), etc.. Bats (Order Chiroptera) have been observed here but not identified.

There are very few introduced or **feral mammals** within the reserve, and none doing any obvious or major damage to the habitat. Foxes and feral cats are present in the area, but do not seem to be common here. Occasional rabbits may be encoun-

◆ Similar remarks apply to the activities of gophers, ground squirrels, and other rodents in the grassland and chaparral habitats of southern California; they are important as the **original** cultivators of these natural habitats, and are constantly creating ideal new locations for the germination of native annuals like lupines and poppies, etc. (also weeds, of course).

tered in some of the weedy border areas. But the habitat-wrecking feral pigs and goats (or their signs) have never been observed within the reserve, although pigs are sometimes present in dense creek-bed thickets below the reserve. The numerous (and often locally-destructive) diggings of the echidnas could possibly be mistaken for the activities of rabbits or feral pigs, but the former are easily identified (at least when the soil is damp) by their unmistakable small "nose-prints". Also, echidna diggings are usually crater-like or irregularly-rounded in outline, as opposed to the roughly parallel-sided troughs and other scratchings made by rabbits.

MISCELLANEOUS TOPICS

OBJECTIVES

Our immediate and foremost objectives, in naming this property a reserve, are to PERMANENTLY PRESERVE AND PROTECT (insofar as possible) ALL the plants and animals still living on this superb remnant of the Geraldton Region's natural heritage. It is destined to become a "Living Museum". It could eventually evolve into an open-air laboratory for ecological research — a place where future biologists, naturalists, photographers, artists, or writers, etc., could come to study (or purely to observe and enjoy) this typical and very representative sample of the unique Moresby Range native flora, still growing in its original abundance and diversity. [1, 4] Those who simply crave and appreciate unspoiled natural beauty—whether or not they are academically "qualified" — will also be welcome here, provided they understand our policies, and are willing to heed the restrictions outlined (see pp. 26-27).

Research: Another major objective is to leave the native flora and fauna on this land entirely undisturbed, letting all natural events and plant successions occur here as they will, meanwhile OBSERVING, RECORDING and PHOTOGRAPHING any changes over the years—in other words, a long-term ecological study of a specific natural habitat. My own research interests primarily involve botany and entomology (collecting and photography; insect life histories and behavioural studies, etc.). Those who can help us sort out any of the numerous taxonomic problems, with the local flora and fauna, **will be especially welcome visitors here.**

Another objective is the one of a naturalist who has always wanted to personally **own** such a virgin habitat, PURELY for the satisfaction of knowing that it has been rescued from eventual destruction, and simply to maintain it as a "retreat" or natural area, to which he and others who appreciate such things (and there are many) can go, always knowing that it will still be there — not to return some months or years later only to find it bulldozed under. Our "civilization's" STANDARD routine, of total destruction based on greed, has been observed by this writer (both in Australia and overseas) countless times before in other relatively remote localities outside growing cities. Exactly the same pattern can be predicted with absolute certainty

for most of the remaining wild habitat in the Geraldton district; it is simply a matter of time and growth . . . Shrewd real estate men, with only one well-known motive, are quite aware of this fact already.[11, 16]

We are DEFINITELY NOT interested in turning Howatharra Hill Reserve into a general "tourist attraction". (There are already numerous so-called "natural" areas available for such uses. In America, these places are commonly known as Recreation Areas, which term is more accurately spelled "Wreck-creation".) We have **not** designated our land a nature reserve only to watch it degenerate into a trampled and littered Public Picnic Ground! Recreation areas are needed, of course; I do **not** deny this. But I **DO** take issue with those who would permit the ruin of every last piece of reserved natural habitat by throwing it wide open to a largely ignorant, noisy, trampling, unseeing, uncaring, trigger-happy, litter-flinging public and their obnoxious, destructive machines (trail bikes, etc.)[5] . . .(For ample evidence to verify this description, one merely needs to make a few observations in any National Park.)

Many are of the opinion (sadly-mistaken) that, if a "natural area" or reserve still harbours **some** of its dominant native TREES or larger shrubs, it represents the "original" condition: The richer and more varied associations of native plants that grew there originally (the **smaller** shrubs, annual wildflowers and tiny ephemerals, etc.) are gone and quite forgotten. (In many cases they were **gone** before they were even known!) In their places grow introduced grasses and other weeds — often having colourful flowers. The overall picture may still give a **superficial** impression of a "wild" or "undisturbed" habitat, but this impression is far from the truth. (Most sections of Kings Park, Perth, are rapidly approaching this condition, unfortunately.) A fragile and complex ecosystem cannot possibly remain in its original diverse state when constantly disturbed, burned or trampled by people or their machines and livestock. It requires no great insight to reach this conclusion, if **unfettered** observation is employed.

There is simply NO solution to this problem — if one wishes to guarantee the permanent preservation of ALL the original and more fragile, sensitive, or tiny native plants of a habitat — other than to **exclude the majority** of visitors, and limit "use" of the area only to those educated or aware individuals (and this has nothing to do with academic qualifications) who already have a **sympathetic** understanding of the problems, and who are therefore quite willing to adhere to the restrictions that must be imposed in order to effectively protect the ENTIRE habitat.

The above discussion has not even mentioned the brutal devastation caused to fragile ecosystems by permitting the entry of mindless and unsympathetic off-the-road vehicle drivers into such places. Education may partly remedy this deplorable situation, but also needed is a more highly-evolved and AWARE race of **Homo sapiens,** more attuned to the sensitive and delicately-balanced natural world upon which they are so dependent for their very survival. [2, 3, 6, 7, 8, 16] It seems quite unlikely (if one comprehends the daily news) that such

a Utopian condition has even a remote chance of developing in the presence of ever-increasing pollution, over-population, and materialistic striving — with all their associated evils and stresses. [2, 3, 7-10] (NOTE: Bracketed [ ] numbers refer to the "Quotations" section, starting on p. 30.)

DEDICATIONS

(1) **Botanical:** We would again like to draw attention to the fact that, had it not been for the great abundance and persistence of certain poison bushes (**Gastrolobium**) on this land (see "Recent Past History" section), this country probably never would have survived into the 1970's in its present form—as nearly virgin habitat—and there probably would have been nothing worth preserving. Therefore, the botanical dedication of Howatharra Hill Reserve should go to our two potent poison bushes, **G. oxylobioides** and **G. spinosum** var. **triangulare!** (4 leaf-prints of the latter are on the back cover.) They alone were primarily responsible for saving this unique habitat from destruction by sheep, in the decades prior to our purchase of it. Howatharra Hill Reserve owes its existence to the presence of these hated plants of the pea family (Fabaceae).

(2) **Entomological:** We would also like to dedicate Howatharra Hill Reserve to the memory of one of the world's greatest pioneer entomologists, a prodigious writer and observer, the Frenchman, J. Henri FABRE (1823-1915), who would have been in paradise living on this land: Never, in his long life, would he have been able to unravel **all** the entomological mysteries that are hidden in these hills! [15]

ACKNOWLEDGEMENTS

(1) First and foremost, we will always be grateful to R. W. F. Starling of Howatharra for his willingness to sell us the scrub-covered "corner" of his farm in 1974, and for helping us in various other ways since (such as with part of the new fencing), and also for his permission to enclose two small areas **outside** our boundaries for the protection of two species of shrubs that were not represented anywhere within our reserve at the time of purchase; one of these plots is immediately NE of Zone 6 (for 3 large **Hakea orthorrhyncha,** NM. 1228), and the other is a 30ft x 40ft plot about 100 yards SE. of Z.4 (for over 75 of the very rare **Grevillea bracteosa,** NM. 1131); (2) to L. Shervington of the Chapman Valley Shire, Nabawa (in 1974) for his enthusiastic support of this project; (3) to several taxonomists at the W.A. Herbarium (South Perth), particularly P. G. Wilson, A. S. George, and A. S. Weston, for their frequent assistance with Howatharra plant identifications; (4) to J. S. Beard, K. Wyrwoll, and N. Robinson (Perth), N. B. Tindale (Palo Alto, Calif.), and Miss Alison Ashby (Victor Harbour, S. Aust.), for their specialised assistance and advice at various stages; (5) to W. C. Patten of Oakajee, and his son, Owen, for their efforts (in 1976) to produce the really top-class fence that now encloses the E. sides of Z. 4-6 and 10, and the N. side of Z. 7; (6) to Mr and Mrs C. H. Royce of "Windermere" (our nearest neighbours NW. of the reserve) for assistance with the storage of fencing materials, and for their hospitality on numerous occasions; (7) to many other friends and colleagues in W.A., interstate, and overseas, for their moral support and enthusiasm expressed since we first announced our plans for creating this private reserve.

OWNERSHIP AND MANAGEMENT (PRESENT AND FUTURE)

This land was privately purchased and entirely paid for by D. and N. McFarland, while resident in Geraldton; our freehold title to it became official on January 6th, 1975. It is described by the Registrar of Titles (in Vol. 1396, Fol. 177) as "Lot 1, Howatharra." It is a subdivision combining, under the one title, 40 acres formerly at the **west** end of Victoria Location 10189 (N. side of Howatharra Road)

with 66 acres formerly in the **northwest** corner of V.L. 10550 (S. side of Howatharra Road), all surveyed and purchased together, in 1974, from R. W. F. Starling (farmer) of Howatharra. The Department of Lands and Surveys Map No. 157/80 (1966) shows details of the property boundaries in this district, but "Lot 1" did not exist at the time this map was made; therefore, see Locs. 10189 and 10550. A good aerial photo of the area (scale 1:8000) also exists, this being photo No. 5153, film No. W.A. 792, run No. 10 (6 Sep. 1962) — Department of Lands and Surveys, Perth.

LEGAL ARRANGEMENTS are already in existence to guarantee (insofar as is possible) the permanent preservation of Lot 1, which we have named Howatharra Hill Reserve, as a "living museum". If our instructions are carried out, it will remain available in perpetuity for study and enjoyment by all who care about such things, **long** after the relatively few remaining scraps (remnant patches) of the Geraldton-Northampton district's unique botanical heritage have been burned, bulldozed and plowed into oblivion by landowners who are either ignorant of what they are doing OR, quite simply, do not care . . . Admittedly, 106 acres is far too small to enclose and preserve samples of ALL the diverse Moresby Range habitat types (or rich and unique plant associations), but at least it represents a firm step in that direction **through private initiative.**

If for any reason we are unable to retain private ownership of this land in the future, we will resell it to one of several conservation groups, first making certain (through legal documentation) that the reserve will continue to be "used" ONLY in the manner and for the purposes outlined in this booklet—and that these will remain its only uses in perpetuity. (See the sections headed "Objectives" and "Policies & Restrictions".)

Whenever we are away from the district, we arrange for various friends to periodically visit the reserve in the capacity of deputy wardens, or to assist in other ways (checking fences, gates and signs, or accompanying the occasional visitors who have obtained permission to enter the area, etc.).

BEFORE considering a visit to this reserve, please read thoroughly the two sections just named above!

POLICIES AND RESTRICTIONS

(See also "OBJECTIVES" Section)

In view of the fact that this is a **privately-owned** piece of land, which we have (to a LIMITED extent) decided to make available to certain selected individuals for study or inspiration, and in view of the fact that we have very definite ideas about exactly what "uses" we wish made of our land, we find it necessary to impose certain restrictions. These will have to apply, WITHOUT EXCEPTION, to ALL who visit the reserve:

(1) ONLY individuals who have permission from the owners (or other local caretakers) will be welcome on the reserve. Anyone encountered there without permission will be dealt with as a trespasser on private property. It is for this reason that we have heavily-posted the reserve borders with signs stating: "Flora and Fauna Reserve — NO ENTRY — Trespassers Prosecuted." This will probably afford little protection (to the kangaroos) from trigger-happy "sportsmen", but at least such signs make the legal situation quite clear, if nothing else. (As all boundaries are thoroughly posted, no trespasser can possibly claim that he "didn't know" . . .).

(2) Of course, NO WEAPONS of any description will be permitted on the reserve for obvious reasons.

(3) Large of noisy groups of people will not be welcome here at ANY time, even if they claim to be interested in plants! We prefer to give access only to single individuals, couples, or very SMALL groups (preferably LESS than 5 at any one visit). Occasional exceptions might be made to accomodate certain **small** universtity classes, or other **advanced** study groups wishing to carry out serious research or observations here. However, we will definitely exercise our **right to refuse** entry to any group or individual, if we have reasons for so doing.

(4) This reserve is NOT a children's playground or "amusement park". We will hold parents or guardians **totally** responsible for any children brought with them: Unless they are able to EFFECTIVELY impress upon their children ALL restrictions outlined here, they will be asked to leave, and will not be welcome to return again unless the offending children are left at home in the future. **PLEASE DO take this item (and the next) seriously at the outset, and thereby avoid hurt feelings later!**

(5) **NO DOGS,** cats, or any other pets will be allowed within the reserve; if animals are brought, they will have to remain INSIDE cars throughout the visit. The reason for this restriction should be obvious after reading the "Fauna" section.

(6) Positively NO MOTOR VEHICLES (of ANY description) will be allowed to enter ANY part of the reserve, other than via the private road which crosses the **S. section,** and that only by permission. (The main gate is kept locked at all times.) Vehicles can be parked along the edges of Howatharra Road, just **outside** the main gate, or elsewhere along the public road which passes between Zones 6-7, heading northeast (the Bella Vista Road). Any vehicles given permission to enter must turn around ONLY in one of the two designated turn-outs (between steel posts) in the south section. PLEASE DO NOT drive off the edge of the road **anywhere else** within the reserve.

(7) ALL WALKERS invited to visit the reserve must keep strictly to clearly-defined roads, trails, or firebreaks. At all times **PLEASE** try to avoid treading on small plants! Between about May-November, this habitat is blanketed with an incredible collection of **tiny** and **frail** native ephemerals; these plants CANNOT survive trampling! (See the section headed "NATIVE EPHEMERALS", page 10.) Anyone with even average powers of observation should have no trouble whatsoever in comprehending the reason for this request.

(8) Anyone bringing FOOD or drinks into the reserve must eat at the designated picnic area (or in their car). Please dispose of any litter in the bin provided, or take ALL litter back to the car. FIRES (in **any** form, including smoking) **cannot** be permitted anywhere within this reserve, at any time of the year, for any "reason" whatsoever.

(9) Absolutely NO COLLECTING of native plant material, seeds, insects, or any other native fauna will be allowed within the reserve, unless explicit permission has been given by the owners or others in charge. Similar restrictions apply to collecting of stones, or any disturbance to the existing rock formations or ground surfaces, and also to any disturbance of termite mounds, nesting birds, mammals or reptiles, etc.

(10) Botanists, zoologists (particularly entomologists), and naturalists contemplating serious ecological, taxonomic, or behavioural research projects in the Geraldton district will be welcome to initiate studies on this reserve, **PROVIDED** their proposed research will NOT involve conflict with any of the restrictions here listed . . . If the work would require ANY form of environmental disruption or manipulation (such as burning, mutilation or destruction of vegetation, or any disturbances to rock formations or soil, etc.) permission is NOT likely to be granted. The **same** refusal would also apply to most projects that could involve the removal, killing or disturbance of any native flora or fauna on the reserve (with the exception of insects other than buprestid beetles). General seed or plant-collecting projects are definitely OUT! (This restriction would not apply to botanical research requiring only a FEW carefully-cut voucher specimens at the outset, provided the species involved are reasonably abundant on the reserve.) Insect studies involving limited and "reasonable" collecting (**i.e.** — NOT huge series) will be permitted (with the exception of harsh bush-beating), if serious taxonomic or other research is the motivation, and evidence can be produced to verify this. Overturning of **isolated** rocks or logs (by entomologists searching for insects) will be permitted, but ONLY if they are carefully replaced **where they were;** prying rocks or boulders away from the "cliff" faces (breakaways) **cannot** be permitted.

PLEASE NOTE: "Hobbyist" or **commercial collectors** of seeds, plants or any insect groups will never be welcome here; they will be dealt with as trespassers if encountered, as will anyone's stray stock (goats or sheep, etc.)!

(11) Any recording-equipment (or etc.) brought into the reserve by researchers will have to be placed in such ways that NO harm is done to nearby vegetation, rocks, or soil surfaces. We cannot offer protection against vandalism or thieves, so valuable equipment should not be left unattended anywhere on the reserve in a conspicuous location.

(12) **PERSONAL SAFETY AND COMFORT:** Anyone entering this reserve and walking on its trails (with OR without our permission) does so **strictly at his or her own risk!** We cannot be held responsible for accidents or injuries that might occur here. It is easy to slip on loose rounded rocks on the steep slopes. Good hiking boots (to give ankle support), with soft, sure-grip soles, are strongly recommended in this habitat — also, long pants

for those who wish to avoid scratched legs! Warm sweaters or jackets are needed for chilly mornings in the May - October period. Hats, sunglasses, sun-screening cream, and plenty of drinking water are recommended for clear, hot days (September or October - April).

An effective repellent for use against the relentless **bushflies** is particularly recommended, if one is hoping to do exacting or precision-work in this habitat, at any time between approximately mid August and late April (for example, such pursuits as close-up **photography**, or the collecting of elusive Diptera and Hymenoptera, where **unimpeded** vision and/or hearing are important factors in the successful netting of specimens). David Gray's "Scram" and "Swipe-a-Fly" have proven to be the most effective brands locally available. **Don't forget to bring your camera, close-up attachments, and plenty of film!**

Feral colonies of honey bees (**Apis mellifera**) are a definite hazard around ALL rocky outcrops (particularly in Zones 1, 2, and 10), and they are sometimes quite aggressive. Anyone likely to suffer a severe reaction from bee stings should keep this fact clearly in mind . . . (And bring Isuprel or Franol tablets!) We periodically attempt to eradicate honey bee colonies in areas where they are a nuisance, but some colonies (in Zones 1-2) are deep within the rocks and cannot be easily eliminated; also, new colonies can rapidly become established where there were none before. **Please be forewarned!** Poisonous snakes are only a minor danger in this habitat; however, visitors should always be alert when walking where visibility is limited by vegetation. Stick to the roads if worried about snakes!

(13) CORRESPONDENCE: Please DO NOT write requesting insects, seeds, or plant cuttings, etc., unless needed only in SMALL quantities, for **illustration** or **research purposes only** (and please describe nature of intended research)! Anyone requesting material will be expected to take note of and **refund** the full postage we paid on it. Reprints of any resulting publications would be a greatly appreciated courtesy. Anyone within Australia sending research requests, or queries about the reserve, or about travel to this part of Australia, etc., will have to **enclose a self-addressed, stamped envelope** if a reasonably prompt reply is desired. (Overseas correspondents please enclose paper money, such as U.S.$1.00). **We are NOT backed by any institution! We are NOT a travel agency, and we do NOT have outside office help available!** The correspondence-load is already heavy, and we are only able to devote a LIMITED amount of time each week to correspondence and all other desk work. Replies cannot always be sent on a "first-come first-served" basis; in fact, replies cannot even be guaranteed, as we are often away or totally involved in other work. But first consideration (for a speedy reply) will always be given to those who have the thoughtfulness to accompany their demands with some form of repayment, and other time-saving aids like self-addressed envelopes! . . . (Demands or queries not so accompanied may sit unanswered for months.) Try to include ALL queries in the first letter, so that ONE complete reply will satisfy the need. OVERSEAS CORRESPONDENTS must realise that, unless a letter is clearly marked "air mail", and the FULL air mail postage rate is paid, it will go via surface and it will take between 8-17 WEEKS to reach Geraldton (minimum is **at least** 6 weeks)! Air mail (between U.S. and Geraldton) normally takes between six and 10 DAYS, provided there is no postal strike at the time . . . Please send full payment and S.A.E. (9in x 4in), with any request for another booklet.

You may find it cheaper to obtain duplicates by making your own photocopies instead: PLEASE FEEL FREE TO DO SO! However, the material in this booklet (or any part thereof) is NOT intended for publication in any other form, **unless with the author's written permission.**

Any enquiries regarding the Reserve should be directed to the:

Regional Manager
Gascoyne and Greenough Regions
Department of Conservation and Land Management
Cathedral Avenue
Geraldton, Western Australia 6530
Telephone: (099) 215 955

If we are not around Geraldton or Northampton when you arrive here, certain members of the Geraldton Wildflower Society (S.G.A.P. branch) would know of our whereabouts. Officials at the Geraldton Tourist Bureau or the Public Library (both in Cathedral Avenue), or Mr G. Phillips at the Community Education Centre (Gregory Street), should be able to provide the names of some Geraldton Wildflower Society members who know about the Howatharra Hill Reserve.

For potential **INTERSTATE OR OVERSEAS VISITORS**, a thorough review of the sections headed "Climate and Seasons" and "Miscellaneous Remarks" (under Flora) would be highly advisable. Most native plants of this region have very definite seasons of growth and dormancy, with the latter period normally occupying **more** than half the year in most species. Unless your visit is planned so as to be here sometime **between early August and mid September**, the maximum number of species will NOT be found in bloom. By late September - October, many of the more unusual or interesting native ephemerals (such as certain composites, most orchids, lilies, sundews, and triggerplants, etc.) will be finished blooming or already dying, as temperatures increase and the rains cease.

It is worth mentioning that the IDEAL TIME for most botanists to visit **this part** of Western Australia falls neatly within the latter half of the summer vacation period for students and teachers in the U.S.A.! (See section headed "Climate and Seasons".) This period also happens to fall within the most pleasant time of the year in the Geraldton district (April-October), when it is never very hot and bushflies are scarce.

ABBREVIATIONS AND TERMINOLOGY

Certain words or abbreviations used in this booklet may not be known to some readers. These are defined below:

aff. (preceding a species name) means showing an **affinity** with that sp., but doesn't compare favourably (cf.) with it in all details.

calyx — all the **sepals** of a flower, collectively.

corolla — all the **petals** of a flower collectively.

endemic — confined to a given region or locality and not native anywhere else; as used in this booklet it refers to the **southwestern corner** of W. Aust., from approx. Carnarvon to Ravensthorpe to about 100 mi. E. of Esperance (**i.e.** — the Southwestern Botanical Province of W.A.), where **endemism** at the species level is thought to be close to 80% (Beard, 1969).

Family (Fam.) — a grouping of related genera (see genus and species below); has the **standard** ending of **-aceae** for plants (**-idae** for animals), and the first letter is always capitalised (except when the name is employed as an adjective, as in "myrtaceous" which is derived from the family name Myrtaceae), but family names are NOT italicised or underlined. Plant families can also be broken down into Subfamilies (-oideae), Tribes (-eae), or Subtribes (-inae) for a more detailed understanding of relationships.

fl. or **fls.** — flower(s).

genera — the plural of genus.

genus — the smallest natural group containing distinct species (as the genus **Drosera**, which contains the many spp. of sundews); large genera are frequently subdivided into sections for the sake of convenience, but the **same** generic (genus) name is applied to all the related species, regardless of section. The first letter of the generic name is ALWAYS capitalised, and the whole word is italicised or underlined.

inflorescence — the complete flower or flower cluster, including its supporting stem(s), and the arrangement of fls. thereon.

lf. or **lvs.** — leaf or leaves.

monotypic — a family or genus founded for **one** unique species, no other close relatives being known.

n. sp. or **sp. nov.** — new species (not as yet named).

Order — a grouping of related families, as used in plant and animal classification; the first letter is capitalised, but the name is NOT italicised. The standard ending for plant orders is **-ales.**

phenology — the science or study of the relations between climate and periodic biological phenomena (flowering and fruiting of plants, migration or nesting of birds, emergence of insects, etc.).

sclerophyllous — having hard or tough, leathery lvs., usually capable of surviving many months of drought. Most sclerophyllous plants are also evergreens.

s.l. — in the broad sense (the opposite of s.s. — see below).

species — the particular "kind"; the **basic unit** for each supposedly distinct kind in plant or animal classification;

species is spelled the same (ending with "s") whether singular or plural. The species name (specific name) is the **second** word in the complete scientific name, the generic name being the first word; if there is a **third** word in the name, this is usually the variety (in plants) or the subspecies (in animals). The species or subspecies name is always italicised (or underlined), but the first letter should NEVER be capitalised. (By this distinction, generic and specific names can be instantly distinguished in lists or indexes, etc..) When merely the abbreviation "sp." directly follows a generic name, this implies that the writer has not been able to identify the species with any certainty, or it may be a new one still awaiting to be officially named and described through publication; "spp." following a generic name implies more than one of the species in that same genus, or all the spp. in that genus, depending on its use.

sp. — standard abbreviation for species, **singular** (see above).

spp. — standard abbreviation for species, **plural** (see above).

s.s. — in the strict (or restricted) sense; the opposite of s.l. (see above).

ssp. — standard abbreviation for **subspecies, singular** (see above).

sspp. — standard abbreviation for **subspecies, plural** (see above).

taxonomy — the science or study of plant or animal classification.

variety (var.) — a minor variation or colour form (etc.) of a plant species; in zoology, the term **subspecies** is nearly equivalent to the term variety in botany. The name is italicised but never capitalised, and it follows directly after the species-name where applicable.

A FEW APPROPRIATE QUOTATIONS

The first 3 are from the two sources credited, and 4-14 are from H. D. THOREAU (American naturalist and writer: 1817-1862). The points at which these came to mind, during the preparation of this booklet, have been indicated in the text by the bracketed numbers shown below (see "Recent Past History" and "Objectives" sections).

[1] "In a piece of untouched bushland, cut off from the burdens of our sophisticated 'civilization', we find that refreshment of spirit that only the wilds of Nature can offer . . . We **must,** before it is too late the world over, see that places such as Dryandra are kept for this vital purpose . . . If this book stimulates some of its readers to set about the task of conserving such areas of natural bush for our delight and that of future generations, it will have fulfilled its main purpose . . ."
— Vincent Serventy (1970), p. 12 and 202 in **Dryandra— The Story of an Australian Forest.** (in W.A.) . . . (We hope Mr Serventy will be pleased with our efforts at Howatharra Hill!)

[2] " . . . A leaven of wildness is necessary for the health of the human spirit, a **truth** we seem to have forgotten in our headlong rush to control all nature . . . "
— Eliot Porter (1962), in Preface of his book, **In Wildness is the Preservation of the World.** (Ballantine Books, New York).

[3] " . . . There is **no science** and **no art** of greater importance than that which **teaches seeing,** which **builds sensitivity** and **respect** for the natural world . . . We can now prove that the natural and civilized worlds **must** live together or perish separately . . ." — David Brower (1962), in Foreword to the above book.

[4] "What we call 'wildness' is a civilization other than our own." (Thoreau's) — **Journal** (16 February, 1859).

[5] "For one that comes with a pencil to sketch or write, a thousand come with axe or rifle."
— **(The Maine Woods,** Chesuncook).

[6] "I think that the existence of man **in** nature is the divinest and most startling of all facts. It is a **fact** few have realized." — **Journal** (21 May, 1851).

[7] "There can be no very black melancholy for him who lives in the midst of nature and has his senses still."
— **(Walden,** Chapt. 5).

[8] "How many of our troubles are house-bred!"
— **Journal** (28 March, 1858).

[9] "Sympathy with nature is an evidence of perfect health." —**Journal** (18 November, 1857).

[10] "How important is a constant intercourse with nature and the contemplation of natural phenonema to the **preservation** of moral and intellectual health! The discipline of schools or of business can **never** impart such serenity to the mind." —**Journal** (6 May, 1851).

[11] "If some are prosecuted for abusing children, others deserve to be prosecuted for maltreating the **face of nature committed to their care.**"
— **Journal** (28 September, 1857).

[12] "We seem to think that the earth must go through the ordeal of sheep-pasturage before it is habitable by man." — **(The Maine Woods).**

[13] "Nature would not appear so rich, the profusion so rich, if we knew a USE for everything."
— **Journal** (11 August, 1853).

[14] One of Thoreau's justifications for his neglect of what others called the "serious business of life" was his observation that "this curious world which we inhabit is more wonderful than it is convenient; more beautiful than it is useful; more to be admired and enjoyed than USED."
— J. W. Krutch (1962), in Intro. to E. Porter's above-named book.

——**And one of the best from J. Henri Fabre:**

[15] "Scientists fear lest a page that is read without fatigue should not be the truth."

Unfortunately, this lucid observation remains as applicable in the 1970's as it must have been when Fabre first felt impelled to utter it . . . For the sake of accuracy, one small change should be made, however: the insertion of the word "Most" at the beginning of the quotation.

For those in whom Fabre's observation strikes a sympathetic chord, may we suggest the following perceptive and refreshing essay, by one of America's great entomologists (1865-1937)? It is still quite applicable 55 years later: "The Dry-Rot of our Academic Biology" by Prof. W. M. Wheeler, published in **Science** (19 January, 1923); also in **Foibles of Insects and Men** by Wheeler (New York: A. A. Knopf, 1928), and in the classic, **Essays in Philosophical Biology** by Wheeler (1939). The latter book was recently re-issued (1967) by Russell & Russell, N.Y. (by arrangement with Harvard University Press); chapt. 6 (pp. 117-142) is the "Dry-Rot" essay in this edition. Further evidence that this same highly-infectious and mentally crippling disease still persists, in virulent form, is hilariously presented by Farley Mowat (1963) in **Never Cry Wolf** (pp, 8-16), pub. by Secker & Warburg, London; Dell Publishing Co., N.Y., produced an 18th edition of this book in paperback (1973).

If the adrenalin flows after reading the above, an advanced (possibly terminal) case of Dry-Rot is the unfortunate diagnosis.

[16] " . . . The old Lakota was wise. He knew that man's heart away from Nature **becomes hard;** he knew that lack of respect for living, growing things soon led to lack of respect for humans too. So he kept his youth close to its softening influence." — Chief Standing Bear of the Lakota band of Sioux Indians, in **Touch the Earth** by T. C. McLuhan (1973) — pub. by Sphere Books (Abacus), London.

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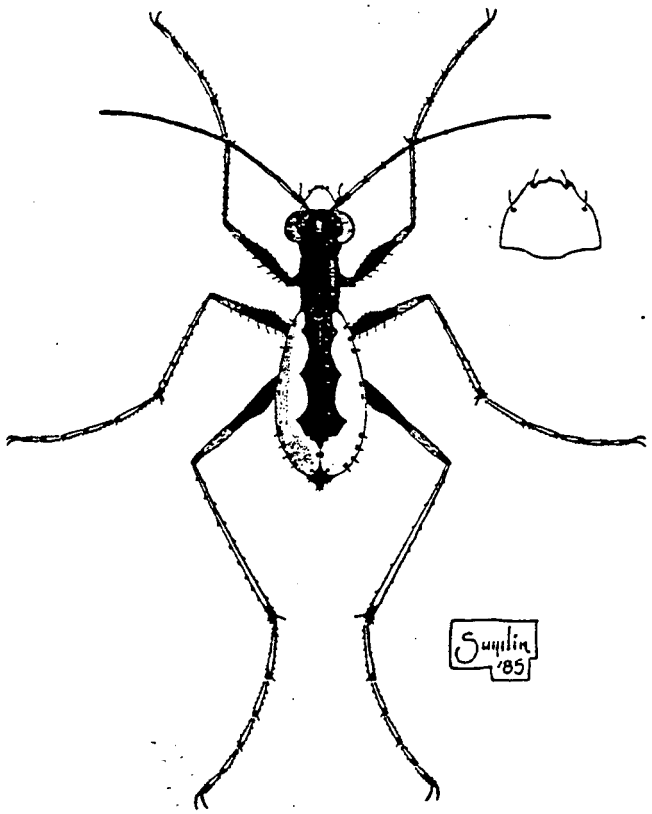

Cicindela arachnoides (Sumlin)

Drawn from the holotype male collected on Howatharra Hill Reserve in Western Australia by Noel McFarland on July 11, 1978. Presently housed at the CSIRO, Canberra, ACT, Australia.

COVER DESIGN by Noel McFarland.
Front Cover — see Proteaceae (p.17)
Back cover — see Fabaceae (pp.14 & 25)
All leaves are natural size

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