BEEKEEPING AND LAND MANAGEMENT

Proceedings of a Workshop,
November 4, 1985,
Perth, Western Australia

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Proceedings of a Workshop held at the
Department of Conservation and Land Management (CALM)
Hayman Road, Como, W.A.
November 4, 1985

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Department of Conservation and Land Management,
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PREFACE

This report contains the papers presented at a Workshop convened by the Department of Conservation and Land Management, which brought together professional beekeepers and staff from the Departments of Agriculture and Conservation and Land Management.

The expansion of agriculture in Western Australia over the last 25 years has affected alike the resources available to the beekeeping industry and the conservation values of much of south-western Australia. For many years conservationists and beekeepers were allies in seeking the retention of large areas of uncleared native vegetation.

However, in recent years some concern has been expressed by conservationists, biologists and conservation agencies, that honey bees may be having an adverse affect upon native species of plants and animals. This has led to moves to exclude the placing of hives from some national parks and nature reserves.

Some other practices, such as regular prescribed burning on some of the lands managed by the Department of Conservation and Land Management (CALM), are also perceived by beekeepers to adversely affect the honey industry.

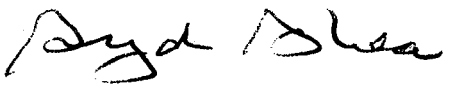
In recent times professional beekeepers have had to contend with other adverse factors as well. These have included large fluctuations in the price of honey, loss of productive areas due to wildfires, and competition from hobbyists and semi-professional beekeepers, who are not totally dependent on income from honey production for their livelihood.

In response to representations to me from the Beekeeper's Section of the Primary Industry Association of Western Australia, the workshop was arranged to do two things: first, to present the best current information relevant to the interactions between beekeeping and land management; secondly, to provide a forum for an exchange of views between beekeepers and land managers on the problems facing the honey industry. I believe the workshop achieved these two aims.

Accordingly, it is hoped that these proceedings will stimulate further constructive dialogue between the industry and those responsible for the management of publicly owned lands in Western Australia.

I wish to express my thanks to the following people:

Don Grace and John Blyth of CALM, for organising the details of the workshop; Professor Robbin Thorp, for extending his already busy schedule in Australia to present a paper at the workshop and lead the discussion session; all speakers for their talks and preparation of papers presented in this proceedings; and finally, thanks to all who took part in valuable discussions throughout the day, so ensuring the successful exchange of views, which is what the workshop was all about.



Syd Shea
Executive Director
Department of Conservation and Land Management

FOREWORD

WORKSHOP OPENING

Hon. Ron Davies, M.L.A., Minister for Conservation and Land Management, Parliament House, Perth.

I am pleased to have the opportunity to open what promises to be a valuable and informative workshop.

Western Australia has large areas of relatively unmodified land, and the Department of Conservation and Land Management is responsible for the management of a considerable proportion of it, comprising State forest, national parks and nature reserves.

In particular, the State has a system of national parks and nature reserves of which Western Australians can be proud. This system makes up a total of over 14 million hectares, about 6% of the State's surface area. It includes plant communities with the greatest diversity of any in the world, and plants and animals found only in Western Australia, some of which are exceedingly rare.

Management of these areas to retain their natural qualities for the enjoyment of people, now and in the future, is an important commitment of my Government. One of the major roles of the Department of Conservation and Land Management is to ensure that no loss of diversity of flora or fauna occurs in reserves under its control.

In relation to the other part of the title of this workshop, the beekeeping industry, it is a relatively small but significant one, with a total income in Western Australia last year of about 2.5 million dollars. It involves over 1 600 registered beekeepers, of whom 93 are professionals, working more or less full-time on honey production.

The industry has always relied heavily on large areas of natural vegetation, and has traditionally supported conservation of such areas. These areas are, in south-western Australia, more and more restricted to publicly owned land, and so the industry is increasingly dependent on areas managed by the Department of Conservation and Land Management.

In recent years, a deeper understanding of ecological processes, and the results of some limited biological research, have led land managers to question what effect large numbers of honeybees may be having on native plants and animals. Increasingly, agencies responsible for management of nature conservation areas have tended to exclude apiary sites from some parks and reserves.

This attitude on the part of land managers has come at a time when the beekeeping industry is having considerable problems from fluctuations in sales and price of honey. My Government has been sympathetic to the difficulties facing honey producers, and has made a number of decisions to assist them. These decisions have included: deferral of an increase in the charge for site rental; waiving of rental altogether for producers with sites burned out on the Beekeepers Reserve; and a moratorium on the closure of certain nature reserves to beekeepers, at least until the regrowth of the Beekeeper's Reserve.

The Government recognises that the industry is a legitimate and valuable one, and that it requires public land for its successful operations. At the same time, we are committed to the protection of nature conservation values, and CALM is responsible for management to bring that about.

Such conflicting demands on public land sometimes produce an impasse, with entrenched views being held firmly by each side.

This need not be the case. A satisfactory arrangement can usually be reached by a full knowledge of the issues involved and a full and open discussion of them.

One of the problems in the present case is a lack of clarity as to just what information is available, what it tells us, and what management options are open to us. This workshop should represent the first step in providing the background of knowledge upon which sound planning, and further research and discussions, can be based. I am confident that, with this knowledge, and with good will on both sides, the difficulties that exist can be overcome.

It gives me great pleasure to declare this workshop open.

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PURPOSE AND CURRENT MANAGEMENT OF STATE FOREST IN WESTERN AUSTRALIA

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In this paper I discuss the purpose and management of State forest and Crown land in WA and relate this to some of the aspects of beekeeping which are influenced by forest policy and management.

Most readers will be aware of the history of land tenure and land allocation in the South West (or forested) part of WA. Although a few minor timber reserves (including what are now the Warren and Beedelup National Parks) were set aside shortly after the turn of the century, dedication of State forests did not commence until the passing of the Forests Act in 1918. The process was not "completed" until well into the 1950s because of opposition by various parties. Today the bulk of the forest left on Crown land in the South West is State forest, though there are also many forests on

* Timber reserves (both Land Act and Conservation and Land Management Act)
* Areas held freehold by the Executive Director of the Department of Conservation and Land Management (CALM)
* Small reserves for miscellaneous purposes (e.g., "Settlers Requirements") scattered through the forest area
* Catchments vested in the Water Authority
* Road reserves
* Vacant Crown land

There are also extensive woodlands in the Goldfields region, some of which are State forest.

My discussion focuses mainly on State forests and timber reserves in the South West, because they represent the bulk of the forested area under the control of CALM, but I also mention vacant Crown land. National parks and nature reserves are addressed in a separate paper by my colleague, Dr Wilson.

The purposes for which State forests and timber reserves were set aside and are managed, have steadily evolved and become increasingly formalized over the last 60 years. Although it is often said that timber production is the sole pre-occupation of forest managers, in fact a policy of multiple-use has nearly always been espoused and practised in WA. From the earliest days, our forests have provided, in addition to timber: water catchment, minerals, grazing, recreation, scenic beauty, scientific study, a refuge for native plants and animals, and of course, the nectar and pollen on which the honey industry is based.

It has also long been recognized that many of these activities or land uses, though perfectly legitimate in themselves, can be mutually exclusive. That is, they cannot happily co-exist, either in space or in time. This was tolerable while our forest was extensive and our population small. There was always "somewhere else" to relocate conflicting activities. However the situation became intolerable by the late 1960s when land use conflicts, particularly in the northern jarrah forest and in the karri, came to a head. At about this time four major events of significance to forest management in WA took place.

1. The advent of bauxite mining on a very large scale in the jarrah forest.

2. A major increase in timber demand, especially in the karri forest, and this coincided with new and reduced estimates of the timber resource.

3. A realisation, both by the scientific community and the public, of the fragility of Perth's water supplies, as a result of salinity caused by forest clearing for agriculture.

4. The arrival of the environmental movement from the USA, via New Zealand and the Eastern States, with forests as the major preoccupation. This coincided with major research studies by foresters into dieback and the conservation values of State forests, all contributing to pressure on traditional uses.

Stemming from these influences, a major land use study and policy review was undertaken during the early 1970s. These were published as the Forest Policy, and the land-use plan for State forest in General Working Plan 86 of 1976, and since then updated in 1982.

These statements for the first time formally spelt out the basic aim of forest management in WA: "Conservation through planned use and management, for the greatest long-term social and economic benefit to the community".

Eight major land uses were identified:

1. Conservation of flora, fauna and landscape
2. Forest production (including timber, honey etc.)
3. Water production
4. Forest protection
5. Scientific study
6. Recreation
7. Public utility (e.g. roads, powerlines, reservoirs)
8. Mining

The land use study which had previously been done by Mr Joe Havel of the then Forests Department, and others, enabled the forest to be classified according to capability, legislative and economic constraints, and the consequences of various land use options.

Table 1 summarises the priority land uses. The location of the Management Priority Areas are shown on maps contained in the 1982 General Working Plan.

In this system, every part of State forest has been allocated to one or other of the 8 priority land uses. For each priority use area there has been an additional allocation of compatible uses (for example timber production and water production) and incompatible uses (for example, flora conservation and water storage).

These forest policies were developed by the former Forests Department in consultation with a wide range of other Government and scientific agencies, and approved by two successive governments. They have been adopted by the new Department of Conservation and Land Management *pro tem*, and are undergoing major review in 1986 as part of the scheduled 5-yearly forest management review. The public is invited to participate fully in this review. It is expected that Regional Management Plans for the forest regions will replace the General Working Plan.

One very important feature of the new CALM Act has been the spelling out, for the first time in legislation of the State's statutory obligations with respect to forest management aims and planning processes.

The Act specifies that our native forests are to be managed so as "to ensure the multiple use and sustained yield of the forest resource for the satisfaction of long-term social and economic needs". The term "multiple use" recognises a wide range of products and benefits, among them pollen and nectar. In the case of plantations of exotic trees, the Act requires that managers achieve "the optimum yield in production, consistent with the satisfaction of long-term social and economic needs".

Finally, the Act requires that management plans must be prepared for all Departmental lands and specifies the public consultative processes to be adopted. This is a major step forward in the history of WA land management.

How does honey production fit into this scene?

Firstly, honey production is currently regarded as compatible with priority land use on over half of the area of State forest and Timber reserve (Table 2).

Secondly, members of the honey industry may now positively contribute to the planning process.

In fact, the major problem with availability of areas for beekeeping is not land use designation, but temporary management constraints, such as the following.

1. Areas recently burnt. The Department's prescribed burning programme continues to be a controversial subject to apiarists. We are fully aware of the effects of fire on the flowering cycles of trees. However, more than 60 years of experience in forest firefighting in the south-west of WA has also taught us that fuel reduction burning is essential in forest country if wildfires are to be contained. Without it, we simply cannot guarantee the safety of West Australians, or of the many other important forest values from the ravages of bushfires. It also must be said that many years of research has not revealed any permanent damage to flora and fauna in the forest as a result of the burning programme.

   What we can do, and do, to satisfy the special needs of apiarists, is to minimise the amount of burning, to lengthen rotations as far as safely possible, and to rearrange burning schedules according to the status of the flowering cycle. In this we try to work in with the apiarists and make best use of their local knowledge and expertise. As we improve other aspects of our fire control systems (e.g. detection) so we can do more in these areas.

We are continually trying to refine and update our fire control methodology and skills. This is one of the major research interests in the Department. I hope in the future we can achieve the same standard of excellence of result, with less prescribed burning, and this is certainly the long term aim.

2. Quarantine areas. The forest quarantine programme has greatly inconvenienced many forest users, including apiarists, but in the long term, as with the fire management programme, this will be for the good of the forest and the community. Again, our knowledge is improving greatly in this area and better, smoother management will result.

3. Finally: Logging. The timber industry is the most controversial forest activity in this State, and also the area for which our Department receives most criticism. In many ways this is an irony, because most people like timber as a product, and use timber or timber derivatives daily. If only it could be obtained without having to cut down trees!

However, an important point must be made: the West Australian Government accepts the timber industry as a legitimate forest use. This Department is therefore obliged to make provision for it in our management plans. A very large proportion of the forest does not have timber production as the priority use, and this includes about half the karri forest. As professional land managers, we are dedicated to the ideal of a "perpetual forest" in WA. We ensure that all areas logged are regenerated, and the new forest is properly loved and husbanded, so that future generations can enjoy the same range of values as do those today.

Despite what you may have heard, WA forests are not being "over burned and overcut", and despite the twin introduced problems of dieback and bauxite mining, overall our WA forests are in very good nick. In the long term, logging will not disadvantage the beekeeping industry: the two can co-exist.

In fact they must co-exist, because I cannot see any Government deciding to terminate the timber industry in the forseeable future.

So far I have talked mainly about State forest. This Department also issues Apiary Sites for vacant Crown land (VCL). However, we do not manage this land. Under the new CALM Act it is possible for us to become the managing authority for designated areas of VCL, but this has not happened for any areas yet and I for one do not wish to take on too many extra areas too quickly. CALM is already greatly understaffed for our responsibilities across the State, and are struggling to do the job we want to do on the land we already have.

However, I am very well aware of the problems apiarists experience in relying on sites on unvested, unmanaged Crown lands. I refer mainly to wildfire, access and inappropriate controlled burning. These are problems for the community at large to overcome. Our regional and district staff will be trying to help in the years ahead in the main problem areas, particularly the northern sand plains, where we now have district staff for the first time.

Finally, I wish to mention the policy towards honey production from State forest in our General Working Plan. This states:

"The aim is to sustain the present level of beekeeping, with due regard for location of Apiary Sites to avoid transference of disease and conflict with major land use objectives".

This policy is continuing to be applied by CALM, but is being reviewed together with all our other forest management policies. I hope we can get a good input from groups like that assembled for the beekeepers workshop, during that policy review.

TABLE 1

PRIORITY LAND-USE CATEGORIES:
STATE FORESTS AND TIMBER RESERVES
(1982 General Working Plan)

Category	Approximate Area (ha)	Percentage
Flora, fauna and landscape values	269 000	13.1
Hardwood production	347 000	17.2
Softwood production	30 000	1.5
Water production	242 000	12.0
Catchment protection	364 000	18.0
Catchment prot/flora, fauna etc.	105 000	5.1
Catchment prot/hardwood production	62 000	3.1
Protection of forest values	415 000	20.6
Scientific study, education	30 000	1.5
Recreation	76 000	3.8
Road, river and stream reserves	79 000	3.9

TABLE 2

COMPATIBILITY OF HONEY PRODUCTION WITH PRIORITY LAND USES IN STATE FORESTS AND TIMBER RESERVES

COMPATIBLE

Hardwood production
Protection of forest values
Water production

INCOMPATIBLE

Many catchment protection areas (due to the risk of dieback being spread by vehicles)

Many flora, fauna and landscape areas (risk of dieback spread)

Areas used for recreation (high level of human activity)

Scientific study/education areas (high level of human activity)

Most softwood production areas (lack of suitable flowers)

Note: Some areas designated for recreation, and roads, river, and stream reserves, may be available at times for honey production.

MANAGEMENT OF NATIONAL PARKS AND NATURE RESERVES IN WESTERN AUSTRALIA

Barry R. Wilson, Director, Nature Conservation,
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The Department of Conservation and Land Management (CALM) is a very large department with diverse functions. As the name indicates, these fall into two main areas:

i) conservation, meaning conservation of natural resources, particularly the native biological resources of the State, i.e. plants and animals;

ii) land management, meaning the management of land owned by the Crown for the purposes of preservation and/or utilization on a sustainable basis, of those natural resources.

The fundamental objective in nature conservation, the bottom line as it were, is to ensure the indefinite persistence (or survival) of as many of our native species of plants and animals as we can, and to ensure the indefinite persistence of samples of natural ecosystems and habitats.

The unhappy truth is that our generation is both the witness to, and the cause of, large scale habitat destruction and a species extinction rate such as the world has never seen before. These are unwelcome facts reported to us by our biologists. Details of the causes of this phenomenon may be disputed but the fact of appalling land degradation and extinction rates in our time is indisputable.

Some people might say 'so what?'. I don't propose to consider that question. I assume that we accept the position that we must do all we can to preserve the world's flora and fauna, especially our own, for a variety of philosophical, practical, environmental, cultural and commercial reasons.

The National Conservation Strategy, to which our State is a signatory, proposes that we take action which will help maintain maximum species and genetic diversity.

The single most important way to achieve this is by reservation of special tracts of land where habitats are preserved and where species of plants and animals may live their normal lives and propagate, reproducing their kind, generation after generation. The idea is that conservation of species is best achieved by protecting their habitats.

Another important way to achieve our conservation objective is to protect the animals and plants themselves, and we have special regulations controlling such activities as commercial fishing, hunting and wildflower picking. However, this aspect of the responsibilities of this Department is not one which concerns me today. The important aspect I want to address which relates to today's topic is the purpose and management of land reserved for nature conservation.

Under the CALM Act there is provision for two kinds of conservation reserve in WA, i.e. NATURE RESERVES and NATIONAL PARKS.

We have a system of reserves, some large and many small, which, between them, contain representative samples of habitats and ecosystems and, hopefully, a comprehensive suite of our plant and animal species. In fact these areas have been selected to try to cover the range of flora and fauna of the State. Unfortunately this ideal is not fully realized. There are still many habitat types and many species which are not represented in our reserves. However, we are now well on the way in that direction.

We can think of these reserves as living museums. They constitute a resource of genetic material for possible future use and sites where studies of ecology and evolution may be conducted, as well as preserves of flora and fauna.

Some areas are considered to be of great importance for these particular purposes and we reserve them as nature reserves.

But there is also a need for wild places where people can go to enjoy just being in the bush or on the beach, away from traffic and trains, and telephones. Some of our reserves preserve particularly attractive land for this purpose as well as for conservation and these are reserved as national parks.

National parks serve dual purposes then; they preserve flora and fauna but people are encouraged to go there for enjoyment and recreation. Unlike State forests however, there is no provision for the commercial use of resources within national parks.

The trouble is that the presence of people means roads and tracks, cooking fires and rubbish. Inevitably people in parks means that the conservation value of the land is compromised to some extent. Therefore national parks are managed to meet such demand by the public for recreation as may be compatible with the maintenance of the environment and wildlife at an acceptable level. Nature reserves do not have this people function - their sole purpose is for the preservation and study of wildlife, although some passive recreation may be acceptable.

I want to stress the point that the national parks and nature reserves in our system should, ideally, be selected to meet the particular requirements I have described. In other words, the land would be divided up into that which is suitable for agriculture, that which is suitable for forests, or towns, or grazing, or recreation, or conservation, and allocated according to the need for these purposes. We may properly question whether this land-use allocation, as it stands today, is fair and balanced. But that is a different issue.

It is true that conservation generally comes last on the priority list. In the south-west land division at least, many of our reserves for nature conservation are merely what was left after everyone else had a go, so that they do not truly represent the variety of habitats and wildlife which was present originally. Nevertheless, they are remnants of what once existed, and they are utterly priceless. They support the last remnant populations of many plant and animal species which otherwise would be extinct.

In some cases particular areas of public land may serve more than one purpose. I have already spoken of the dual role of conservation and recreation for national parks.

As discussed by Mr Underwood elsewhere in these proceedings, State forests also serve multiple roles, including timber production, public recreation and conservation.

It can even be argued that agricultural land could serve multiple roles, if we set out to do that. The current interest in agro-forestry is a case in point, as is the current interest in preserving a small percentage of native vegetation on all private land.

The key to this idea of multiple use of the same land is whether or not, or to what extent, the different uses are compatible.

Note that the definition of national park in our Act states that these parks will be used "to fulfill so much of the demand for recreation by members of the public as is consistent with the proper maintenance and restoration of the natural environment and the protection of indigenous flora and fauna".

In other words, public recreational activities in the park must be managed in such a way that the conservation values are not seriously impaired. That isn't easy; it is the reason for having management plans and on-site rangers.

In the case of State forest, the primary function in some areas is timber production, but overall, the forest is managed to support other uses such as recreation, conservation and honey production.

In the case of nature reserves there is only one function. They are selected and preserved solely for the purpose of conservation and the study of indigenous flora and fauna. The Act says they are to "maintain and restore the natural environment and to protect, care for and promote the study of indigenous flora and fauna".

Management of nature reserves is geared to ensuring the survival forever of all the native species of plants and animals which live on them, and to preserve their genetic diversity, community structures and ecological processes. They are single purpose reserves.

Of course, that single purpose may, in some cases, be compatible with other uses as well. If it could be shown that some particular kind of people-use of the nature reserve has no significant impact on the species there, or on their habitat, a case could be made for multiple use.

It is generally considered that active recreation is not compatible with the purpose of nature reserves. Camping and the use of vehicles are not usually permitted there.

It is not my duty on this occasion to address the question of the effect of honeybees on parks and reserves. That is a matter which is discussed elsewhere in these Proceedings.

However, what does need to be said here is that in practice, beekeeping is permitted on some national parks and nature reserves. In the past the Western Australian Wildlife Authority established the following criteria.

"The placing of hives of bees on nature reserves will be permitted provided:

(i) the nature reserve falls within the geographical area of the State where feral bees are already present.

(ii) the nature reserve is greater than 500 ha in size.

(iii) the particular area within the nature reserve has not been specifically excluded from use by the beekeeping industry in accordance with a specific management decision by the Authority.

(iv) the particular area within the nature reserve is one in which the siting of hives is unlikely to inconvenience or endanger the public".

Using these criteria the W.A. Wildlife Authority designated 31 nature reserves on which beekeeping is to be allowed (7 with existing sites), and 25 (5 with existing sites) on which beekeeping would be excluded. The application of these regulations was suspended by the Government in recognition of the current problems of the industry, especially the burning of the Beekeepers Reserve.

It is my task in concluding to emphasise that the Act under which national parks and nature reserves are established is quite specific about the purposes for which they have been selected, and to which

they may be put. The conservation values of these lands are their purpose and may not be compromised by other uses. The issue which confronts us as managers is whether beekeeping in these lands does or does not compromise that purpose in any way.

AN OVERVIEW OF THE BEEKEEPING INDUSTRY

Alan C. Kessell, Senior Apiculturist,
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There were no honey producing bees of the *Apis mellifera* strains in Australia when the white man first settled. The original introduction of the species was from England. The first introductions to the Swan River Colony arrived in 1846 and they quickly adapted to their new environment.

In more recent times, the following table, based on registration records, shows that beekeeping in this State is still on the increase.

Year	Registered Beekeepers	Hives
1950	400	27 000
1970	600	45 000
1982	1 500	55 000
1984	1 600	57 000

The major increase in registered beekeepers is in the hobbiest groups with less than 10 hives of bees, while in the commercial group there has been a decline in numbers over the last 30 years.

Initially the first commercial beekeepers were able to produce sufficient honey from their hives without moving more than 80 km from their base. Commerical apiarists established themselves in areas such as Gingin, Toodyay, Bakers Hill, York, Narrogin, Katanning, Esperance, Walpole, Pinjarra and Guildford.

With the clearing of land for agriculture, beekeepers had to move further afield but even at the end of the 2nd world war there was ample room for apiary sites.

After the war, with the opening up of huge areas such as 1 million acres/year for about 10 years for war settlement and conditional purchase farms, and the introduction of large machinery for clearing, beekeepers really began to feel the loss of natural resources.

The traditional beekeeping areas, containing trees such as York gum, wandoo and moort, which produced some of the better grades of honey, were also the target for farmers as the soils supporting these trees were richer and more suitable than others for agriculture. Unfortunately the beekeepers were forgotten and only small reserves were left in many of these areas for use by the honey industry.

When the coastal areas were opened for agriculture, beekeepers were successful in obtaining two areas of reserve now known as the Beekeeper's Reserves. If we had known then what we are aware of today, I believe we should have pushed for more beekeeping reserves.

It is unfortunate that with all the clearing on a dry land farming basis, the majority of agricultural crops grown are of no benefit to beekeepers as a pasture for their bees and they need the native flora to maintain their production.

Beekeepers are now moving long distances to produce honey crops. Honey producing areas have extended to beyond Northampton, Kalgoorlie and Esperance, necessitating hundreds of kilometres each shift.

In addition to these distances that beekeepers now have to travel, other factors including dieback of jarrah, extensive woodchipping and control burning of forest areas, have severely depleted the quantity of good quality honey being produced.

As the major marketing outlets, export and local trade are centred around Perth and Fremantle, most commercial outfits tend to be based close to the metropolitan area.

With declining access to areas of native vegetation and the high cost of transportation in shifting apiaries over long distances, the industry is under severe pressure, forcing the cost of production higher.

As we are traditionally exporters of honey, exporting a major portion of our annual crop, it is necessary to rely on world parity prices which today in some instances barely cover the cost of production.

This fact was borne out in a recent survey conducted by the Department of Agriculture on the cost of production of honey in Western Australia. It was shown that in 1982/83 beekeepers were selling honey at below the cost of production.

The total value of the industry in Australia including pollination of crops, whether planned or accidental has been estimated at $400 million annually. An estimate for W.A. has not been established but we would have to contribute strongly to that figure.

Beekeepers need to be able to take advantage of all sources of nectar and pollen whether they are native or cultivated, if we are to survive as an industry.

RESOURCE UTILISATION - PAST

Sam C. Cook, Executive Member,
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Prior to 1935 the nectar resources of Western Australia were mainly used only in the beekeeper's own district. Unlike the present, country based beekeepers outnumbered metropolitan beekeepers.

The first major migration of bees occurred in 1935 when a few beekeepers moved their hives into the great karri forests of Manjimup and Pemberton. From then on migration, with the improvement of roads and trucks, gained momentum.

Gradually all the nectar resources, particularly on private property, were being utilised, as their flowering cycles occurred. Many apiary sites spaced 6.6 km apart granted by the then Forest Department were also used. Later the spacing was changed to 3 km.

Contrary to the present a much greater proportion of the honey produced was obtained from the wandoo woodlands and from other eucalypts, then thriving on farmlands throughout the south-west of Western Australia.

Were it possible to take a satellite photograph of the forest existing in the south-west of Western Australia in 1932 and compare it with one taken in 1975 it would reveal the loss of beekeeper's nectar producing sources that have occurred in my fifty three years of beekeeping.

Looking back it seems almost incredible that the once immense areas of flourishing *Eucalyptus* forests have largely disappeared to be replaced by various forms of agriculture. This is a change that beekeepers could never have created.

Visualise if you can, that great honey producer - summer flowering *Eucalyptus wandoo*, of the wandoo woodland: stretching from about 70 km south of Perth to beyond Cranbrook, west of the Albany Highway for many kilometres, and east of the Great Southern Highway and beyond.

In the 1930's farms were only scattered except along the Great Southern Railway to Albany. For instance, in the Kojonup and Cranbrook districts there were tens of thousands of hectares of uncleared conditional purchase land.

I can recall in 1946 visiting one farmer to ask if we could locate an apiary on his property. He said, "There is a dam down there, you can put them by it". That dam was in a wandoo woodland of some 1 500 ha and no cleared land was visible. There were many other farmers with very little cleared land and they were all happy to co-operate with beekeepers.

However, that great source of nectar was not to last. With rising prices for wool and other produce the outlook for farming was rosy. So the bulldozers and chains were called in. By the late 1960's the huge machines had decimated these vast areas of wandoo along with many hectares of jarrah (*Eucalyptus marginata*) and marri (*Eucalyptus calophylla*).

Now there remains only the remnant of these great woodlands. Their place has been taken by pasture plants which, except for capeweed, are not nectar producing.

These remaining isolated patches of wandoo do at times flower, producing a small crop of honey for a few beekeepers. However, it is insignificant in comparison with the past. Another alarming feature is that all the trees are ageing and in some cases are not healthy, possibly having only a limited life. The largest remaining area of wandoo in the south is Dryandra State Forest near Narrogin.

Now let us look to the north-west and east of Perth.

The spring flowering wandoo of the Mundaring Weir catchment has suffered from heavy cutting for timber in the past but is capable of giving reasonable crops of honey. Likewise, to the north-west, Julimar State Forest was subjected to very heavy cutting for timber and tannin extraction. There is very good regrowth, and sufficient mature trees, that occasionally give a small honey flow. The wandoo is mainly confined to Julimar and Spice Brooks and their tributaries. It is possible that jarrah and marri predominate in the forest as a whole.

The other great source of nectar, autumn flowering wandoo, has almost all been cleared for agriculture in the Victoria Plains, Chittering, Moora and Toodyay Shires. The Bindoon Army Training Area has also taken a large part of Julimar Forest. Consequently, where many beekeepers could obtain honey from wandoo in the past only a fortunate few can at present.

Probably the next greatest loss would be that of the dying of parts of the jarrah forest affected by jarrah dieback, *Phytophthora cinnamomi*. Dieback quarantine too has reduced the amount of jarrah and marri available because of limited access to some quarantine areas.

On occasions nectar supply has been depleted by heavy felling of jarrah for timber supplies. Bauxite mining has also removed many hectares of jarrah and will continue to do so for many years to come. The trees in the rehabilitated pits will take a considerable time before producing nectar. Although many of the trees planted are known nectar producers under forest conditions, nobody knows if they will perform the same in plantations.

Jarrah forest is a very important source of honey production. Marri is probably the most important species as it flowers more regularly than other eucalypts. It is usually a heavy producer of very good quality honey.

Another good nectar producer was York Gum, *Eucalyptus loxophleba*. It was widespread in the wheatbelt, particularly in the shires of York, Beverley, Northam, Toodyay, Bolgart and Moora. It has been reduced by clearing for agriculture to very small woodlots and scattered trees on individual farms. Occasionally, under favourable conditions these small areas flower very well and still give a worthwile yield of honey.

An area that was showing great potential before clearing for agriculture commenced in the 1960's was the mallee *Eucalyptus* belt of the south coast extending from Gnowangerup to beyond Esperance. Sadly, there is very little of this left. Beekeepers have only memories of that great honey producing mallee area, made up mostly of *Eucalyptus platypus*. The many areas of this small tree produced a considerable quantity of excellent honey.

So you will see it has been a continuing story of lost nectar resources and search for replacement apiary sites that mainly did not exist.

Even the great karri (*Eucalyptus diversicolour*) forests of Manjimup and Pemberton were not immune. Clear felling and wood chipping has severely depleted this once great source of nectar from karri and to a lesser degree marri. Many apiary sites are now almost devoid of mature karri. Although the speed of regrowth in the clear felled areas is remarkable it will be many decades before the young trees have the quantity of flowers to produce sufficient nectar for honey production.

The great area for honey, pollen production and breeding of bees to increase colony strength for future honey flows was the coastal heathlands from about Wanneroo north to Dongara. This area contained many great honey and pollen plants. The main ones were parrot bush (*Dryandra sessilis*) and other *Dryandras*, *Hakea trifurcata* and other *Hakeas*, as well as various heaths of the genus

Leucopogon. *Banksias* were also important, including *Banksia menziesii*, *B. attenuata*, *B. candolleana*, *B. prionotes*, *B. hookeriana* and *B. sphaerocarpa*. All that remains since clearing for agriculture are the national parks, nature reserves and the beekeepers reserves.

In concluding I wish to emphasize that there has been a continual loss of nectar sources. Unless beekeepers can maintain their use of existing apiary sites their livelihood will be in jeopardy.

RESOURCE UTILIZATION - PRESENT

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Alan Kessell and Sam Cook have described elsewhere in these Proceedings how nectar and pollen resources for beekeeping have been declining over the years and that hive numbers have increased over the same period. Given these two factors, diminishing resources coupled with increased hive numbers, at some point we must reach a stage where the available resources that are economical to work are fully utilized. I would strongly suggest that we have already reached that stage. Any further decline in the resources available to beekeeping will cause a decline in honey production with an accompanying decline in the viability of beekeeping.

The resources for beekeeping in WA are principally on Government controlled land. Apiary sites are located on State forest, vacant Crown land, beekeepers reserves, nature reserves and national parks, under a system of apiary site permits administered by the Department of Conservation and Land Management. The apiary site permit system provides for the orderly use of resources by beekeepers.

Beekeepers also utilize resources on private property; however this resource is limited due to clearing for agriculture as has already been mentioned.

All resources have some degree of importance to the beekeeper, although some resources are more important for a number of different reasons. Some are more reliable for honey production, others for hive build up and maintenance because of their pollen qualities and others because of their proximity to the beekeeper's home base.

Some of the honey and pollen resources which are very important are on the coastal plain and include *Dryandra sessilis*, *Hakea trifurcata* and *Banksia menziesii*. Marri (*Eucalyptus calophylla*), jarrah (*E. marginata*), wandoo (*E. wandoo*) and karri (*E. diversicolour*) are also important resources in other parts of the State.

The principal objective of commercial beekeepers is to have a continuous supply of nectar and pollen available to our bees. Commercial beekeepers in WA are migratory beekeepers. Beekeepers migrate their hives to many different honey flows during each season in order to maintain their hives in good condition and hopefully gain sufficient honey production to generate an acceptable annual income. Each different resource in many different locations is important and each resource fits together to build up a pattern of migration.

For the commercial beekeeper to develop the migratory pattern that he will follow during a season there are five principal factors he considers when studying the potential resources. They are, the flowering period, flowering time, the flowering cycle, extent of bud set and lastly the economics of working each resource.

The flowering period of most of the resources we work is between 4 to 8 weeks. Many of the eucalypts flower over a period of 6 weeks as is the case with jarrah and marri for example and many other of the resources worked during spring. Different varieties often complete flowering in 3 to 4 weeks, for example: *Hakea trifurcata* and capeweed. A few resources worked by beekeepers may flower over a long period; two examples which are best known are York gum and karri. It is important to know the flowering period of each resource for maximum resource utilization.

Coupled with flowering period is flowering time during each season. The resources utilized by beekeepers all have their own particular time when they commence flowering. Some of the varieties already named can be used as examples: *Hakea trifurcata* flowers early July to early August, capeweed early September to early October, jarrah

mid November to late December, marri early February to mid March, while karri, beginning in March, flowers over several months. There are other varieties with different flowering times.

The third consideration is flowering cycle. Not all of the available resources flower each season. Usually, most of the resources worked during the spring flower each season. During the summer and autumn the resources utilized tend not to flower annually. Jarrah and blackbutt for example flower bi-annually. Wandoo and karri appear to have a flowering cycle of 4 years apart, although both have been known to flower anywhere from 1 to 7 years apart. The flowering cycle of many *Eucalyptus* species, including mallees, is often determined by seasonal conditions, as is the fourth factor I mentioned, the amount of bud set. Favourable seasonal conditions stimulate many species to set a heavy crop of buds resulting in a good flowering and a surplus of nectar production. The beekeeper has to study the amount of bud set on the resources he utilizes to determine the amount of blossom that will be available for nectar production.

The fifth factor mentioned is the economics of working each resource. With production cost steadily rising and returns decreasing in real terms the cost of working each resource has to be considered. An estimate of the production potential of each resource has to be made. The cost of shifting bees from one resource to the next and the distance of the resource from the beekeeper's home base are considered. Obviously a honey flow closer to one's home base having a similar production potential to a distant flow would be favoured. However honey resources at long distances are utilized when there is no closer alternative. The level of profitability of beekeeping has declined severely in recent years and therefore it is essential for beekeepers to continue to utilize the resources that are available to the industry.

As noted earlier, the principal objective is to have a continuous supply of nectar and pollen. If this continuous supply is not available then two detrimental consequences occur. The first is quite obvious, honey production stops and therefore no income is being generated. The second consequence is a decline in hive strength or condition. During periods of little or no nectar or pollen, hive populations quickly decline. Also, during these periods it is difficult to carry out hive maintenance work such as re-queening, building up replacement hives or making up nuclei. The compounding effect of the decline in hive population is felt when the bees are placed onto the next honey flow. If hive populations have not decreased too severely then they can increase their population to working strength in about 5 weeks. This is because the brood cycle is 3 weeks from egg laying to hatching and then bees spend about 10 days as nurse bees before being worker bees, hence a period of about 5 weeks. If hive populations should decline to very low levels, as occurs during droughts or long periods of no or very little pollen and nectar, then it may take 2 to 3 months to increase numbers back to productive levels.

So, the net result is not just a short period of income loss as many may think, but can be a long period of low honey production because of the inability to take full advantage of following honey flows. What does all this mean to this workshop? As I said in my introduction, any further decline in the resources available to beekeeping will cause a decline in honey production with an accompanying decline in the ability to keep hives in strong productive order. Each available resource is important to beekeepers and is used at various times during different seasons to complete a pattern of migratory beekeeping. The further loss or withdrawal of resources has to be detrimental for beekeepers.

The normal migratory pattern worked by most beekeepers in this State begins in July when bees are placed on coastal plain sites where there is *Hakea trifurcata* and other scrub varieties flowering. Here bees commence early build up for later spring flows. Following

H. trifurcata the predominent species is *Dryandra sessilis* (parrot bush) which provides a pollen and honey resource to late September. About this time many hives have reached good production strength and are moved to flows of capeweed, York gum or Patterson's curse. At this time the beekeeper encounters one problem which is unusual at other times of the season. That problem is swarming. Beekeepers work very hard to control bees from swarming because with each swarm goes a good queen and the worker bees required to keep the hive at production strength. Methods of swarm control include re-queening with the young queens because they have less tendency to swarm, reducing the strength of over strong hives by taking off nuclei, keeping the honey extracted from the bees so they have plenty of room to work and also breeding strains of bees which don't have a swarming tendency.

Following the spring period beekeepers move onto early summer flows of coastal jarrah in late October - early November followed by jarrah through the Darling Scarp during November - December. As jarrah doesn't flower each year other flows worked could be wandoo in the Dale forest, mallet at Dryandra, peppermint along the coast or mallee in the Goldfields around Coolgardie.

During mid-summer resources of blackbutt, powder bark or mallees are utilized, and in early February the marri commences flowering. As marri has a wide distribution through the State beekeepers are usually able to find resources of marri to work during February - March each season. After the marri has finished some of the autumn flows worked are northern wandoo, southern yate and Menzies banskia on the coast. The main autumn flow species, although unfortunately it doesn't flower often enough, is karri. The attraction of karri is that it flows over a long period, is a heavy producer of nectar and produces a top quality table honey.

At the end of the season bees are taken onto coastal plain sites, where heathland varieties are flowering, to maintain hives until early spring.

In this brief description I haven't been able to mention every possible resource nor describe every possible individual migratory pattern. Each individual beekeeper develops his own pattern of migration according to what resources he has available to use. The brief description given helps indicate how the honey and pollen resources in this State are currently being utilized.

To conclude, I believe those resources which are economical and practical to work are being fully utilized by beekeepers. Any decline in the resources currently being utilized will have a detrimental effect on the Western Australian beekeeping industry. With the current low level of profitability in the industry it would be difficult to adjust to any change in the present method of resource utilization.

WORLD OVERVIEW OF THE INTERACTIONS BETWEEN HONEYBEES AND OTHER FLORA AND FAUNA

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Honeybees are native to Europe, Asia and Africa. They have been introduced into the Americas, Australia and New Zealand during the past 100 to 200 years, but their basic ecology and potential impact on native ecosystems of these areas have received little study.

Honeybees require: food - in the form of pollen for brood food and nectar for adult energy; nest cavity - of about 45 liters (15-80l) with a small (<75 cm^2) entrance at the bottom; water - to regulate hive temperature and to liquify honey; propolis (sticky resins, waxes) - to seal nest cavities.

Honeybees may forage up to 10 km (maximum 12 km), but 95% will be within 6 km and 50% within 1.6 km in nature with food resources dispersed. In agricultural crops, most forage within 250 m (80-90% <1.5 km) and rarely beyond about 3 km.

"Honeybees are good botanists!" Individual honeybees tend to be highly host specific, even discriminating between subspecies or cultivars of the same species. They remain faithful to one species, and usually to a limited area of its flowers, on one trip and usually over a series of successive foraging trips. They can communicate (dance language) location of new food sources to their hive mates which allows them to make efficient use of available and ever changing food resources.

Honeybees live in perennial colonies. Their population increases and reproductive swarming are greatest in spring. They need maintenance resources in autumn, and live on accumulated stores in winter.

National parks policies presumably will pertain to commercial colonies which are present at certain times of the year (e.g. overwinter maintenance) or in certain years (e.g. when there are major nectar flows). Thus, it is important to keep differences between feral and commercial colonies in mind.

Comparison Between Feral and Commercial Populations of Honeybees

Factor	Feral Colonies	Commercial Colonies
Population size	10-30 000	20-60 000
Nest cavity size	451 (15-801)	125-2501
Annual honey production	20 kg	50-100 kg
Presence in environment	Continuous, if conditions permit	Temporary, moved in for peak resource
Survival rate	Low, 25% first year, 80% subsequently	High, if pesticide & disease controlled
Swarming	All at least one each year	About 25% of colonies per apiary per year

Honeybees produce a variety of products including: honey, beeswax, queens and packages of bees, pollen, propolis, royal jelly and venom. But their greatest value is as pollinators of agricultural and native plants. In the USA it was estimated that the value of crops for 1980 requiring or benefiting from pollination by honeybees and the value of crops resulting from seed requiring bee pollination was nearly $12 billion (USA). Similar estimates for California alone were nearly $1.5 billion (USA) for 1980.

Many native plants are efficiently pollinated by honeybees, especially where native bee populations have been reduced due to human activities (e.g., land clearing, pesticide sprays of forests and range land). Many birds and mammals feed on fruits and seeds resulting from pollination by honeybees. Plants produced from such seeds also provide shelter for wildlife. Many insectivors include honeybees in their diet, capturing them at the flowers (e.g. mantids, spiders, birds), or from their hives (e.g. bears, skunks).

Many heavy metals, pesticides and other pollutants are translocated in plants from roots to pollen. Such plants can be identified from pollen trapped at bee hives. Distance and direction can be "read" from food dances of the bees. Thus, honeybees are valuable environmental monitors.

Recently in Australia honeybees have been charged with several potential negative impacts on the environment.

1. Competition for food with native bees and birds resulting in reduction or elimination of natives since honeybees feed <u>all</u> year.

2. Aggressive displacement of native species from flowers.

3. Inefficient pollination:
    a. Nectar and pollen thieving ("tearing flowers open").
    b. Causing genetic changes in plant populations through increased inbreeding or outbreeding.
    c. Causing hybridization of native plants through interspecific pollen transfers.

4. Competition for nest sites (e.g. tree holes used by native birds and mammals).

5. Diseases of honeybees affecting feral honeybees and native bees.

6. Replenishment of feral swarms from commercial colonies.

Available information permits the following responses to the charges listed.

1. Competition assumes a limiting resource. Many native bees may remain dormant over one or more seasons if food is scarce. Pollen is a more important currency for native bees than nectar. Many native bees possess special adaptations that allow them to be more efficient pollen foragers than generalist honeybees. Honeybees tend to concentrate on the richest resources. Commercial hives are not moved into areas during seasons of poor resource availability. Studies suggesting a decrease in forager density of native pollinators in response to presence of honeybees are equivocal and do not address permanency nor potential decreases in population density of the natives in subsequent seasons.

An attempt to investigate the potential impact of honeybees on native bee populations is being undertaken by Dr Evan Sugden currently at the Australian Museum, Sydney, working in cooperation with Dr Graham Pyke and me. Dr Sugden is studying the impact of placing an apiary of 24 hives in a line of trap nests for native twig nesting bees and wasps at the Nadgee Nature Reserve in SE New South Wales. If food is a limiting resource, then the reproductive success of native bees and wasps should be lowest in trap nests nearest the apiary. It is hoped that resources to continue the study will be made available in the meantime since it is important that all such studies cover more than one year so that any conclusions can take into account variability between years.

2. Aggression by honeybees toward other visitors at flowers is rare and considered unimportant, even in studies claiming honeybees outcompete native bees.

3. Honeybees and many other flower visitors do avoid legitimate pollination mechanisms of some plants.

a. Honeybees do probe for nectar at the bases of flowers through holes made by birds, bumble bees and carpenter bees. Their trowel-like mandibles and flexible maxillae are not adapted to "tear" open flowers. Thus, honeybees are secondary nectar thieves where flower piercing has been observed in Europe and the USA.

b. Increased inbreeding or outbreeding that would lead to genetic changes in plant populations is influenced by too many variables to be attributable to a single pollinator species.

c. Hybridization is an important ongoing evolutionary phenomenon. Some cases of recent hybridization can be attributed to native birds (Australian mistletoes), or native bees (*Aquilegia* in California). Many cases of recent hybridization are attributable to disturbance of the environment by human activities, altering habitats of parental populations, bringing them into closer proximity, creating new habitats in which the hybrids survive best, etc. Individual honeybees tend to be highly host specific, and least likely to mediate interspecific pollen transfers.

4. Nest site requirements of feral honeybees are usually not identical with those of birds or mammals. We need more information on how much these requirements overlap and whether nest site availability is limiting to the populations of the natives concerned. In cases where honeybees have been observed occupying nest holes formerly occupied by cockatoos, further search has found suitable holes unoccupied by either. Human caused reduction of food resources for the cockatoos may have had a greater impact on their population densities than availability of nest sites.

5. Diseases of honeybees are transmitted between feral and commercial populations. The appearance of EFB (European Foul Brood disease) in Australia has reportedly reduced feral colonies in the southeast. Diseases of honeybees are not cross-infective to native bees, or vice versa, where the honeybee has been introduced.

6. Commercial colonies swarm much less frequently than do feral colonies and with careful management this can be further reduced so that replenishment of feral colonies from commercial ones can be minimized.

Concluding remarks:

We need well documented research on which to base any policy decisions. Most of the research to date has been directed at proving that there is or has been a negative impact of honeybees on native flora and fauna in areas where it has been introduced. Research results to data have been equivocal and have not clearly demonstrated such an impact. Some people have taken the view that the honeybee should be considered guilty of all charges, whether supported by hard scientific evidence or not, and that it is up to the beekeeping industry to prove otherwise. Others feel that, since the honeybee during the past hundred years since its introduction has already established in most of the areas suitable for its survival, the burden of proof should be on those who argue it has a negative impact. Regardless, there is need for research on the potential benefits of the honeybee in the environment, especially in national park lands, to balance the search for negative impacts, so that the policy makers can make their decisions based on the best data attainable. All the evidence needs to be put into perspective, including other potentially negative activities permitted in national parks.

It is also important that follow up research be conducted in areas where commercial beekeeping has been practiced but where it is or will be banned or restricted. Changes in the environment due to the removal of honeybees need to be documented and evaluated for the positive, negative or lack of impact to determine whether the banning policy should stand or be altered.

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HONEYBEES AND NATIVE FLORA IN WESTERN AUSTRALIA

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Introduction

The objective of the workshop was stated to be directed at sharing information on the inter-relationship between the commercial apicultural use of native Western Australian plant communities and the overall landuse management objectives of the Department of Conservation and Land Management. My role in the workshop was to share with you some of the research my students and I have accumulated over the past few years on the interaction between the introduced honeybees and native flora and fauna, and to express any concerns relating to potential impacts of the use by commercial apiarists of native Western Australian plant communities to the long term preservation and conservation of these native ecosystems.

Past Research

Since 1978, Dr William A. Loneragan and I have been involved in research relating to the management of Crown land in the region between Badgingarra and Dongara. The research has been carried out in cooperation with the W.A. Bush Fires Board, the Apiculture section of the W.A. Department of Agriculture and the W.A. Department of Conservation and Land Management. The objectives of the Department of Botany in this research have been:

1. To determine the flora and natural arrangement of plant communities in the northern sandplain heathlands;

2. To establish the plant species important to the apiculture in the region;

3. To determine the response to fire of species and communities in the region;

4. To help develop a policy of management to protect adjacent developed lands from wildfires while maintaining sufficient areas of prime honeybee pastures and the conservation of plant species and communities.

In this research we have been indebted to the Terrestrial Ecology classes of 1979 and 1980, and to P.G. van der Moezel, J.C. Rullo and R.T. Wills, whose graduate rasearch programmes have contributed to our knowledge of these ecosystems. In the preparation of this paper I am also indebted to discussions with Dr S.D. Hopper, Dr P.J. McMillan and to Mr R. Peakall.

Areas of Concern

In the preparation for the paper it became obvious very quickly that there was little already published data on the impact of the introduced honeybee (*Apis mellifera*) on native Western Australian ecosystems. In the following sections I have attempted to collate the currently available information along with statements shared with me by various persons by way of personal communication. Although I share with you the sources, I alone bear the responsibility of the unsubstantial anecdotes and rumours.

In the native ecosystems of Western Australia, there are three potential impacts relating to the use by commercial apiarists. These three areas of concern are the following.

1. Can feral honeybees occupy nest holes to the exclusion of native birds?

2. Do honeybees in some way interrupt the normal pollination - seed set cycle in native Australian plant species?

3. Can honeybees deplete nectar and/or pollen to a point where native animals cannot co-exist due to limited food resources?

Nest Site Competition

The use of native ecosystems for commercial apiculture has lead to feral bee populations in most areas of the south-west of Western Australia. The question now arises, "Could feral honeybee colonies occupy enough potential nest sites of native birds, especially parrots and cockatoos, to be detrimental to the long-term survival of these species?" Dr Peter McMillan, formerly of the Claremont College of Advanced Education, now retired, reported to me that five wandoo woodland nest hollows formerly occupied by Galahs in the Northern Eneabba Reserve were occupied in 1985 by feral honeybees.

Research carried out by Dr D.A. Saunders of the CSIRO Wildlife and Rangelands Research Division at Helena Valley, on populations of Carnaby's Cockatoo in the dissected regions of native vegetation and wheat farms in the vicinity of Badginarra, indicates that the populations of these white-tailed black cockatoos are limited not by the restriction of nest sites caused by land clearing in the woodland, but by reduction of the heathland regions which provide much of the cockatoo's food resources. The research also has found that the conversion of Western Australian heathlands to wheat fields has increased numbers of Galahs and Corellas, because these bird species can utilize grain left over in the fields following the harvest.

Dr Jim Turner, working to re-introduce Sugar Gliders to a native forest reserve near Sydney, found that although honeybees filled some tree hollows capable of harbouring these small marsupials, the bees filled only a small portion of the available hollows.

Although my report so far has concentrated on the impact of honeybees on bird nest sites, the impact could also affect native colonial insects. However, because most native bees in Australia are solitary and even the communal native bees nest in the ground, I feel

the impact on native insects through this means of competition to be minimal.

Restriction of the clearing of native heath and woodlands will benefit both the populations of birds species and the apicultural industry, and it is in the interest of both the apiarists and professed conservationists and preservationists to work together to prevent further destruction of the land now covered by native vegetation. If Crown lands and reserves of native vegetation can be preserved, I feel there are few worries about honeybees occupying nest hollows to the complete exclusion of native animals.

Competition for Food Resources

The other two concerns are somewhat interrelated. Both relate to the role of food resources made available by flowering plants to attract a vector which facilitates the transfer of pollen from one individual of a species to another individual of that species. If honeybees take nectar and pollen from flowers without effecting pollination, seed set could be affected. If honeybees rob flowers of a food resource required by native bees, then the native bees could be starved out of existence.

Research carried out by Mr R.T. Wills in the Beekeeper's Reserve, a 90 000 ha region of sandplain heaths and woodlands between Jurien and Dongara, has documented that of the 320 floral species so far identified, 118 species serve as sources of honey and/or nectar for the introduced honeybee (R.T. Wills, pers. comm.). The species visited by honeybees differ widely in floral morphology. For example, honeybees vist radially symmetrical flowers like those of *Leucopogon conostephioides*, as well as bilaterally symmetrical flowers like *Scaevola canescens* and *Hemiandra pungens*. Even highly modified flowers, such as those in the genus *Banksia* where the flowers have been modified to contain only the modified anther and stigma structure called the pollen presenter, provide food resources

to honeybees. Honeybees seem to be highly versatile feeders and are capable of exploiting food resources from a wide variety of native Western Australian species.

Honeybees visit flowers with a wide range of sugar concentration of the nectar and protein content of the pollen. At the Department of Botany's research area in Kenwick, sugar concentrations of the nectar of four co-occurring species of *Banksia* ranged from 20% by weight in *B. attenuata, B. menziesii,* and *B. littoralis* to 39% in *B. telmatia* (Lewis 1980). A study in the northern sandplain by Rullo (1982) measured crude protein contents of a variety of honeybee-collected pollens. Values ranged from 12% in *Leucopogon striatus* to 29% in *Dryandra nivea.* Data collected during the winters of 1981 (van der Moezel 1981) and 1982 (Rullo 1982) from pollen traps on experimental hives in a northern sandplain heathland between Jurien and Badgingarra provide data on pollen preference for species in these winter honeybee pastures (Fig. 1).

The pollen collected by honeybees in the early winter period of both years was dominated by *Leucopogon conostephioides,* but as the flowering of other species became more abundant, preference shifted to these other species. *Acacia stenoptera* and *Daviesia epiphylla* were common species collected in 1982 but were rarely collected the year before during the midwinter period. Common species in the pollen traps during late winter were *Dryandra nivea, Leuocopogon striatus, Boronia ramosa* and *Arctotheca calendula.* The collections of van der Moezel (1981) and Rullo (1982) also confirmed the highly constant collecting patterns of the introduced honeybee despite being provided with a wide variety of blossoms at any one time in the collecting region. Only rarely do pollen loads from *Apis mellifera* contain mixed pollens.

Native bees and wasps tend to show less pollen constancy. A study at the Yule Brook Botany Reserve near Perth showed native bees carried single pollen loads with a combination of pollens from

Hypocalymma angustifolium, *Eriostemon spicatus* and *Acacia cyanophylla* (Lewis 1980). Reports in the literature also confirm the less constant nature of native bee pollen foraging. Armstrong (1979) reported that native bees show little blossom constancy. In an older reference, Hardy (1910) reported that native bees carry pollen from as many as 11 plant genera in a single pollen load.

Our data from the Northern Sandplain indicate that although numerous (up to 60 species at any one time) species are available for pollen and/or nectar collection, only a relatively few native plant species are utilized by the honeybees and they tend to be the common species flowering in abundance during that time. The honeybees tend to continue to exploit these species for as long as they continue to provide the food resources before switching to new resources. It therefore appears that there could be other flowering species in a region to provide food resources for the less-constant native bees and wasps. Removing concentrations of commercial hives at times when flower availability drops off would ensure that competition for a limited resource between honeybees and native bees would be lessened.

Observations of Nectar and Pollen Robbing

Honeybees have the mouth parts and strength to sometimes enter flowers in search of nectar and pollen in ways which bypass the reproductive structures of the flowers, thus reducing the normal chance of cross pollination occurring and a reduced number of seeds being set. I have noted this process of "nectar robbing" by honeybees in *Templetonia retusa*, the common cocky's tongue of coastal limestone areas, species of *Crotalaria*, the northwest bird plant and *Erythrina*, the coral tree commonly planted in the metropolitan area. In each of these cases the honeybees enter the flower at the base of the corolla and seem to damage the flower to extract the nectar. In all cases, however, I have observed numerous fruits and seeds later in the season, thus indicating that pollination does seem to be occurring, either serviced directly by the honeybees despite the entry of the flowers below the anthers and stigmas, or by

other pollinators in spite of the damage to the corolla. Other species in the genera *Bossiaea, Gastrolobium, Oxylobium, Banksia, Calothamnus* and *Beaufortia* have been reported to me as being visited by honeybees in ways which seem to bypass the stamens and stigmas of the flowers. Honeybees have also been reported to visit species of orchids with highly evolved and specific pollinating mechanisms. These include species of *Drakaea, Prasophyllum* and *Eriochilus*. It appears to me, therefore, that pollination of Western Australian native plant species could be affected in some way resulting in a reduced potential for cross pollination and seed set.

Nectar robbing by honeybees could also limit the food resource of native animals which also use nectar as a food base. Buprestrid beetles once common in the flowers of *Nuytsia floribunda* now seem rare (Peter McMillan, pers. comm.). Honeybees could be the cause of such population reductions, but in the case of *Nuytsia floribunda, Iridomyrmex* ants are also now common nectar robbers and thus could contribute to the decline of the native species of beetles. In New South Wales, Graham Pyke has observed that honeybees have the capacity to reduce nectar supplies to such an extent that New Holland Honeyeaters must increase their territory sizes to obtain sufficient nectar supplies for survival. The potential that honeybees could have a negative effect on native animals, therefore, does exist. The effect, however, is far less than the loss of regions of native bush to agricultural or urban development.

Summary Statements

1. Conservation of native vegetation habitat is the most important requirement of both the apicultural industry and nature conservation societies and, therefore, it should be a priority item in the future to ensure that as much native vegetation is reserved as possible.

2. Concentrated use by large numbers of commercial hives could have a negative effect on the continued, long-term survival of certain native bees, wasps and/or birds through competition for nectar and pollen by honeybees.

3. Honeybees are versatile foragers, tend to be constant but only visit a small proportion of the species blooming in a region at any one time.

4. More limited data on native bees indicates that these insects are often very much less constant than honeybees and could forage species not favoured by honeybees.

5. Proper timing of access to reserves could limit potential competitive situations.

6. Funding of research on the interaction of the introduced honeybee and native ecosystems should be encouraged to better manage native communities in the presence of this introduced species.

Conclusion

There is little doubt in my mind that honeybees could have sufficient impact in a confined region of native bush to affect native insect and bird populations. I also feel that there is plenty of evidence to suggest that sufficient nectar and pollen resources are available to supply more insects than commercial hives place in an area, and because native insects visit a wide variety of plant species, they could frequent species not visited by the honeybees, and therefore survive.

I feel certain highly-used national parks should be protected from commercial beekeeping pressure. I also feel that we should work toward providing additional areas specifically set aside for commercial beekeeping. It is far superior to have areas for beekeeping which will also conserve native plant species and plant communities, protect watersheds for potable water, and prevent salinization and erosion, than to allow the land now in native bush to be converted to agriculture or urbanization. More open Crown land should be placed under beekeeping reserve status. In regions currently undergoing replanting programmes, such as the Collie Basin, apiculturalists should be consulted to ensure that species with high nectar production are planted whenever possible.

It is obvious that further research on the impact of honeybees on national parks is needed.

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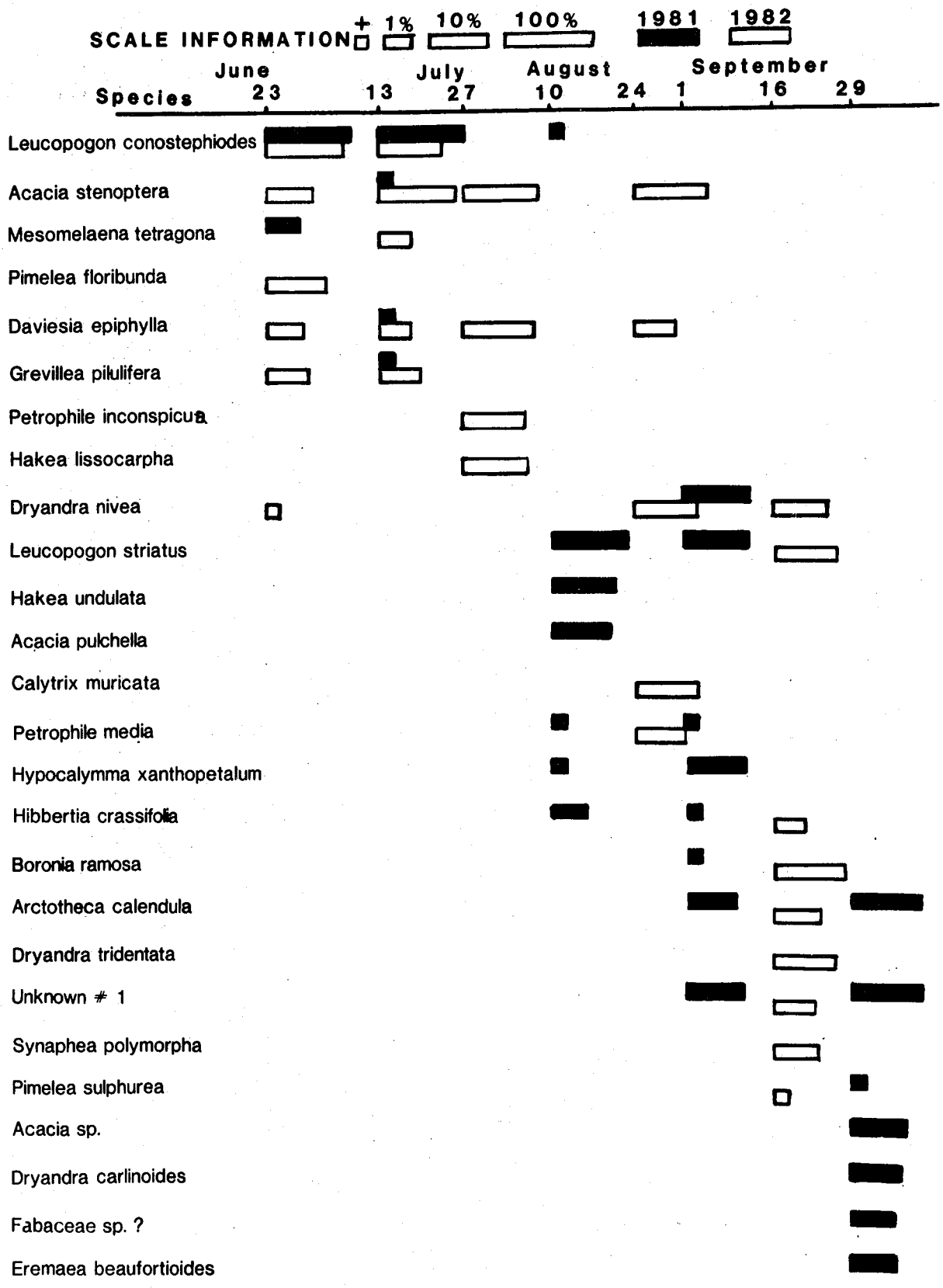
Figure Legend

Fig. 1. Pollen preference for the introduced honeybee (*Apis mellifera*) in native heathlands near Badgingarra. The proportion of the pollen trap collection from experimental hives for the week prior to the collecting date are provided using bar graphs placed on the date of collection axis. The proportional value of each species utilizes the log scale depicted at the top of the figure. Data from 1981 (the solid bars) follow van der Moezel (1981). Data from 1982 (the open bars) follow Rullo (1982).

POLLEN PREFERENCE STUDY



IMPACT OF HONEYBEES ON WESTERN AUSTRALIA'S NECTARIVOROUS FAUNA

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Abstract

The impact of honeybees on native nectarivores in Western Australia is a new field of study with few experimental investigations completed to date. It is known that the State has a rich nectar-feeding fauna, including many animals found nowhere else such as Honey Possums, some honeyeaters and a range of beetles, bees and wasps. While most such animals are generalists, feeding on a range of plants, some specialize on single species at a given place and time. Highly specific pollination relationships are unusual, but are known in the case of certain orchids and the male thynnid wasps they attract through sexual deception.

Honeybees feed on most Western Australian genera and species known to be important as food for native nectarivores, including eucalypts, banksias, grevilleas, dryandras, hakeas and kangaroo paws. They can forage at lower early morning temperatures than native bees and wasps. Honeybees may effectively pollinate some native plants, but are nectar or pollen thieves for others. Nectar has been shown to be a limiting resource for some honeyeater populations. Experimental introduction of hive bees depletes nectar and pollen in wild communities, and may lead to reduction in population sizes of honeyeaters and native bees.

Nectarivores with restricted breeding ranges (e.g. thynnid wasps) are highlighted as the most likely candidates for local extinction when placed in competition with hive bees. They should be high on the priority list for future investigations.

It is concluded that there may be a conflict of interests in permitting beekeeping on conservation reserves, and that research on key areas where negative impacts are most likely is needed to establish the management of beekeeping on CALM land on a firm factual understanding.

Introduction

Like the multi-million dollar export trade in wildflowers (Burgman and Hopper 1982), beekeeping in Western Australia is strongly reliant on native vegetation as the source of its raw material (Kessell, this volume). A central problem that both industries face is that much of their basic resource in the south-west has been eradicated for agricultural development over the past forty years. Furthermore, a substantial proportion of what remains has been set aside for conservation in national parks, nature reserves, State forests and water catchment reserves, land largely administered and managed by the Department of Conservation and Land Management (CALM).

In the case of the wildflower industry, it is Government policy that commercial picking should be excluded from conservation reserves (Burgman and Hopper 1982). Beekeeping, on the other hand, has continued in national parks and some nature reserves, despite concerns expressed by land management authorities (Moore *et al.* 1983; Nichols 1986), conservationists (Anonymous 1985) and the scientific community (e.g. Keighery 1985; Paton 1986; Ford 1986).

It is important that the basis for these concerns should be presented and discussed now, both to the Government in relation to determining policy for the management of CALM lands, and to the beekeeping industry, whose future directions are very much dependent on the policy decisions taken by Government.

My task here is to review scientific studies pertinent to the question of the impact of honeybees on nectarivorous fauna, and to suggest areas where future research in Western Australia might be most profitably directed.

The Nectarivorous Fauna

The world-renowned richness of Western Australia's wildflowers is paralleled by an equally remarkable and diverse nectar-feeding fauna. Of special importance are:

i) the Honey Possum (*Tarsipes rostratus*), the only mammal in the world that is entirely dependent on nectar and pollen for food (Wooller *et al.* 1984);

ii) a rich complement of honeyeaters and other nectar-feeding birds (Hopper and Burbidge 1986);

iii) a nectarivorous insect fauna with many unusual and unique elements (Armstrong 1979) such as among the spectacularly coloured buprestid beetles, the thynnid wasps, and the specialized solitary bees with elongated tubular mouth parts recently described by Houston (1983).

It is noteworthy that with the exception of a few small tropical genera, Western Australia lacks social bees comparable in lifestyle to the honeybee (Michener 1965).

Food plant preferences and pollination by native animals

Rather than highly specific plant-pollinator relationships, the most commonly encountered situation in Australia is that nectar feeding animals feed on a range of plants throughout the year and across their geographical distribution. Relevant data are provided in reviews for possums and gliders by Smith and Hume (1984), for birds by Ford *et al.* (1979), Paton (1986) and Hopper and Burbidge (1986), and for insects by Armstrong (1979). Such flexibility in the choice of food plants is clearly appropriate in the south-west where seasonal conditions sometimes render the flowering of individual plant species unpredictable, but the richness of wildflower communities means that some food plants will be in flower whatever the season.

While studies of the food plant preferences of nectarivorous fauna at the species level show overwhelming generalization, recent work on the behaviour of individuals and populations at specific places and times indicate that feeding may narrow down to a single species of plant that is offering the most nectar for the least effort (e.g. Hopper and Burbidge's (1978) study of Red Wattlebirds and kangaroo paws; Churchill and Christensen's (1970) study of Purple-crowned Lorikeets and karri). In this respect the native animals may behave in a similar fashion to honeybees.

It is important to note that not all native nectarivorous animal species are generalists able to feed on many plants in a community. Specialized feeding at least to genera of plants has been documented for Purple-crowned Lorikeets, which have only been seen taking nectar and pollen from eucalypts in Western Australia (Hopper and Burbidge 1986), and for species in the bee genera *Euryglossa* and *Hylaeus* which are known to feed only on *Calothamnus* and *Eremophila* respectively (Houston 1983). Further study is needed in this area, particularly of nectarivorous insects.

There is scant experimental evidence that animals feeding on nectar are actually effective pollinators of Western Australian plants (Hopper and Burbidge 1986). This is another area in need of much more research. It is clear, however, that where a broad spectrum of animals feed on flowers, some are usually more important as pollinators than others (e.g. Hopper 1980a; Hopper and Burbidge 1982). Moreover, in the case of certain orchids, highly specialized species-specific pollinator relationships have been documented (Stoutamire 1974, 1975, 1983). This situation is best developed among the hammer orchids, flying duck orchids, elbow orchids and some spider orchids, all of which are confined to the south-west and wheatbelt regions of Western Australia between Shark Bay and Israelite Bay (Hoffman and Brown 1984).

Food plant preferences and pollination by honeybees in W.A.

The native food plants of honeybees in Western Australia are well known to beekeepers and some have been listed by Smith (1969). Scientific literature on the subject is meagre, however, with the welcome exception of northern heathland data reported by Bell (this volume). There are also a few recent pollination studies that mention honeybees among the insects observed at flowers (e.g. Hopper 1978; Lamont 1985). A systematic and rigorously documented survey on this subject is needed for Western Australia.

Present data show that a diverse array of wildflowers are visited by honeybees, including most genera and species of plants known to be important as food for native nectarivores (e.g. eucalypts, banksias, grevilleas, dryandras, hakeas, kangaroo paws). An important competitive advantage honeybees have over native bees and wasps is their ability to forage at lower temperatures (Bond and Brown 1979; Paton 1979). They are often seen at flowers earlier in the morning and thus are able to harvest overnight nectar and pollen production before native insects are flying.

The role of honeybees as pollinators of native plants is very poorly documented. As with native animals, exclusion experiments are needed. Loneragan (1979) established that honeybees improved seed set in a population of karri. The same might be expected of other open-flowered species where honeybees would regularly contact anthers and stigmas (e.g. small flowered eucalypts, species of *Urocarpus* etc.). On the other hand, honeybees are more likely to be nectar and pollen thieves on larger bird-pollinated flowers where nectaries and stigmas are well separated (e.g. the large soft flowered peas *Templetonia retusa* and *Daviesia epiphylla* (Bell, this volume), from which honeybees take nectar through holes chewed through the base of the petals).

Recent studies by R. Peakall (pers. comm.) show that honeybees remove pollen but fail to pollinate flowers of nectar-producing leek orchids (*Prasophyllum* spp.). In this case the honeybees are the wrong size and shape to fit the intricate flower structure in a way that ensures that pollinia are placed on the stigma.

Is nectar a limiting food supply?

Given that honeybees and native animals in Western Australia feed on the same plants, a question central to the issue addressed by this workshop concerns whether nectar supply is a limiting factor controlling population sizes of the native fauna. If so, honeybees would be competing for a limited resource and would reduce the numbers of native nectarivores.

Some studies on honeyeaters show that population size indeed may be closely correlated with nectar supply. For example, Paton (1979) at Cranbourne, Vic., observed that the number of territorial honeyeaters declined from 10 to 4 over two months as the number of *Banksia* inflorescences at his study site declined from 410 to 103. Similar adjustments in territory size were reported by Ford (1981) for Red Wattlebirds feeding on *Eucalyptus cosmophylla* on Kangaroo Island. Pyke and Recher (1986) also documented a correlation between the number of resident breeding honeyeaters and nectar supply in heathlands north of Sydney.

The mechanisms involved in such population changes have been investigated in a series of elegant experiments by Rooke (1980). He controlled nectar supply by experimentally introducing and removing artificial nectar feeders in a wild population of New Holland Honeyeaters, and also in a more controlled situation with caged birds. Significant increases in aggressive behaviour occurred whenever nectar supply was reduced.

The experimental introduction of hive bees was used by Paton (1979) in Victoria to document their impact on nectar supply and honeyeater behaviour. Significant depletion of the nectar produced by *Grevillea aquifolium*, *Callistemon macropunctatus* and *Amyema pendulum* occurred when the bees were introduced. Honeyeaters responded by spending less time feeding on these major food plants, by searching for alternative food sources, and by increasing their territory sizes.

Paton caged flowers of the *Callistemon* so as to exclude birds but allow access to nectar for honeybees, and documented a significant reduction in seed set on the caged flowers. This is the first experimental study in Australia known to me which shows that honeybees have a detrimental effect on plant reproduction through their competitive effect on native pollinators. Much more work in this field is needed.

The experimental introduction of hives was also used by Pyke and Balzer (1982) in Kosciusko National Park to test for competition with native bees. They recorded significant declines in the average densities of native bees over distances of 50 m, 200 m, and 400 m but not 1 000 m from the experimental hives in two separate tests.

Thus, the handful of scientific experiments conducted to date in Australia all point to a detrimental impact on numbers of native nectar feeders when hive bees are introduced into wild communities. There is a clear need for this line of research to be pursued in areas of mutual interest to land managers and beekeepers in Western Australia.

Is extinction possible?

Professor Thorpe (this volume) makes the point that even where it is shown that populations of native nectarivores decline on the introduction of hive bees, it remains an open question as to whether extinction of these populations is likely. There are no recorded cases of such extinctions, but this could be due either to a lack of relevant research or reflect the real situation. This is a key area deserving research in Western Australia.

Possibly the highest risk organisms warranting study are those whose breeding range is narrowly circumscribed. For example, some species of nectar-feeding thynnid wasps are known to have breeding areas confined to a few hectares (Ridsdill-Smith 1970). The females are flightless, living underground and parasitizing beetle larvae. When ready to mate, they emerge from the soil, ascend vegetation a little way and emit an odour that attracts the winged males. Mating occurs in flight and while feeding on nectar, after which the female is uncoupled and mates again or returns underground.

These wasps are the highly specific pollinators of Western Australian orchids mentioned previously. Experiments using orchid flowers as bait show that populations of male wasps are usually confined to small areas of a few hectares (Stoutamire 1974, 1975, Hopper and Brown unpubl.). Moving bait flowers as little as 10 m can often make the difference between attracting wasps or not.

If narrow mating grounds are the common situation for these wasps, the impact of hive bees may well profoundly affect the ability of the wasps to secure sufficient nectar to sustain the population. This hypothesis warrants careful experimental examination, not only because of possible impacts on the wasp populations, but because many of the orchid species they pollinate are rare.

Recent studies of seed set in hammer orchids (*Drakaea* sp.) show that some populations are pollinated rarely or not at all (A.P. Brown, pers. comm.). Some wasp populations, by inference, may have gone extinct in south-western Western Australia. The role (if any) of the honeybee in this process warrants urgent investigation, particularly on national parks and nature reserves where beekeeping is currently permitted.

Beekeeping and the spread of dieback

An impact of beekeeping in national parks, particularly along the south coast of Western Australia, is the risk of spreading dieback disease (*Phytophthora cinnamomi*). Without appropriate hygiene, regular vehicle movements over diseased ground may lead to the transfer of the fungus to uninfected sites. Death of susceptible species such as species of Proteaceae and Epacridaceae usually follows, many of which are of central importance both to the maintenance of hive bees and to the native nectarivores. The susceptibility to dieback of several of the dominant plants in south coast heathlands, such as banksias (McCredie *et al.* 1985), looms as a major management problem. Local extinction of these dominants will have many repercussions, including significant reductions in the number of nectarivores that are dependent on them for food (e.g. Honey Possums and several species of honeyeaters - Hopper 1980b; Wooller *et al.* 1984).

Conclusions

On present evidence, it would be premature to draw definite conclusions about the impact of honeybees on Western Australia's nectarivorous fauna. Not enough research has been completed. However, a start has been made, and sufficient experimental results exist to suggest that there may be a conflict of interests in permitting beekeeping in parks and reserves set aside for conservation. Hive bees feed on the same plants that are important to native nectarivores, nectar is a limiting resource to animal populations in some circumstances, and the introduction of hives therefore may deplete numbers of native nectarivores.

Animals with limited breeding ranges such as some thynnid wasps are the most likely candidates for local extinction due to competition for food with honeybees. They should be investigated from this point of view as a matter of priority, particularly as some of the orchids dependent on them for pollination are rare and endangered.

While these doubts linger, it is in the interests of both the beekeeping industry and land managers to have the relevant research undertaken as soon as possible. I am confident that significant progress could be made on resolving the issues raised at this workshop with the establishment of as little as a two person research team and sufficient logistic support for a carefully designed five year experimental programme.

Acknowledgements

I am grateful to participants at the Workshop on Beekeeping for their lively discussion of this paper, and to numerous colleagues in the Australasian Pollination Ecologists Society who have debated and researched many of the issues raised above. The responsibility for the ideas presented, however, is mine alone.

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ENVIRONMENTAL PROTECTION AND BEEKEEPING - FIRE REGIMES, DIEBACK AND ACCESS

ABSTRACT

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Administration of the industry and allocation of sites is the responsibility of the Department of Conservation and Land Management (CALM). CALM will develop a policy for beekeeping, integrating the policies of the amalgamated Departments.

Land is vested in the Lands and Forests Commission (State forests and timber reserves) and the National Parks and Nature Conservation Authority (national parks and nature reserves).

Fire policy for State forests will be similar to the previous policy. Some changes to timing/intensity are expected, for example in the Lane Poole Reserve.

Policies for parks and reserves will be similar to previous policies. Some increase in prescribed burning is anticipated. Firebreak construction and maintenance will continue. Initial attack will rely mainly on the volunteer brigades. CALM will provide planning and research expertise and officer/staff backup at Large Fire Organisations.

Notification to beekeepers of prescribed burning programmes will continue.

Dieback. Major changes are not anticipated. Areas of Disease Risk may be considered for parts of the south coast and northern heathland. No new sites will be available in DRA's, but transfers may be approved. Entry by permit will continue.

The Apiary Sites Allocation Committee will be retained.

THE EFFECTS OF THE MANAGEMENT OF PUBLIC LAND ON BEEKEEPERS

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The management of public land in WA is a large, complex operation, involving many Government departments. The Department of Conservation and Land Management (CALM) is the principle Government agency in the role of public land management.

Beekeeping is just one industry that has to be considered in the overall management structure.

I will briefly outline some of the management practices which affect beekeeping or beekeepers. Beekeepers have apiary sites on many different types of public land. These include State forests, vacant Crown land, nature reserves, beekeepers reserves, and national parks. The management for each type of public land is different, according to the principle use of each land area.

A great deal of public land is managed well under specific management plans, particularly in the case of State forests. Mining, logging, and clear-felling are activities whose effects lead to the loss of nectar resources for a long period or even permanently. The management for dieback quarantine restricts the movement of beekeepers within the quarantine areas. Dieback quarantine has resulted in the closure of much of the State forest to beekeeping. Another management practice affecting beekeeping is the closure of many minor tracks throughout the forests. Many of these minor tracks have serviced apiary sites in the past and their closure creates greater difficulty of

access for beekeepers. The management for recreation and tourism affects beekeepers because apiary sites have to be placed where they will not cause any concern to the public.

The next area of land management I wish to discuss in more detail than the above, is the controlled burning of forest areas. Apiarists recognise that the fuel reduction of litter build-up within the forest areas is necessary, and do not wish to suggest that this practice should stop. The practice of fuel reduction provides safety from forest fires for so many; for the apiarist, it protects himself, his hives, and equipment, from being burnt.

However, controlled burning does affect the apiarist in a number of ways, often in quite a minor fashion, but occasionally more severely. Burns carried out during the period of bud set on the eucalypts can cause the trees to shed the new buds, leading to the loss of a later honey flow in the area. Cool burns have little or no effect on the budding of the eucalypts. Hot burns, which scorch the tops of the trees, causes complete bud drop.

From an apiarist's point of view, burns carried out after the trees have finished flowering, would be the ideal situation to aim for. This we believe, would not affect the tree's natural flowering cycle and would create an ash bed for the seed set which has occurred. Apiarists believe that greater consideration should be given to this aspect of burning times, especially in the cases of wandoo and karri forests.

The four main eucalypts worked by apiarists in the forest are jarrah, marri, wandoo and karri. Marri has a short budding period of only 2 months, during December-January, and hence, autumn or spring burns have little effect.

Jarrah has a 12 month budding period and usually buds every second year. Burning could be done in the autumn or spring, after flowering. Wandoo and karri have a budding period of 2 years but

usually set buds at intervals, four to five years apart. It should be possible to programme most burning away from the period of bud set.

The depletion of many species of understorey plants caused by the frequency of control burning is also of some concern to apiarists. Bees often get nectar and pollen from the many understorey species that grow in forest areas.

We would suggest that some consideration be given to occasionally extending the period between burns to allow the understorey to re-establish.

The last area of public land management and its effects on beekeeping, which I wish to discuss, would be better described as 'lack of' public land management in regard to wildfire.

Wildfire can affect the apiarist in a number of ways. For example, destruction of hives and equipment, time and expense involved in firefighting, etc., but the greatest affect is the loss in the short-term, long-term, and often permanently, of nectar producing flora.

The uncontrolled burning of large areas of the west coastal plain is of particular concern to beekeepers.

Lightning strikes would be the most common cause of fires on the coastal plain. However, fires from lightning strikes do not usually develop into large severe fires, because of two factors.

Firstly, lightning strikes occur during thunderstorms which often are associated with some rain. Secondly, thunderstorms are usually combined with heat troughs which generally are followed by a cool change in weather conditions. Often damp dewy nights which come with the cool change are sufficient to put the fires out.

Fires which start from a man-made cause are the greatest concern to the apiarist. The causes of unnatural fires are many and vary widely. Deliberately lit fires occur regularly; a situation often brought on because various people feel threatened by large areas of dense vegetation. Some other common causes are accidental fires from machines or cigarette butts, camp fires, or cooking fires, fires escaping from clearing burns or burning rubbish tips. Whatever the initial cause of a fire, the end result is the unnecessary destruction of natural vegetation. Man-caused fires, when started during hot dry weather conditions, very quickly get out of control and become large destructive wildfires which are extremely difficult to control. The best known example of this is the west coastal wildfire from 16-21 January 1984, which burnt 117 000 ha or 1 170 km^2.

It has been established that this wildfire started adjacent to a number of 'squatter' shacks near North Head, either from a barbeque or camp fire. The day temperature at the time was in excess of 40°C.

The opening up of the coastal plain for agriculture, and many other activities such as tourism and recreation, has mainly occurred over the past 30-40 years. As human activity has increased, so have the number of fires occurring along the coast.

The situation now for apiarists is that most of the best country (limestone) is burnt and has been burnt fairly regularly in the past 20 years.

The loss to the apiarist of honey, wax and pollen production for a period of five to six years following a burn is substantial. On average, one third of an apiarist's annual production comes from the coastal areas. In some cases, apiarists can relocate to other unburnt areas but as more areas become burnt in the regeneration period this option becomes more difficult to achieve.

The five to six years of production loss occurs because the main honey producing plants, *Dryandra sessilis* and *Hakea trifurcata*, regenerate from seed. It takes 2 years before *Dryandra sessilis* shows its first one or two flowers per plant. It is 3 to 5 years old before it starts yielding sufficient quantities of nectar and pollen to support commercial apiaries. At about 8 years old, the species mentioned and many others, would be in full production.

With fires becoming more and more frequent many apiarists are now becoming very concerned about the long-term damage that is occurring to the coastal vegetation. Many of the species after fire have to regenerate from seed and, as mentioned earlier, take some years before flowering. It is believed that the period before any quantity of viable seed set is even longer. In the case of *Dryandra sessilis*, for example, it is about eight years. In the many situations where fires burn country at short intervals, the sought-after honey producing species and indeed, many other species, are being reduced or even completely lost. The changing ecology in many areas of vegetation towards fire tolerant species must be of great concern to us all.

Before any effective fire management plan can be developed along the west coast, for fire control, the attitude of so many will have to change. The impression one gets so often is that the country is just scrub of no particular use or importance to anyone and should be burnt as often as possible so it is of no danger to anyone. The other impression one gets so often is that each interested group is only concerned with their own interest or area and do not recognise that they must be part of an integrated system of fire management.

Some people suggest that because beekeepers use the country, it is our responsibility to protect it. Others suggest beekeepers should not be there anyway. If we all stop and think, there are a lot of reasons why an effective, properly financed, fire management plan is required.

Some of these reasons are:

(i) The protection of the natural environment for future generations.

(ii) The protection of the many species of plants which are not fire tolerant.

(iii) The protection of fauna.

(iv) The loss to the tourist industry through wildflower tours and recreation.

(v) The loss to the beekeeping industry.

(vi) The loss to the cut flower and seed industry.

(vii) The risk of damage to surrounding farmland.

(viii) The risk to coastal towns.

(ix) The danger to human life.

(x) The cost of fighting large wildfires.

To conclude, I would like to say that hopefully, beekeepers will have a greater input into the formulation of management plans for public land in the future. This would help to overcome some of the adverse effects the management of public land has had on beekeeping in the past.

AN ENDANGERED FUTURE FOR FLORAL RESOURCES FOR BEEKEEPING IN WESTERN AUSTRALIA

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The future of beekeeping on large areas of public land in Western Australia is being questioned as changes to their classification and management are proposed. I wish to discuss a number of specific examples and their significance to the beekeeping industry. The main ones are summarized in the Table below.

1. The Closure of Nature Reserves by the Western Australian Wildlife Authority (WAWA) in 1983

In 1983, WAWA advised its intention to withdraw 11 reserves, totalling 18 000 ha in area, from use by beekeepers. These reserves are mainly *Hakea* and *Dryandra* heathlands on the coastal plain, and are very valuable as sites for wintering, spring build-up and breeding of queens. Twenty four apiary sites were involved, most considered valuable. To compensate for this loss, WAWA nominated 26 other reserves, previously closed to beekeepers, which could be made available for apiary site selection by commercial beekeepers.

PUBLIC LANDS WHERE THE FUTURE FOR BEEKEEPING IS BEING QUESTIONED

Name	Current Status	Proposed Status	Apiary Site #	Area
11 WAWA Reserves (closure proposed 1983)	Unknown (? Conservation of flora & fauna)	Unchanged	24	18 000 ha (approx.)
Shannon Basin	State Forest	National Park	36	61 000 ha
Lane-Poole Reserve	State Forest	National Park	20	65 000 ha
"Wandoo Reserve"	State Forests, MPAs, and vacant Crown land	National Park	(>100)	323 830 ha
Area north of Fitzgerald River National Park	Vacant Crown land	? to be added to the National Park	?(30)	About 40 000 ha
Ludlow	State Forest	National Park	?	About 2 000 ha
Hyden, Ravensthorpe, Balladonia area	Vacant Crown land		?	About 3 000 000 ha

In response to a PIA request, an evaluation survey was undertaken by Mr R.C. Burking of the Apiculture Section, Department of Agriculture. His very comprehensive report revealed that 14 of these reserves were totally unsuited to beekeeping. Whilst the remaining 12

were found to have some potential for beekeeping, they did not provide similar vegetation and flowering periods to the reserves nominated for closure.

In mid-1984, a deputation to the Minister for Fisheries and Wildlife secured an undertaking that the 1983 proposals would not be put into effect until such time as the Beekeeper's Reserve and Crown Land devastated by the disastrous wildfire of January 1983 was deemed to have recovered.

2. Shannon/D'Entrecasteaux National Park Proposal

The Shannon basin, currently State forest, covers 61 000 ha of prime karri forest, has 36 current apiary sites within it, and is an extremely important honey source.

Moves for the establishment of a national park in this area date back to 1972. The Shannon River basin became the focal point of the voluntary conservation movement in the mid-1970s, and their battles to secure its exclusion from wood-chipping spawned numerous very active organisations.

When a Labor Government was elected to office in February 1983 the Premier announced that logging in the Shannon Basin would cease and in June 1983 instructed the Forests Department to manage the area as though it were a national park. About 25% of the karri forest in the basin has been logged.

A strategy for the management of the proposed national park was published in 1984 and a call was made for public submissions. These closed in early 1985 and are currently being considered by the Shannon/D'Entrecasteaux Planning Group. It appears very likely that most of the roads in the Shannon Basin will be closed and that even if beekeepers are not specifically excluded, most sites will no longer be accesible.

3. Lane-Poole Reserve

This is an area of 65 000 ha of largely jarrah forest, in the Murray River catchment. It produces honey most years, with the main flow every second year, and supports over 20 apiary sites. Originally State forest, its purpose has recently been changed to conservation and recreation.

A draft management plan has recently been published and gone through public review. The plan recommends the relocation of several sites and the cancellation of six within the Reserve.

4. "Wandoo Reserves"

A total of about 324 000 ha of mainly wandoo forest to the east of the Darling Scarp is the subject of a proposal by the Campaign to Save Native Forests. Four separate areas are involved:

(i) Julimar Management Priority Area (MPA) plus the adjacent Army Training area near Bindoon (48 200 ha);
(ii) Dryandra MPA (25 000 ha);
(iii) Perup MPA (39 000 ha);
(iv) a "Wandoo Reserve" which takes in all of the Dale forest and adjacent areas of Crown land and smaller reserves (111 630 ha).

The wandoo forests of these four areas produce premium honey and are the last remaining large areas of *Eucalyptus wandoo*. The Dale State Forest has produced four honey crops in the last seven years, and is considered to be of prime value to the honey industry. The CSNF claim that honey production is "not appropriate to an Ecological Reserve".

5. Area North of Fitzgerald River National Park

This is a large area of mallee and heathland, supporting about 20 apiary sites. The area is used only intermittently by the industry but assumes major importance in drought years when the emphasis is on survival of colonies rather than honey production.

Despite our long-standing claim for a beekeeper's reserve to be established on Crown land to the north of the Fitzgerald River National Park, it appears that this land will in fact be added to the national park. Beekeepers are prohibited access to this park, so once again it appears that sites we did have on that Crown land will be lost.

6. Ludlow State Forest

This is the only remaining stand of pure tuart forest, and yields honey crops at 4 to 5 year intervals. It is currently managed as a management priority area for conservation, although some conservation lobby groups have proposed its establishment as a national park. It does support a small number of registered apiary sites, and is also worked from apiaries located on adjacent private land. It is considered a valuable honey resource.

7. Hyden, Ravensthorpe, Balladonia area

This huge area is principally mallee country, and is used by the industry in those years where there is a dearth of nectar production during the summer months. This happens periodically due to the staggered flowering of eucalypt species in the south west region, as occurred in 1985.

The Campaign to save Native Forests have proposed the establishment of a major conservation reserve in this area. As mentioned previously, CSNF does not consider honey production to be compatible with management of nature reserves.

Other areas of concern exist. These include the loss of apiary sites by the alienation of part of the Beekeepers Reserve on the northern sandplains, and its inclusion in the Mount Lesueur Nature Reserve, which is destined to be closed to beekeepers as explained in (1) above,

Even the vesting of the Beekeepers Reserve is not yet decided, and satisfactory management is unlikely until a body such as the National Parks and Nature Conservation Authority takes full responsibility for it.

Various other new issues are emerging which threaten to remove floral resources for the beekeeping industry. These include:- the open-cut gold mining proposal for Boddington (largest gold mine in the world!); flooding of the catchment areas for three Western Australian Water Authority dams on the Upper Canning River, Harris River and Dandalup River; large scale water extraction from the Gnangara mound (with consequent lowering of the water table and honey production loss/banksia deaths in the banksia woodlands); clearing of banksia woodland for pine plantings in the area south of Moore River, and the 'Honey MPA' north of Moore River; spread of exotic dieback diseases to the heathland and sandplain species; selective clearing of bull banksia from jarrah forests as a management technique ('hygiene/preventative' measure) against the spread of jarrah dieback disease; logging of previously conserved stream and road reserves in State forests to compensate for timber production losses resulting from the conserving of the Shannon Basin and Lane-Poole Reserve forest resources; and the establishment of another wood-chipping plant at McLeans Sawmill in Denmark which will result in the clearing of substantial amounts of remnant timber stands from private land holdings in the area from Boddington to Albany.

Conclusions

The voluntary conservation movement has been fighting a tremendous battle in recent years and I am sure most beekeepers have great admiration for their courage, tenacity and ideals. Their aims have in fact been the same as those of the beekeeping industry. However, their successes look like adding to the litany of losses to our industry.

Whilst some "hard-line" conservationists are undoubtedly quite deliberate in their proposals to exclude beekeepers from the forest reserves, I believe the majority would support us if they knew the cumulative effect of all these proposals on our industry.

The ball is really in our court now if we are to resist these pressures to exclude us from traditional floral resources.

SUMMARY OF KEY ISSUES AND DISCUSSION

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From the presented papers and the open discussion at the workshop, seven major areas, often overlapping, were identified as sources of concern to the beekeeping industry, or as areas where positive steps could be taken. This brief resumé does not attempt to summarise all discussion which took place, but merely to pinpoint the main features of the present situation, particularly in relation to necessary or desirable changes.

1. Resources

* The decline in honey flora available to the industry is basically due to a large expansion since World War II of clearing for agriculture over much of the south-west and wheatbelt.

* Superimposed upon the diminishing resource of floriferous native vegetation is the increasing proportion of uncleared land managed for conservation of native flora and fauna. In some cases such management may impose constraints upon beekeeping. These constraints may be in relation to public safety or comfort, the prevention of the spread of disease, especially dieback (*Phytophthora cinnamomi*), minimisation of tracks and other land disturbance, or to concerns about the possibly adverse effects of honeybees upon native fauna and flora.

* Opportunities should be actively sought to provide new resources and to use the existing resource more efficiently. New areas of honey flora could be provided by deliberate planting on farms, either as commercial crops or as timber lots, and by the use of suitable species in rehabilitation of mine sites or areas damaged by salination and waterlogging.

* The more effective use of existing resources requires closer cooperation between beekeepers themselves and between beekeepers and land managers, and should include a review of acceptable distances between apiary sites.

2. Economics

* Many issues affecting the industry are basically economic and not open to treatment by land managers. These issues include fluctuations of prices on world markets, increasing costs of transport, increasing numbers of beekeepers at a time of declining resources, and competition with professional full-time beekeepers by part-timers who have other sources of income.

* Solutions to these problems may require structural change within the industry, and depend in large part upon the industry acting cohesivally on its own behalf.

3. Policy

* Three separate agencies and authorities which had responsibilities for management of different classes of land are now amalgamated within the Department of Conservation and Land Management (CALM). At present policies on State forest, national parks and nature reserves are still those determined by the separate agencies before amalgamation. A single policy on beekeeping for CALM lands will be developed in the near future.

* All members of the beekeeping industry should be given ample opportunity to contribute to, and comment on, the new policy.

4. Management

* On land managed by CALM, beekeepers wish to have the opportunity to make input to decisions affecting their operations. These include: overall fire protection; the timing and periodicity of prescribed burning; the degree, timing and conditions of access to various categories of land managed for nature conservation; and the closure of tracks, especially in relation to dieback protection.

* Input to management issues can be via the management planning process, either by consultation during early preparation of the plan, or by submissions as a part of the usual public review of draft plans.

* Attention should be given to the vesting of reserves and management priority areas for beekeeping. Management plans would then be developed for such areas with beekeeping as the primary purpose, and management would be aimed at maximising resources for the industry.

5. Conservation

* On areas managed for conservation of flora and fauna, tracks and clearing of apiary sites have some impact on nature conservation values. The smaller the reserve the greater becomes the proportion affected.

* There is considerable debate about the significance of the effects of honeybees themselves upon native plants and native pollinators. There is some evidence for competition with native species, and for "robbing" of nectar and pollen from some plants, but the significance of this in terms of populations of native species is not clear.

* Populations of feral bees may have more impact on natural ecosystems than commercial operations. Control of feral populations may be an aspect of management which beekeepers can contribute towards.

* Managers of conservation areas are responsible for the maintenance of species and genetic diversity. Thus, some conservatism in management practices is sensible until the ecological significance of commercial honeybees is clarified.

6. Research

* Quantification of the effects of prescribed burning upon beekeeping resources is required. If adverse effects are confirmed, then the possibility of reducing the severity of such effects by different patterns or timing of fires should be investigated.

* As mentioned in point 5 above, more information is needed about the actual effects on native species of flora and fauna of large concentrations of honeybees.

* It is in the interests of beekeepers to encourage research of this kind, both within CALM and other research institutions.

7. Consultation

* Better communication between Government Departments is required to coordinate such things as fire protection, access and other management steps.

* A formal link, such as a consultative committee, between beekeepers and CALM, should be established to enable the regular exchange of information on specific issues.

* Beekeepers need to ensure that they make coordinated and efficient inputs via existing mechanisms, such as the public review stage of management plans.

AFTERWORD: FUTURE DIRECTIONS

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These proceedings illustrate the wide range of views and the complex nature of the issues involved in the management of public lands.

Beekeepers are faced with a variety of problems. The most basic of these is the competition between increasing numbers of apiarists for a rapidly shrinking resource. This is compounded by the very nature of the industry. It is heavily dependent upon an unreliable export market, and has much internal competition between a small number of full-time professionals and a much larger number of part-time professionals and hobbyists.

Further, beekeepers traditionally have been individualists, going about their business independently and in their own way. In the early days this individuality served them well. However, the use of natural resources is now much more complex - there is a wide range of interests competing on publically owned lands for more and more limited resources - for conservation, recreation, timber, minerals, honey and so on.

Discussion, negotiation and compromise are essential parts of the decision making process for all land managers. In this context, a loosely knit group of independent individuals is at a considerable disadvantage. They are often competing with well organised groups who have their own internal position established before entering negotiations with other interest groups and managers.

The difficulties experienced by full-time professional beekeepers due to unreliable markets and competition with part-timers with other sources of income are outside the scope of land managers like CALM. There appears however, to be the need and potential for an industry-wide appraisal of its structure and of the best approach to marketing its products. The recently completed "Inquiry into the Marketing of Honeybee Products in Western Australia" may provide a reasonable basis for such reappraisal. The industry should be able to speak with a united voice in its negotiations with Government, land managers and competing interests.

However, the Government is well aware of the legitimate claims of the beekeeping industry, and of its problems, which must be taken into account in managing public lands.

Responsible land management agencies have two basic requirements. First, sound scientific information about the land and its resources, on which to base management practices. Secondly, regular liaison with, and input from, members of the public and interest groups using these resources.

Thus, there is much the industry can do. First, these proceedings identify a number of issues affecting beekeepers which require further research. The industry could help to encourage research on matters such as interactions between honeybees and native plants and animals, and the timing and pattern of burning most suitable to beekeeping. Such research would assist land managers in determining solutions to the question of how best to facilitate beekeeping as a part of overall management.

Secondly, beekeepers need to ensure that the point of view of their industry is presented in an organised way, via existing processes such as public review of management plans and Government policy, and environmental assessment procedures.

Finally, regular liaison with land managers needs to be established. To this end CALM has, in collaboration with the Beekeepers Section of the Primary Industry Association, established a Beekeepers Consultative Committee, meeting several times a year, to ensure a two way exchange of views and information. This Committee should ensure that the process of discussion and cooperation started by the Beekeepers Workshop can continue and improve.

WORKSHOP ON BEEKEEPING AND LAND MANAGEMENT

List of Participants

1. From Department of C.A.L.M.

Dr. S. Shea	- Executive Director, Crawley.
Dr. I. Abbott	- Entomologist, Como.
Mr. F. Batini	- Environment Protection, Como.
Mr. J. Blyth	- Nature Conservation, Crawley.
Mr. D. Grace	- Fire Management, Como.
Mr. J. Havel	- Director, Planning & Research, Crawley
Mr. C. Haynes	- Director, National Parks, Crawley.
Dr. S. Hopper	- Wildlife Research, Woodvale.
Ms. S. Moore	- Planning, Canning Bridge.
Mr. B. Muir	- Planning, Canning Bridge.
Mr. R. Underwood	- General Manager, Operations, Como.
Mr. P. Hewett	- Director, Forests, Crawley.

2. From National Parks and Nature Conservation Authority.

Mr. R. Pollard	- Beekeeper's representative.

3. From Beekeeper's Organization.

Mr. I. Baile	- President
Mr. S. Cook	
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Mr. P. Detchon	
Ms. F. Malone	- P.I.A.

4. From Department of Agriculture.

Mr. R. Burking
Mr. A. Kessell
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5. From academic institutions.

Dr. D. Bell	- University of Western Australia.
Prof. R. Thorpe	- University of California.
Mr R. Peakall	- University of Western Australia.
Mr R. Wills	- University of Western Australia.