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WORLD BEE HEALTH REPORT

by
ANDREW MATHESON

THE SWARM.

"I believe it is an equally mis-
ants are enemies to bees; for a sm
insects once planted themselves
the shutter of my glass hive.
oved the shu

as busy preparing a hive
ew colony, when
and green damself, q
governess, and
FRIENDS OF BEES.

bird, called the bee-eater, the sparrow,
, and the titmouse, are all enemies to
The titmouse makes a noise at the
hive, and when a bee comes out to see
matter, seizes, and eats it up. He
a dozen at a time.

And first, in the moneth of January
blood out of any veine, vnlesse a
fly constraineth thereto, that yo
therwise chuse. But if you bla
beware of taking any cold in thi
nigh as you can, and walke n
the night time: and vse to cate then the best co
often white wine in this moneth,
And to fast long in this n
lets well prepar

EUROPEAN AND HABITAT CHA
POLLINATION

Bees
Honey bees in New Zealand are fre
because of the country's isolation a
dominantly Italian type, with varyi
The first recorded introduction
1839, when a missionary's si
skep hives containing col
Bumby has recently been res
stands near the former missi
1991 Miss Bumby's portrait was put on display in the house,
between the settlement and the beginning of New Zealand's
were introduced to the South Island from Australia in 184

121

Honey production (millions of kg)

1.0
0.8
0.6
0.4
0.2
0.0

ORIGINAL ARTICLE

TABLE

Year

196
19
19

pests and dis-
der quarantine meas-
darker (mainly European)
y bee, *Apis mellifera*, to New Zea-
umby, arrived at Mangungu in Northland
The mission house used by
The historic Places Tr-
by the New Zealand Historic Places Tr-
european bees. The mission house used by
bees" on the shores of the Hokianga
display in the house, to
the beginning of New Zealand's
from Australia in 184
More Italian
Swiss Alpine
bees has
time of

WORLD BEE HEALTH REPORT

ANDREW MATHESON

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Introduction

Purpose of review

This review is intended to serve as an accessible and reliable reference to the honey bee health status of almost every country in the world. From this readers can infer something about the world distribution of the parasites, pests and diseases surveyed, which is useful both when attempting to obtain supplies of healthy honey bees and when studying beekeeping in different areas. This review may also be useful for readers wanting to know more about bee health in their own countries, especially when published references are not readily available.

Apart from highlighting the obvious (but often ignored) dangers of injudicious international movement of bees, I hope that this review will stimulate discussion on the concepts of bee health status and reliability of reporting, as well as encouraging further reporting of pest and disease records to IBRA.

Previous reviews

IBRA has published in *Bee World* several reports on the distribution of honey bee parasites and diseases. The first world maps appeared in 1981 for *Varroa jacobsoni*¹¹⁰, followed by maps for eight other species in 1982¹⁸⁰ which were updated and extended to ten species in 1983¹⁸¹ and further updated in 1988⁴⁴.

Reports on individual diseases such as chalkbrood (*Ascosphaera apis*)¹¹⁶ and the parasitic tracheal mite (*Acarapis woodi*)²⁷, and earlier news of varroa distribution^{68, 69, 70}, have also contributed to this accumulation of information.

New reports of disease and parasite incidence continue to be made as a consequence of ongoing movement of bees and, more importantly, additional investigations on the health status of honey bees in different parts of the world. A new analysis of the available information is warranted, and in doing this I have taken the opportunity to examine afresh the criteria used for both reporting and recording.

Methodology

Species included in this review

In general only records from *Apis mellifera* and *A. cerana* are covered in this survey, as little management of other species takes place and knowledge of their pathology is limited. (Any exceptions are identified in the tables). For the sake of continuity

TABLE 1. Diseases, parasites and pests included in this review.

Common name	Causative organism
Brood diseases	
American foulbrood (AFB)	<i>Bacillus larvae</i>
European foulbrood (EFB)	<i>Melissococcus pluton</i>
Sacbrood	Sacbrood virus (Thai sacbrood virus in <i>Apis cerana</i>)
Chalkbrood	<i>Ascosphaera</i> spp.
Adult diseases	
Nosema disease	<i>Nosema apis</i>
Amoeba disease	<i>Malpighamoeba mellificae</i>
Parasitic mites	
Tracheal mite	<i>Acarapis woodi</i>
Varroa	<i>Varroa jacobsoni</i>
Tropilaelaps	<i>Tropilaelaps clareae</i>
Other	
Braula (bee louse)	<i>Braula</i> spp.
–	Kashmir bee virus

the same ten diseases and parasites covered in previous reviews are considered (see table 1), even though objections can be made against the inclusion of some.

For instance braula (*Braula* spp.) is not a parasite and is regarded by many as having almost no economic significance. However, it is still an issue for some certifying authorities, and earlier reviews and maps of its distribution contained a significant number of inaccuracies.

Most diagnoses of sacbrood are made on gross symptoms only, and a survey involving laboratory analysis will often produce startling evidence of the almost ubiquitous nature of sacbrood virus. The disease is still significant for beekeepers, at least in part because it can confuse field diagnosis of more serious brood diseases.

As with sacbrood virus, *Nosema apis* may well be universal: found wherever honey bees exist naturally or have been taken. However, while information on nosema is still patchy, it seems prudent to record what data are available.

Because of recent debate on the importance of Kashmir bee virus^{25, 153}, records on the occurrence of KBV have also been included.

Conditions of reporting

Descriptions of bee health status This report employs more stringent criteria for recording the status of a parasite or disease than those used in previous reviews, and I have endeavoured to not present less reliable information as being authoritative. It is necessary to be toughest on negative reports, which claim that an area is free of a particular species. Statements such as: 'None of the known bee diseases

TABLE 2. Descriptions of the status of parasites and diseases used in this report.

Description of status	Symbol used in tables 3–7	Criteria employed
Present	+	Reported in a peer-reviewed article, or an authoritative review or investigation; report by an apparently reliable witness of a disease with recognizable field symptoms.
Suspected present	+?	Anecdotal or hearsay report; field diagnosis of condition without obvious symptoms.
Suspected absent	–?	Limited investigation made with negative results; anecdotal reports about absence of disease with field symptoms.
Absent	–	Rigorous survey carried out, laboratory analyses made where appropriate.
No information		No information available; anecdotal reports of the absence of asymptomatic condition.

have been observed or reported' in a certain country, do not justify that country being recorded as free of all ten species under discussion, especially where most beekeeping is practised using fixed-comb hives. At best these reports are used to suggest that only the four brood diseases under review may be absent.

Many of the references used in this report are less than perfect: to restrict information to only that based on reliable surveys would mean discarding much that is still of value. Five status levels have, therefore, been used in this paper, and are given in table 2.

Bee health status is given on a country level. No information is given on the distribution of parasites or diseases within a country, unless relevant information exists for non-contiguous parts of it (e.g. Alaska, USA; Northern Ireland, UK), and especially where some control exists over movement of bees from the other part of that country. The data given relate to species established in a particular country: records of parasites on bees imported under quarantine conditions, such as tracheal mite in Australia²³⁰, have not been included.

Territorial descriptions The map of the world has changed dramatically in recent years, especially in Europe and Asia. However, areas such as the former Czechoslovakia and Yugoslavia have been retained for this review: it is unlikely that their constituent republics will have significantly different bee health conditions, given the free movement of bees and bee products that took place over several decades when these now independent states comprised single nations.

The former Soviet Union is, however, likely to contain significant differences in parasite and disease distribution across its vast range of different climates and ecological conditions. Because of language difficulties and the limited availability of literature from some new republics the former Soviet Union is still treated as a single entity in this review, but I hope that more information will soon be forthcoming on this large part of the earth's land mass.

Not all countries can be shown on the maps (figs 1–10), but all available information is included in tables 3–7. Countries for which no information has been collected do not appear in the tables. Names given to countries are the commonly used English-language forms. The representation of a state or frontier is done for illustrative purposes only, and makes no judgement about the political status of an area.

References

Purpose A full reference is given for each record in the tables so that readers can make their own assessments of the validity of the health status reported. The references also constitute a selective bibliography, enabling readers to obtain more information on particular items of interest if required.

Selecting references In choosing references, scientific papers or rigorous surveys have been preferred, especially to justify negative reports. In order to keep the number of references manageable recent authoritative reviews have been used where available: in most cases the primary sources used for these reviews have been checked, and erroneous records discarded. Records from the OIE (see below) have been used to fill in gaps, but reliable bee science or beekeeping papers have been preferred where possible.

Personal communications deserve a particular mention. They fulfil neither purpose for references (that of allowing the reader to assess validity, or acting as a source of further information), so have not been used in this review.

Following up references The numbers given for *Apicultural Abstracts* entries (e.g. 575/93) facilitate quick reference to summaries of most of the publications cited. All references are held in the Eva Crane IBRA Library, and where translations are also available from IBRA the reference number is given, e.g. E1234. Full details of how to use this library service are available from the International Bee Research Association.

Other sources of information on bee health status

Another organization which collates information on bee diseases is the Office International des Épizooties (OIE), based in Paris. This body reports animal health information originating from delegates of OIE member countries (currently some 123 in number), with a view to subsequent publication in one of the organization's books or serials. For serious diseases with the potential for rapid spread the OIE acts as a reporting centre, with member countries required to notify the disease's presence within 24 hours. However, no bee diseases are included in this category.

The information on bee diseases published by the OIE is restricted in a number of ways:

- Not all countries are members.
- Of the members, not all furnish reports (nine failed to supply information for the 1991 volume of *World animal health*¹⁸⁴, the latest available).
- Only five bee diseases are considered of sufficient importance to warrant the systematic collection of data and the preparation of health recommendations for international trade in bees (AFB, EFB, nosema disease, and infestation with the mites *Varroa jacobsoni* and *Acarapis woodi*). This list omits the serious mite parasite *Tropilaelaps clareae* and other possibly significant parasites of the genera *Tropilaelaps* and *Varroa*, but includes one disease of practically universal distribution (nosema disease).
- The delegates of OIE member countries are, in general, the heads of government veterinary services in their respective countries. Differences exist in reporting standards for bee diseases: some member states may have a high level of bee health surveillance, while for others bees may be of much less importance. Some countries may even have to use their limited animal health resources to cope with formidable epizootic diseases, including ones with serious implications for human health.

Nevertheless, some OIE records are used in this review, especially where they cover gaps in the bee science literature.

Update in apparent distribution of reported species

This section summarizes the principal changes in status of the ten species under review since the last *Bee World* article on pest and disease distribution⁴⁴. Many of the changes are more apparent than real, as they result from a change in criteria for reporting (especially the downgrading of positive records to dubious or no records).

Parasitic mites

Tropilaelaps *Tropilaelaps clareae* is reported from more countries in east Asia, reflecting its probable universal distribution within the natural range of its presumed host species, *Apis dorsata*. Following the discovery of the mite in Papua New Guinea, its spread through that country is being monitored, and with the finding of *A. cerana* on Australian islands in the Torres Strait⁸⁷, its chances of spreading to tropical parts of Australia are heightened. *T. clareae* has already been reported from tropical Africa where, if established, it has the potential to cause immense harm to beekeeping.

Varroa *Varroa jacobsoni* has been detected in more countries in South America and North America (though not yet, apparently, in Central America). It is now universal in Europe (except for Ireland) and also universal in Africa north of the Sahara. The status of this mite in Niger remains unconfirmed, despite the OIE record for

it. *Varroa*'s spread through Papua New Guinea is, like that of *T. clareae*, a concern for Australia's beekeeping industry.

Tracheal mite This species is now found in both Canada and the continental USA, and has been recorded in several Central American countries. Reports from Europe now indicate that only two Scandinavian countries are apparently free of the tracheal mite. Little is known of its distribution in sub-Saharan Africa, but most reasonably thorough investigations have detected its presence there. Its distribution appears patchy in the Middle East, but it has been found in most other Asian countries where it has been looked for.

Other species

Most changes in the apparent distribution of other diseases and pests are a consequence of using different reporting standards, though some new records are included.

American foulbrood (AFB) is more widespread than previously thought in South America and the Middle East, although it has still not been reported from sub-Saharan Africa.

European foulbrood (EFB) is reported from more countries in South America, Africa south of the Sahara, the Middle East and other parts of Asia.

Little change is apparent in the reported distribution of sacbrood, chalkbrood and nosema. Few reliable records exist on the absence of amoeba (*Malpighamoeba mellificae*). Significant corrections have been made to the records for braula.

Kashmir bee virus (KBV) has been isolated from *A. cerana* in India²⁹ and Papua New Guinea²¹, and from *A. mellifera* in Australia³⁰, Canada¹⁹, Fiji²³, New Zealand¹⁹, Papua New Guinea²¹, Solomon Islands²¹⁴ and the USA⁴⁷. It is quite likely, however, that further investigations using appropriate laboratory techniques will show that KBV has a much wider distribution. Infection with this virus produces no visual symptoms, and little is known of the effect of KBV on honey bees.

Discussion

How accurate are disease status reports?

The reliability of any report on the presence or absence of a disease or parasite depends on the accuracy of the original investigation. It is instructive to look at records for several countries in the 1988 report (e.g. Malawi, Saudi Arabia, Western Samoa), which were based largely on the reporting of field symptoms, but for which a thorough investigation has since taken place. The information given now is significantly different: either much more complete or even nearly the opposite of what had previously been recorded.

Negative results (statements that a country is free of a particular disease or parasite) must be considered carefully. They are reliable only if a thorough survey is carried out, with sampling to a statistically significant level and laboratory analysis performed by competent personnel. Few such surveys have been completed, and importing countries often accept zoosanitary declarations based on inadequate

information. This has led to widespread international movement of serious diseases and parasites.

The length of time for which a country's records remain accurate depends on the likelihood of infected bees or contaminated hive parts or hive products being imported. Experience shows that most countries with land borders are unlikely to be able to prevent diseases or parasites being introduced from neighbouring countries, and that transfer of such species is restricted mainly by physical barriers (such as mountain ranges or deserts) which limit natural or assisted bee movements. Island nations are more likely to be able to prevent such introductions, though this is dependent on the existence of effective legislation and inspection systems.

Newly introduced parasites or diseases may remain undetected by beekeepers for some time. The chances of such infestations being discovered are greatly increased if there is a comprehensive colony inspection programme or, more importantly, a programme of active surveillance for exotic diseases.

Suggestions for further study

New reviews of information which probably already exists As already mentioned, it would be desirable to review the distribution of parasites and diseases in the new republics of the former Soviet Union. Another area of study requiring frequent updates is the mite fauna of Asian species of honey bee, especially as two of the serious mite parasites reviewed in this article originated in Asia. Already there is evidence that *Varroa underwoodi* parasitizes *A. cerana*^{273a}, and that *Eugarroa sinhai* may parasitize *A. mellifera*^{139a}.

This review has treated bee health at a country level, but I hope that it will encourage contributions on the distribution of diseases and parasites within countries, especially including analysis of surveying and recording methods and the reliability of area freedoms required by some importing countries.

New studies needed Rigorous investigations are lacking for most countries in sub-Saharan Africa, and for a number of countries in Asia. More information is needed on the incidence and distribution of several viruses and spiroplasmas which may play a greater role in bee health than has previously been recognized.

Acknowledgements

I am grateful to a number of people who supplied information for this review; also to Dr D Anderson, Dr B O'Neil, Dr H Shimanuki and C Van Eaton for constructive suggestions on the reporting criteria to use, and to the latter two for reviewing the manuscript at the draft stage. This project would not have been possible without access to the extensive resources of IBRA's library, and I thank Salma Zabaneh for valued assistance with finding references.

TABLE 3. Honey bee diseases and parasites in countries of the Americas.
Numbers refer to entries in the list of references, used to justify the bee health status given.

Country	Brood diseases			Adult diseases		Parasitic mites		Other
	AFB	EFB	sac-brood	chalk-brood	nosema	amoeba	tracheal varroa	tracheal laelaps
North America								
Alaska (USA)	+ ²⁶²	+ ²⁶²						
Canada	+ ¹⁵⁴	+ ³²	+ ¹⁰⁶	+ ¹⁰²	+ ²⁰³	+ ¹⁰¹	+ ²⁰²	+ ²⁶¹
Mexico	+ ¹⁸⁴	+ ²⁶⁵	+ ²⁶⁵	+ ²⁶⁵	+ ²⁶⁴		+ ¹⁸⁴	+ ¹⁸⁴
USA	+ ²³⁴	+ ³²	+ ¹⁰⁶	+ ¹⁰²	+ ¹⁸⁴	+ ¹⁰³	+ ¹⁶	+ ^{218b}
(contiguous states)								+ ⁷³
Central America								
Belize	+ ¹⁷¹	+ ³⁸	+ ²⁰⁵	+ ¹⁷¹	+ ¹⁷¹		+ ⁵⁰	+ ³⁸
Costa Rica	+ ¹⁹⁴	+ ¹⁸⁴			+ ⁸⁹		+ ¹⁹⁴	
El Salvador	+ ¹⁸⁴	+ ¹¹³		+ ¹¹³	+ ¹¹³		+ ¹⁸⁴	
Guatemala	+ ⁸⁵							
Honduras	+ ¹⁸²	+ ¹⁸²	+ ¹⁸²	+ ¹⁸²			+ ¹⁰⁹	+ ¹⁸²
Nicaragua					+ ^{218a}		+ ^{218a}	
Panama	+ ⁸⁵	+ ¹⁸⁴			+ ¹⁸⁴		+ ²²³	+ ⁶⁶
Caribbean & other islands								
Antigua	+ ¹²⁸	+ ¹²⁸	+ ¹²⁸	+ ¹²⁸				
Bahamas	+ ¹⁸⁴							
Bermuda	+ ¹¹⁹							
Cuba	+ ¹⁸⁶	+ ¹⁸⁴						
Dominican Republic	+ ¹⁴⁵	+ ¹⁴⁵						
Guadeloupe	+ ²²⁵							

TABLE 3 continued.

Country	Brood diseases		sac- brood	chalk- brood	Adult diseases		Parasitic mites		Other
	AFB	EFB			nosema	amoeba	tracheal	varroa	
Haiti									
Jamaica	+ ³⁹	- ⁵⁹	- ⁵⁹	- ⁵⁹			+ [?] ¹⁸⁴		
Martinique	- ¹⁹⁷	- ¹⁹⁷	- ¹⁹⁷	- ¹⁹⁷			- ¹²⁹		
Nevis	- ¹¹⁸	- ¹¹⁸	- ¹¹⁸	- ¹¹⁸					
St Lucia	- ²²⁹	- ²²⁹	- ²²⁹	- ²²⁹					
Trinidad	- ¹¹²	- ¹¹²	- ¹¹²	- ¹¹²					
and Tobago									+ ¹¹²
South America									
Argentina	+ ¹²	+ ¹²	- ⁶⁷	+ ¹⁰²	+ ¹⁶⁵	+ ¹⁶⁵	+ ⁷⁶	+ ⁶⁸	+ ¹⁶⁵
Bolivia					+ ²⁵⁰			+ ⁷³	+ ¹⁸⁹
Brazil	+ [?] ¹⁶⁸	+ ³²	+ ⁸⁵		+ ¹⁵¹	+ ²³⁷	+ ¹⁵¹	+ ⁷³	+ ¹⁸⁸
Chile	- ⁶⁴	+ [?] ⁶⁴	- ²⁴⁸	- ²⁴⁸	+ ⁶⁴	+ ⁶⁴	+ ¹³¹	- ⁶⁴	+ ¹¹¹
Colombia	+ ¹⁸⁴	+ ¹⁷⁰	+ ⁷²		+ ⁷²		+ ⁷⁶	+ ¹¹⁰	+ ¹⁷⁰
Ecuador	+ ¹²⁷	+ ¹²⁷	+ [?]		+ [?]		+ [?]	- ¹²⁷	+ [?]
French Guiana	- [?] ¹⁹³	- [?] ¹⁹³	- [?] ¹⁹³	- [?] ¹⁹³					
Guyana	- [?] ¹⁹³	- [?] ¹⁹³	- [?] ¹⁹³	- [?] ¹⁹³					
Paraguay	+ ⁴¹	+ ⁴¹			+ ⁴⁵		+ ¹⁰⁹	+ ⁶⁹	+ ¹⁸⁹
Peru	- ²³⁹	+ ²³⁹			- ²³⁹		- ¹²⁹	+ ⁷³	+ ¹⁸⁹
Surinam	- [?] ¹⁹³	- [?] ¹⁹³	- [?] ¹⁹³	- [?] ¹⁹³				- ¹¹⁰	
Uruguay	+ ¹⁸⁴	+ ¹⁸⁴			+ ¹⁷²		+ ⁷⁶	+ ⁷⁴	+ ¹⁸⁹
Venezuela	- ¹¹⁷	+ ¹¹⁷	+ ¹⁰⁹	+ ^{245*}	+ ¹¹⁷	+ ¹¹⁷	+ ⁷⁶	+ ²⁵⁹	+ ¹⁸⁹

* Species described as *Arrhenosphaera cranei*.

TABLE 4. Honey bee diseases and parasites in countries of Europe (including the former USSR).

Numbers refer to entries in the list of references, used to justify the bee health status given.

Country	Brood diseases			Adult diseases			Parasitic mites			Other
	AFB	EFB	sac-brood	chalk-brood	nosema	amoeba	tracheal	varroa	tropi-laelaps	
Albania	+ ¹⁸⁴	+ ¹⁸⁴			+ ¹⁸³		+ ¹⁸⁴	+ ¹⁸⁴		+ ¹⁸⁸
Austria	+ ¹⁸⁴	+ ¹⁸⁴			+ ¹⁸⁴		+ ¹²⁹	+ ¹⁴⁴		+ ¹⁸⁸
Belgium	+ ²²⁴	+ ²²⁴		+ ²²⁴	+ ²²⁴	+ ²²⁴	+ ²²⁴	+ ²²⁴		+ ⁶⁶
Bulgaria	+ ¹⁷⁷	+ ¹⁷⁷			+ ²³³		+ ¹⁸⁴	+ ⁶⁹		+ ¹⁸⁸
Corsica (France)							+ ¹²⁹			
Cyprus	+ ¹⁸⁴	+ ⁶²			+ ⁶²		+ ¹⁸⁴	+ ¹⁸⁴		
Czechoslovakia (former)	+ ²⁴⁷	+ ²⁴⁷	+ ²⁴⁷	+ ¹¹⁶	+ ²⁰¹	+ ¹⁰³	+ ²⁴⁷	+ ⁷⁰		+ ¹⁸⁸
Denmark	+ ^{113a}	+ ³²	+ ^{113a}	+ ^{113a}	+ ^{113a}	+ ^{113a}	+ ⁹³	+ ¹¹⁴		+ ²³¹
Finland	+ ²⁰⁰	+ ³²	+ ¹⁰⁴	+ ¹³⁴	+ ²⁵⁶	+ ²⁵⁶	+ ⁹³	+ ²⁵⁶		+ ^{111a}
France	+ ⁴⁶	+ ⁴⁶	+ ⁴⁶	+ ⁴⁶	+ ⁴⁶	+ ⁴⁶	+ ⁴⁶	+ ⁷³		+ ⁴⁶
Germany	+ ¹⁹⁵	+ ¹⁰⁰	+ ¹¹⁶	+ ¹¹⁶	+ ⁴²	+ ¹⁰¹	+ ¹²⁹	+ ⁷⁴		+ ¹⁸⁸
Greece	+ ²²⁸	+ ²²⁸	+ ¹⁵²	+ ¹¹⁶	+ ²²⁸	+ ²²⁸	+ ²²⁸	+ ²²⁸		
Hungary	+ ⁵⁶	+ ⁵⁶	+ ¹³⁵	+ ¹⁰²	+ ¹⁸⁷	+ ¹⁸⁷	+ ⁵⁵	+ ⁶⁹		+ ¹⁸⁸
Irish Republic	+ ¹³⁵	+ ¹³⁵	+ ¹³⁵	+ ¹³⁵	+ ¹³⁵	+ ¹³⁵	+ ¹³⁵	+ ¹²⁵		+ ¹³⁵
Italy	+ ²⁴³	+ ²⁴³	+ ²⁴³	+ ²⁴³	+ ²⁴³	+ ¹⁰³	+ ²⁴³	+ ⁷³		+ ¹⁸⁸
Luxembourg	+ ¹⁸⁴				+ ¹⁸⁴			+ ²²²		
Majorca (Spain)							+ ¹²⁹			
Malta	+ ⁹⁴	+ ⁹⁴			+ ⁹⁴		+ ⁷⁶			+ ⁹⁴
Netherlands	+ ²²⁴	+ ²²⁴	+ ²²⁴	+ ²²⁴	+ ²²⁴	+ ²²⁴	+ ²²⁴	+ ²²⁴		+ ⁸⁸
Northern Ireland	+ ¹⁸⁴	+ ²⁵⁴	+ ²⁵⁴		+ ²⁵⁴	+ ²⁵⁴	+ ²⁵⁴			+ ²⁵⁴
(UK)										
Norway	+ ¹⁸⁴	+ ²⁸		+ ¹¹⁶	+ ¹⁸⁴	+ ³³	+ ⁹³	+ ¹⁹¹		+ ²³¹
Poland	+ ¹⁶²	+ ¹⁶²	+ ¹⁶²	+ ¹¹⁶	+ ¹⁷⁹	+ ¹⁷⁹	+ ¹²⁹	+ ⁶⁹		+ ¹⁸⁸

TABLE 4 continued.

Country	Brood diseases		sac- brood	chalk- brood		Adult diseases		Parasitic mites		Other braula
	AFB	EFB		nosema	amoeba	tracheal	varroa	tropi- laelaps		
Portugal	+ ¹⁸⁴	+ ¹⁸⁴		+ ²¹⁸	+ ⁷⁹	+ ⁸⁰	+ ¹⁵⁸	+ ¹⁰⁷	+ ¹⁵⁸	
Romania	+ ¹⁹⁹	+ ¹⁹⁹	+ ¹⁹⁹	+ ²²¹	+ ¹⁹⁹	+ ¹⁹⁹	+ ¹⁸⁴	+ ⁶⁹	+ ¹⁸⁸	
Sardinia (Italy)	+ ⁹⁷				+ ¹²⁹		+ ¹²⁹	+ ²⁰⁸		
Spain	+ ¹⁰⁸	+ ¹⁰⁸	+ ¹⁰⁸	+ ¹⁰⁸	+ ¹⁰⁸	—	+ ¹⁰⁸	+ ¹⁰⁸	+ ¹⁰⁸	
Sweden	+ ¹⁸⁴	+ ¹⁸⁴			+ ⁹⁹		— ⁹³	+ ⁹⁸	+ ²³¹	
Switzerland	+ ⁴⁸	+ ⁴⁸	+ ¹⁰⁶	+ ¹¹⁶	+ ²⁶³	+ ¹⁰³	+ ⁴⁸	+ ⁴⁸		
United Kingdom	+ ²⁵³	+ ³²	+ ³¹	+ ¹¹⁶	+ ³¹	+ ¹⁰³	+ ⁷⁶	+ ¹⁵⁵	+ ¹⁵⁵	
USSR (former)	+ ¹⁰⁵	+ ¹⁰⁵	+ ¹⁰⁵	+ ¹¹⁶	+ ¹⁰⁵	+ ¹⁰¹	+ ¹⁸⁴	+ ⁶⁹	+ ¹⁸⁸	
Yugoslavia (former)	+ ¹⁴⁸	+ ¹⁴⁸		+ ⁵⁸	+ ¹⁴⁸	+ ¹⁰¹	+ ¹⁴⁸	+ ⁶⁹	+ ¹⁸⁸	

TABLE 5 continued.

Country	Brood diseases		Adult diseases		Parasitic mites		Other		
	AFB	EFB	sac-brood	chalk-brood	nosema	amoeba		tracheal	varroa
Mauritius	- ⁷¹	- ⁷¹	- ⁷¹	- ⁷¹	+ ⁷¹	- ⁷¹	- ⁷¹		+ ³⁴
Mozambique									+ ¹⁰
Niger					+ ¹⁸⁴	+ ¹⁸⁴	+ ¹⁸⁴		
Nigeria									
Reunion	- ⁸⁴	- ⁸⁴	- ⁸⁴	- ⁸⁴	+ ⁸⁴	+ ⁸⁴	+ ⁸⁴		- ⁷¹
Rwanda	- ³⁶	- ³⁶	- ³⁶	- ³⁶					+ ³⁶
Senegal	- ¹⁷⁶	+ ⁸¹	- ¹⁷⁶	- ¹⁷⁶	+ ¹⁷⁶	- ⁸¹	- ⁸¹		+ ¹⁷⁶
Seychelles	- ²³⁵	- ²³⁵	- ²³⁵	- ²³⁵					- ²³⁵
South Africa	- ²⁶	+ ³²	+ ⁵³	- ²⁶	+ ^{53*}	- ²⁶	- ²⁶	- ²⁶	+ ¹⁸⁸
Sudan	- ¹	- ¹							
Tanzania		+ ³²					- ¹²⁹	- ¹³⁹	+ ¹⁸⁸
Uganda	- ²¹⁵	- ²¹⁵	- ²¹⁵	- ²¹⁵					
Zaire	- ⁸⁶						+ ²¹⁹	- ¹¹⁰	+ ⁸⁶
Zambia	- ²³⁶	+ ³²							+ ²³⁶
Zimbabwe						+ ⁵⁴		- ¹¹⁰	+ ¹⁸⁸

* *Nosema* sp. also affecting brood.¹³²

TABLE 6. Honey bee diseases and parasites in countries of Asia.
Numbers refer to entries in the list of references, used to justify the bee health status given.

Country	Brood diseases		sac-brood	chalk-brood	Adult diseases		Parasitic mites		Other
	AFB	EFB			nosema	amoeba	tracheal	varroa	
Middle East									
Iran	⁷ +	⁷ +	⁷ +	⁷ +	⁷ +		⁶⁹ +		⁷ +
Iraq	¹⁶⁶ -?	^{14a} +	¹⁶⁶ -?	¹⁶⁶ -?			¹⁵ +		⁹⁰ +
Israel	¹⁸⁴ +	¹⁸⁴ +		²⁷¹ +	¹⁸⁴ +		⁷³ +		¹⁸⁸ +
Jordan	¹⁷⁵ +	¹⁷⁵ +	²¹⁶ +	¹⁷⁵ +	¹⁷⁵ +		¹⁷⁵ +		¹⁷⁵ +
Lebanon	²⁰⁷ +	¹⁸⁴ +			¹⁸⁴ +		⁷³ +		
Oman	²² +	²² -		²² -	²² +		²² -	²² -	²² +
Saudi Arabia	¹¹ +	¹¹ +	¹¹ +	¹¹ +	¹¹ +		¹¹ -	¹¹ +	¹¹ +
Syria	²⁷³ +	²⁷³ +					²⁷³ +		
Turkey	¹²⁶ +	¹²⁶ +		^{130a} +	¹²⁶ +		⁷⁰ +		¹⁸⁸ +
United Arab Emirates	¹³² -?	¹³² -?	¹³² -?				⁴³ +		¹⁸⁸ +
Yemen									
Indian sub-continent									
Afghanistan	¹²⁰ -?	¹²⁰ -?	¹²⁰ -?	¹²⁰ -?			²⁷⁰ -	²⁶⁹ +	
Bangladesh	²⁵⁸ +	²⁵⁸ +	²⁵⁸ +		¹⁷⁸ +		²⁵⁸ +		²⁵⁸ +
Bhutan	²⁵⁸ +	²⁵⁸ +					⁷⁵ +	²⁴⁶ +	^{77+*} +
India	²³⁸ +	³² +	¹⁴⁷ +	¹⁴⁶ -	¹⁴⁶ +	¹⁴⁶ -	⁷⁵ +	¹⁹⁸ +	²⁰⁹ +
Nepal		^{13*} +	²⁵⁷ +					⁷⁸ +	^{77+*} +
Pakistan	⁶ -?	⁶ -?	⁶ -?	⁶ -?	⁶ -?		⁷⁶ +	⁷⁴ +	⁴¹ +
Sri Lanka	²¹⁷ -?	²¹⁷ -?	²¹⁷ -?	²¹⁷ -?				¹⁴⁰ +	

TABLE 6 continued.

Country	Brood diseases		Adult diseases		Parasitic mites		Other braula
	AFB	EFB	sac- brood	chalk- brood	nosema	tracheal varroa	tropi- laelaps
East of Indian subcontinent							
Burma	+ ²⁷⁴		+ ²⁵⁸	+ ²⁷⁴		+ ¹⁶⁰	+ ¹⁶⁰
Cambodia						+ ⁷³	
China	+ ⁹⁶	+ ¹⁴	+ ⁹⁶	+ ⁹⁶	+ ²⁶⁰	+ ⁹⁶	+ ⁹⁶
Hong Kong (UK)	+ ¹⁸⁴	+ ¹⁸⁴			+ ¹⁸⁴	+ ⁶⁸	+ ⁷⁵
Indonesia						+ ⁶⁸	+ ¹⁴⁰
Japan	+ ²²⁷	+ ^{214a}		+ ¹¹⁶	— ³³	+ ^{174***}	+ ⁶⁹
Korea (N)	+ ²⁵²						
Korea (S)	+ ⁵⁷	+ ⁵⁷	+ ⁵⁷	+ ⁵⁷			
Laos						+ ⁵⁷	+ ^{273a}
Malaysia	+ ¹⁵⁶	— ²⁰⁶	— ²⁰⁶	— ²⁰⁶		+ ⁷³	+ ⁵⁷
Mongolia						+ ¹⁵⁶	+ ¹⁵⁹
Philippines	+ ²⁰⁴		+ ¹⁶⁹			+ ¹⁸⁴	+ ⁷⁵
Singapore						+ ⁶⁸	+ ⁷⁴
Taiwan	+ ¹⁶¹			+ ⁶¹	+ ¹⁷	+ ⁷⁴	+ ¹⁶¹
Thailand	+ ⁸	+ ²⁶⁷	+ ⁸	+ ²⁶⁷	+ ²⁷²	+ ⁷⁶	+ ⁴⁹
Vietnam		+ ²⁵¹	+ ²⁵¹			+ ²⁴⁶	+ ²⁴⁶

* *M. pluton* found in *Apis laboriosa* in Nepal.** *Tropilaelaps* spp. found on *A. dorsata* and *A. laboriosa* in Nepal.*** Records for *Acarapis woodi* in Japan are contradictory^{75,76}.

TABLE 7. Honey bee diseases and parasites in countries of Oceania (including Australia).

Numbers refer to entries in the list of references, used to justify the bee health status given.

Country	Brood diseases			Adult diseases			Parasitic mites			Other
	AFB	EFB	sac- brood	chalk- brood	nosema	amoeba	tracheal	varroa	tropi- laelaps	
Australia (mainland)	122 +	122 +	18 +	262a +	122 +	35 +	122 —	122 —	122 —	150 —
Cook Islands	255 +	255 —	255 +	255 —	23 +	23 +	23 —	23 —	23 —	—
Fiji	23 +	23 —	23 +	23 —	164 +	164 —	164 —	164 —	164 —	—
Hawaii (USA)	164 +	164 +	164 +	164 +	249 +	249 —	249 —	249 —	249 —	—
New Caledonia	249 +	184 +	—	—	—	—	—	—	—	—
(France)	—	—	—	—	—	—	—	—	—	—
New Zealand	20 +	123 —	20 +	20 +	20 +	20 +	20 —	20 —	20 —	232 —
Niue	212 +	212 —	212 +	212 —	212 +	212 —	212 —	212 —	212 —	—
Norfolk Island	24 —	24 —	24 —	24 —	24 +	24 —	24 —	24 —	24 —	24 —
(Australia)	—	—	—	—	—	—	—	—	—	—
Papua New Guinea	21 +	21 —	21 +	21 —	21 +	21 —	21 —	21 +	21 +	—
Solomon Islands	214 —	214 —	214 +	214 —	214 +	214 —	214 —	214 —	214 —	—
Tasmania	124 +	124 +	124 +	122 —	124 +	122 —	122 —	122 —	122 —	124 +
(Australia)	—	—	—	—	—	—	—	—	—	—
Tonga	185 +	185 —	242 +	185 —	65 +	65 —	65 —	185 —	185 —	242 —
Tuvalu	237a —	237a —	—	237a —	—	—	—	—	—	237a —
Vanuatu	51 —	51 —	51 —	51 —	—	—	—	—	—	—
Western Samoa	213 —	213 —	213 +	213 +	213 +	213 —	213 —	213 —	213 —	213 —

* Assumed free as bees have been imported only from New Zealand.

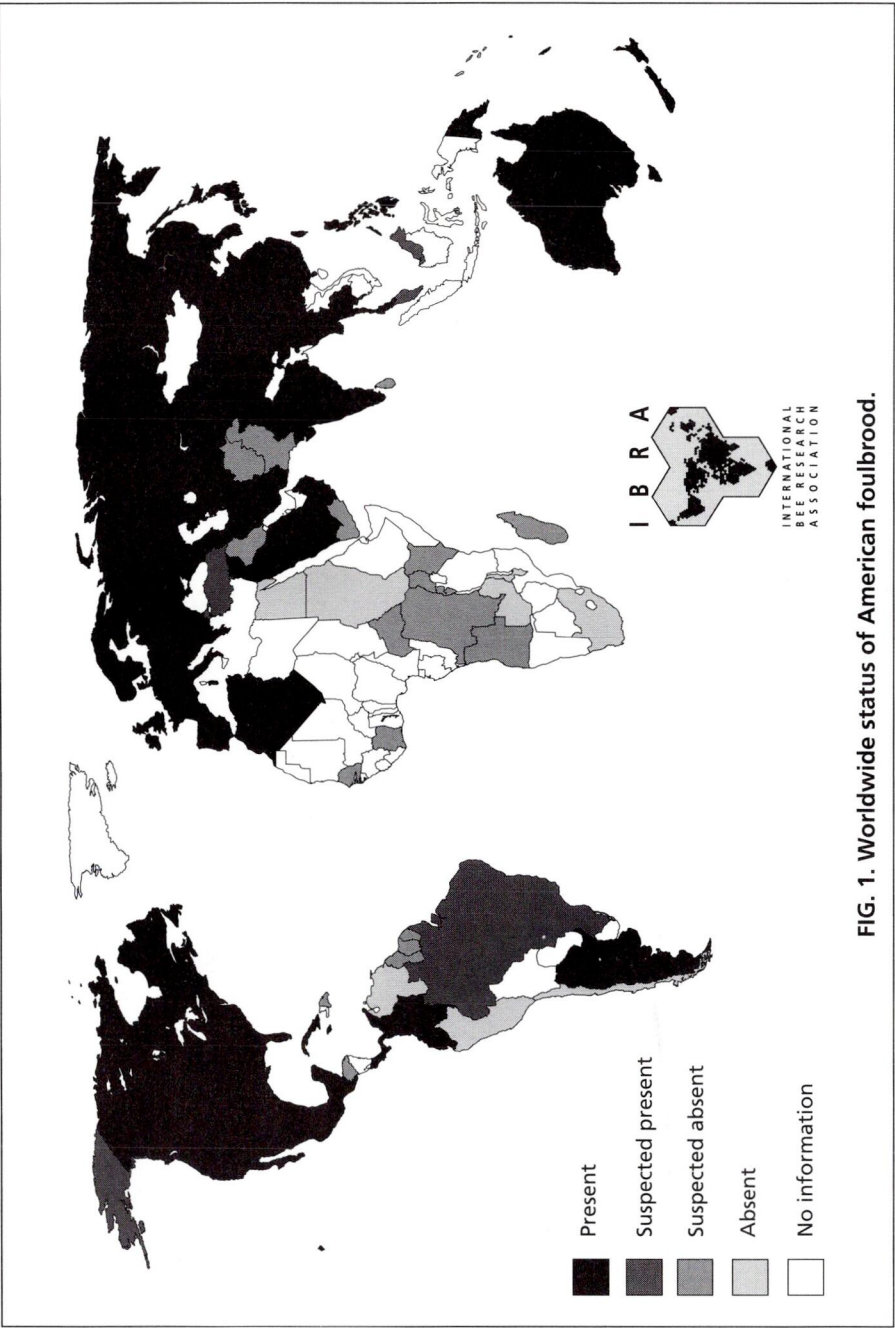


FIG. 1. Worldwide status of American foulbrood.

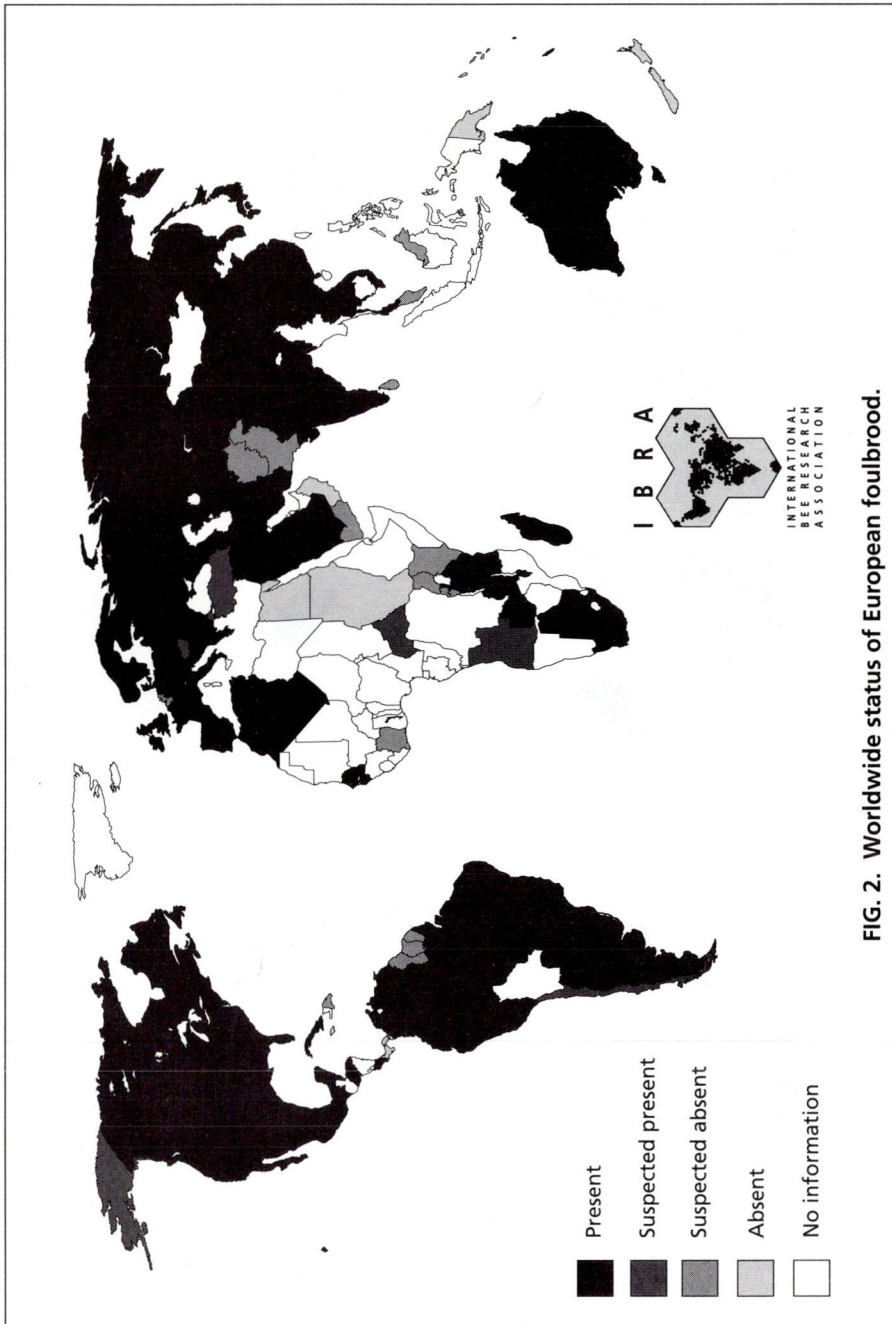
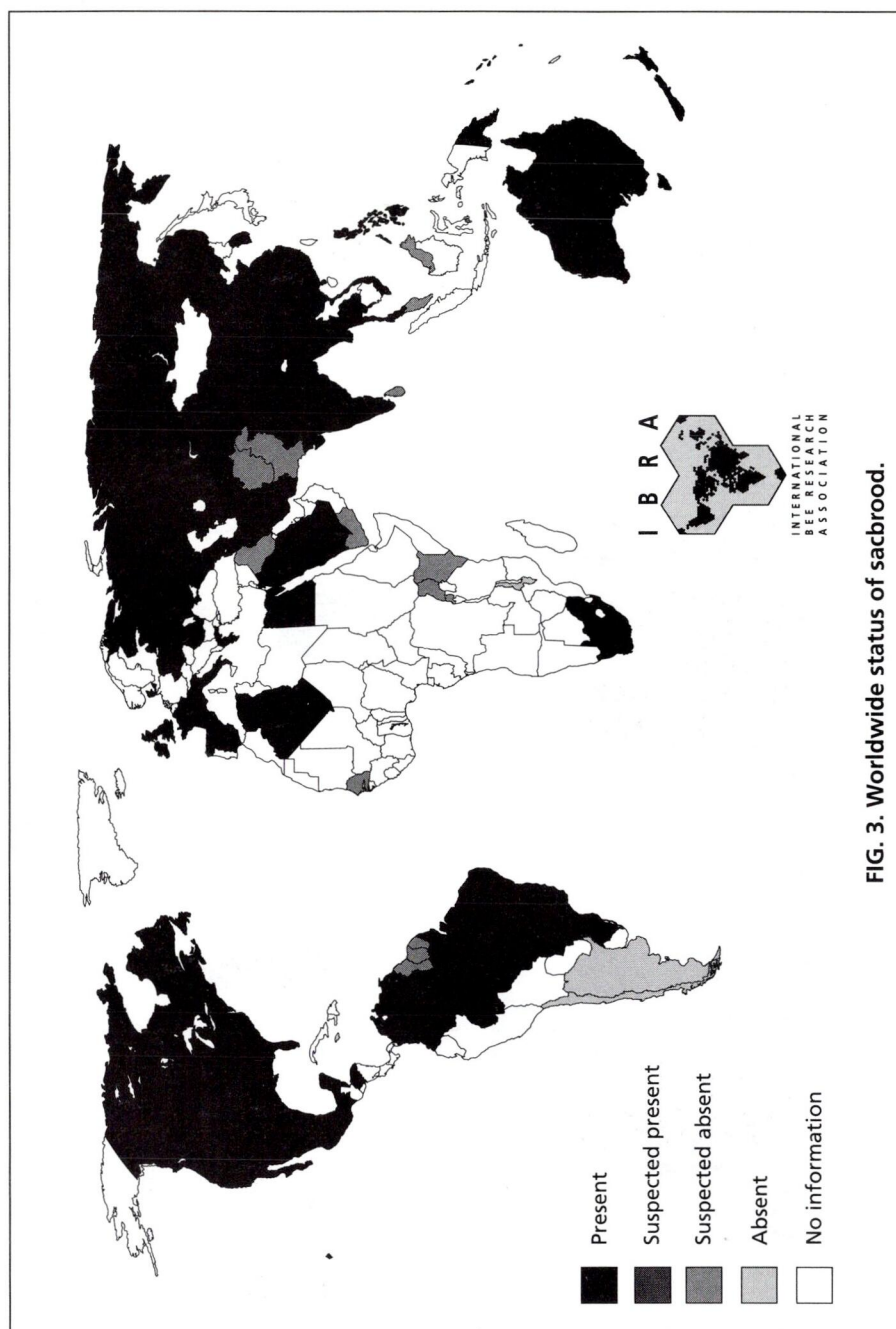


FIG. 2. Worldwide status of European foulbrood.



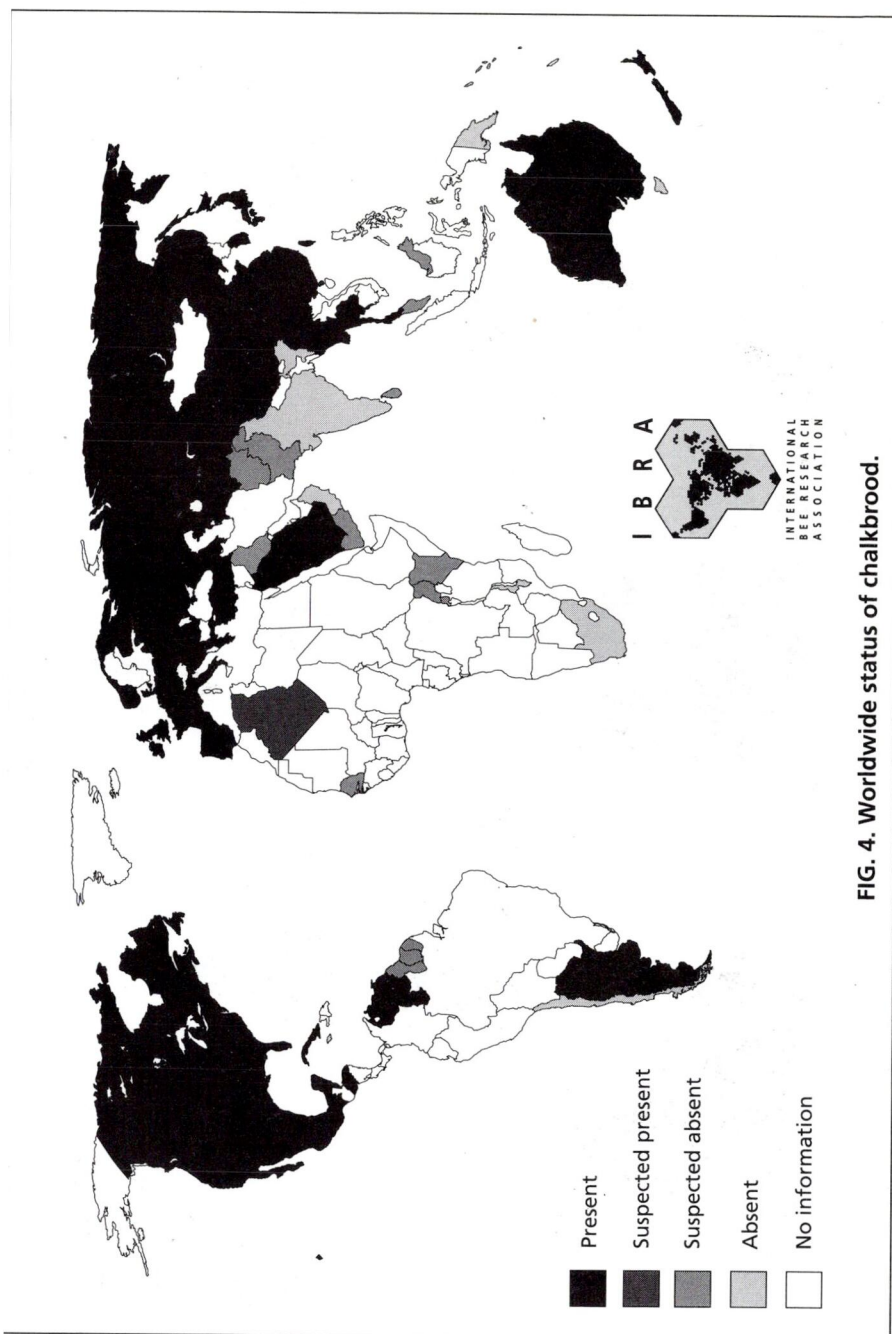


FIG. 4. Worldwide status of chalkbrood.

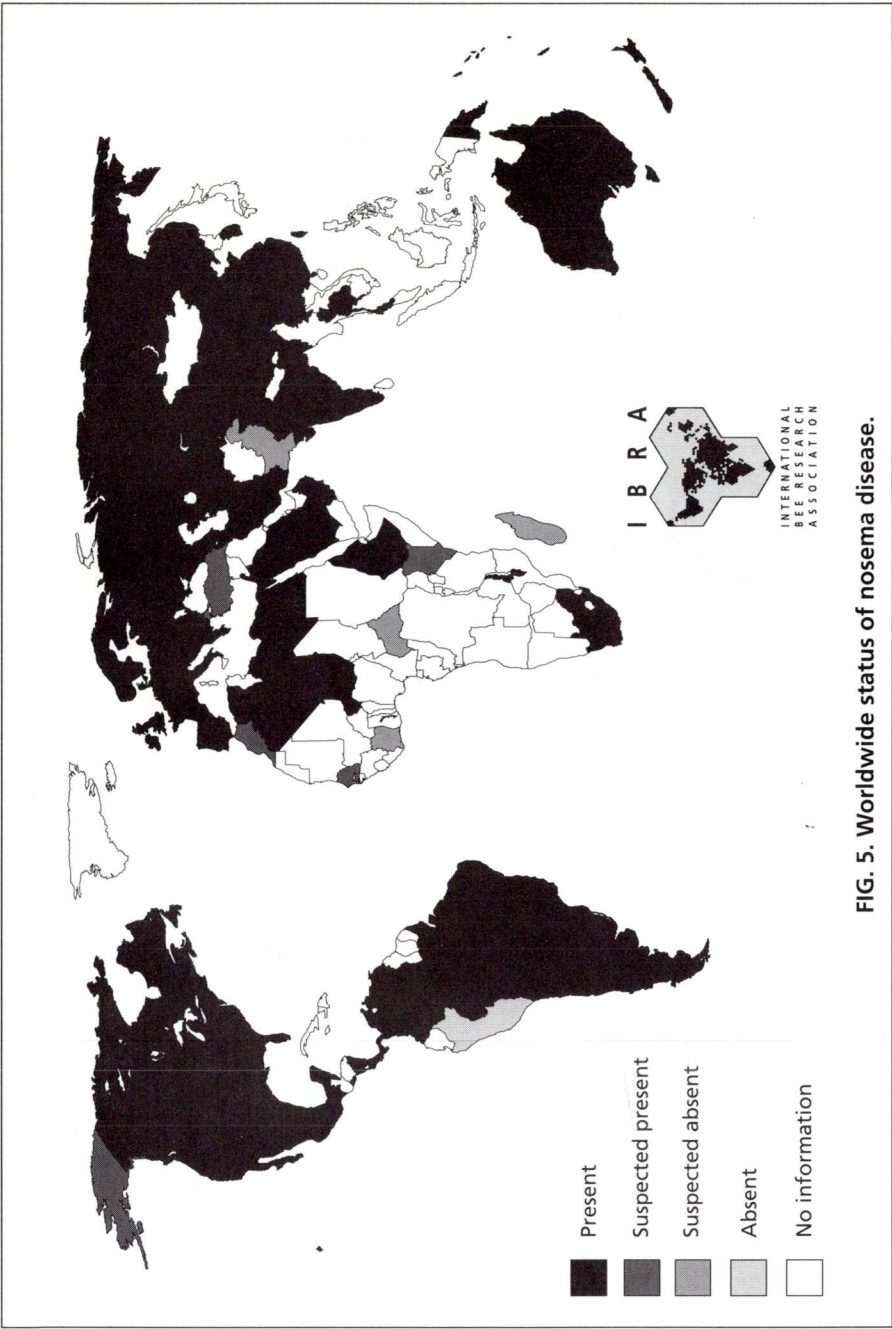


FIG. 5. Worldwide status of nocardiosis.

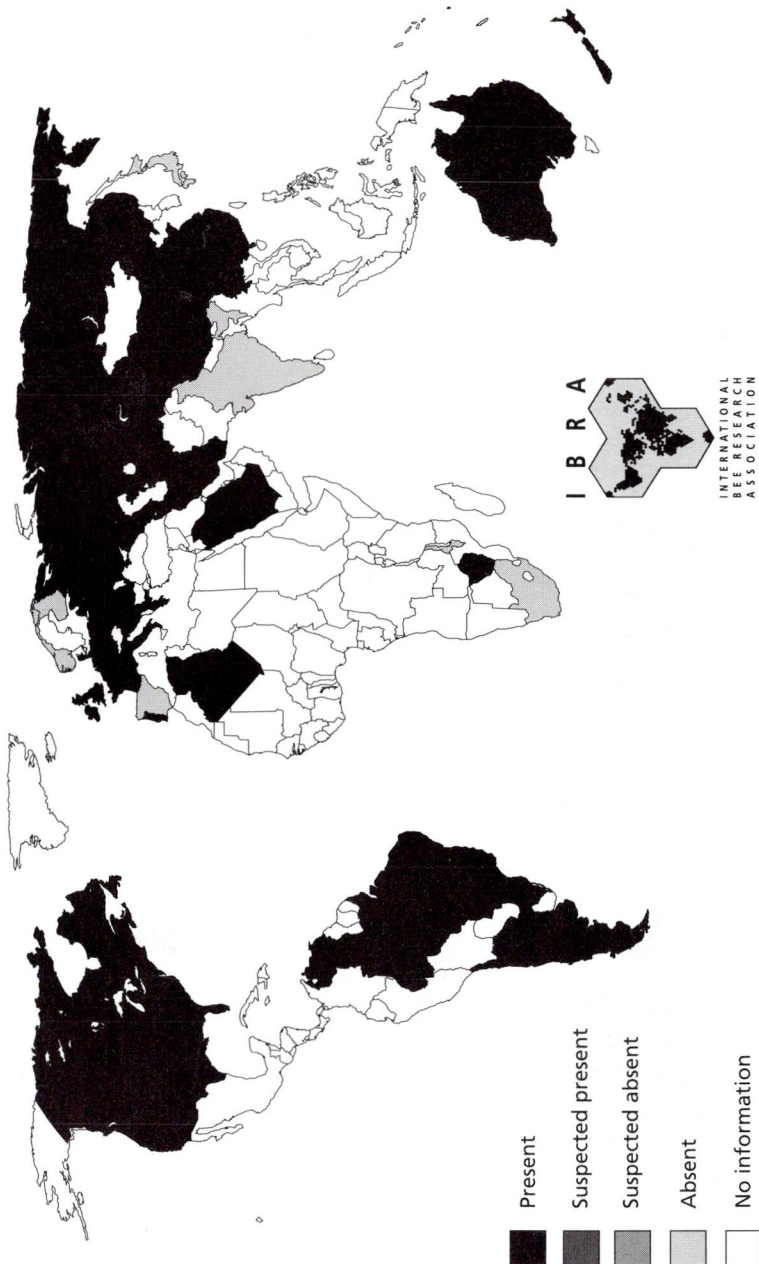


FIG. 6. Worldwide status of amoeba disease.

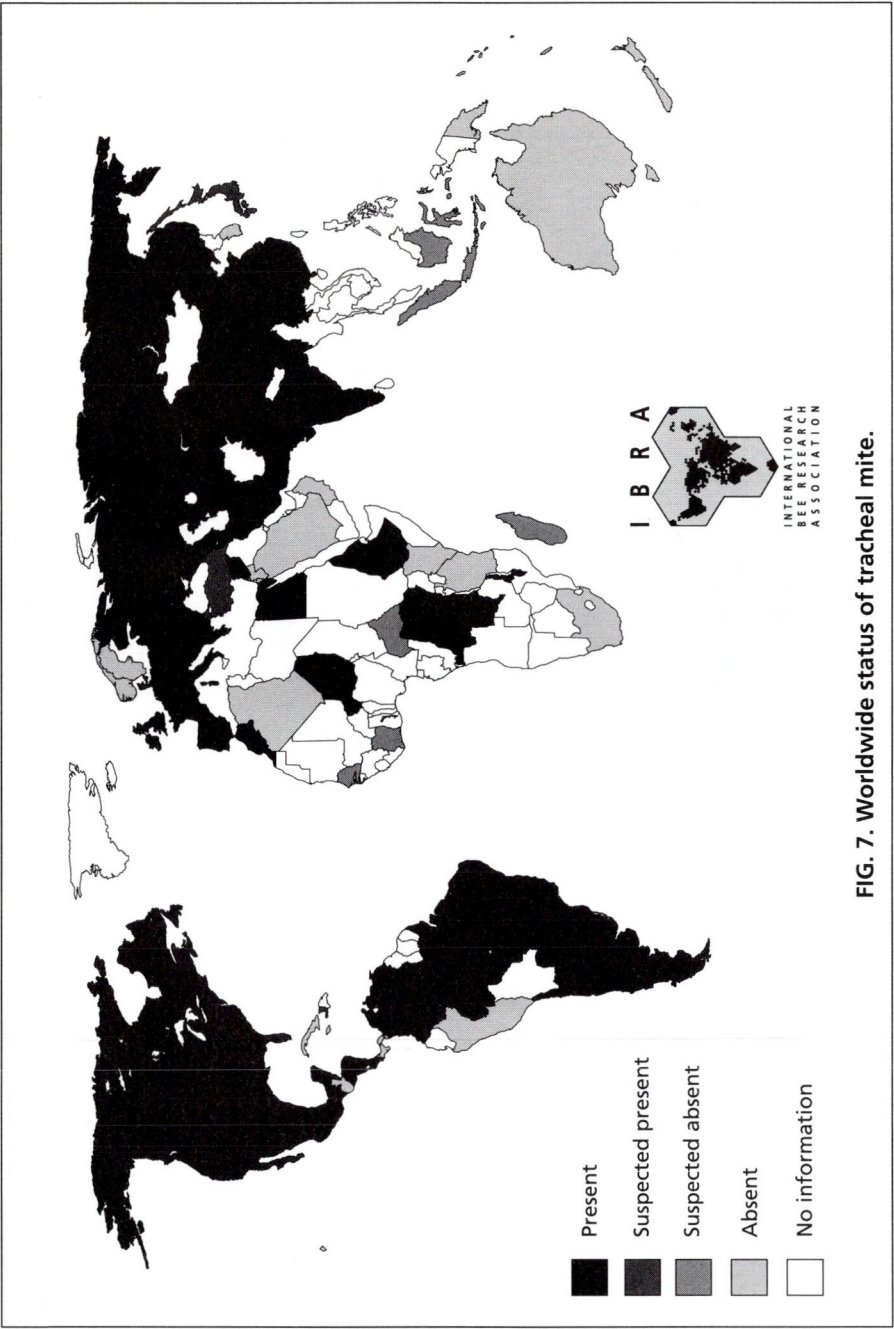


FIG. 7. Worldwide status of tracheal mite.

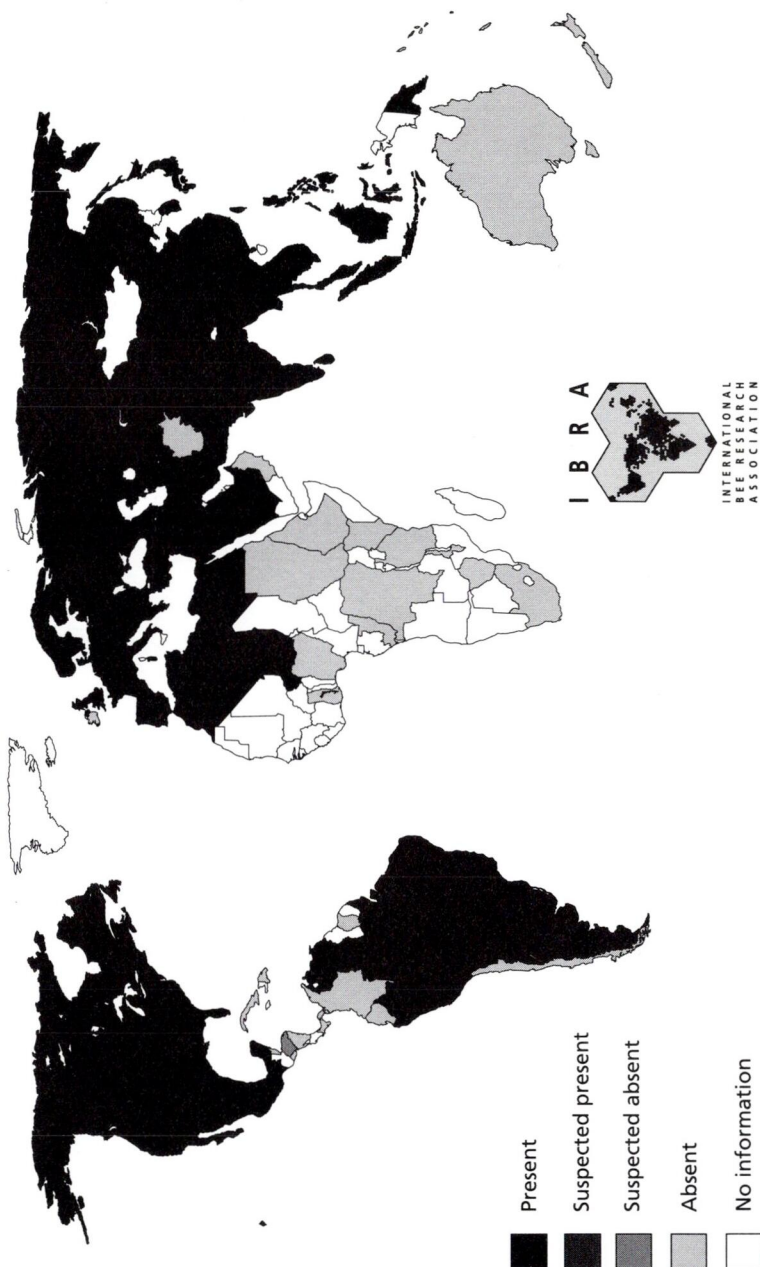
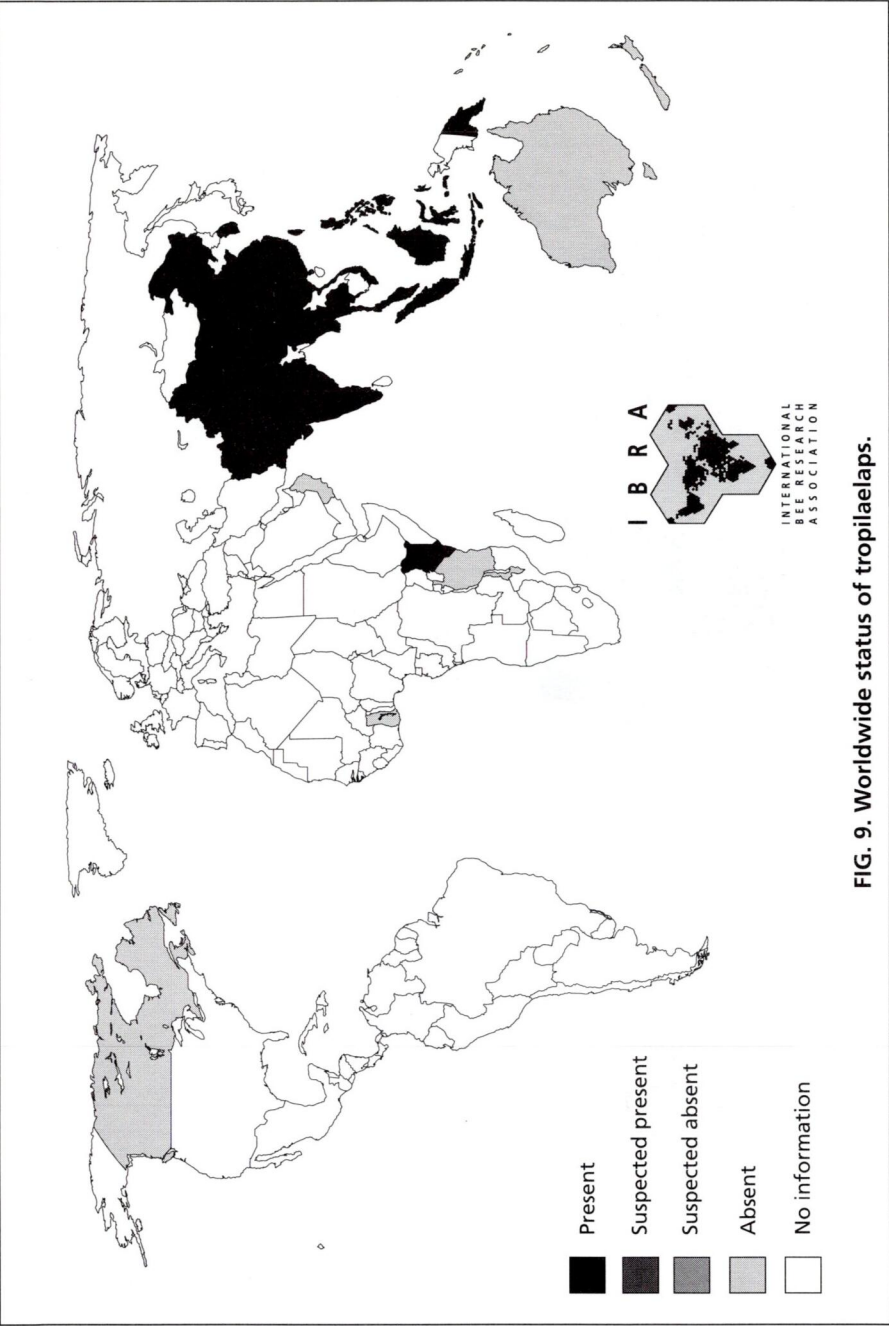


FIG. 8. Worldwide status of varroa.



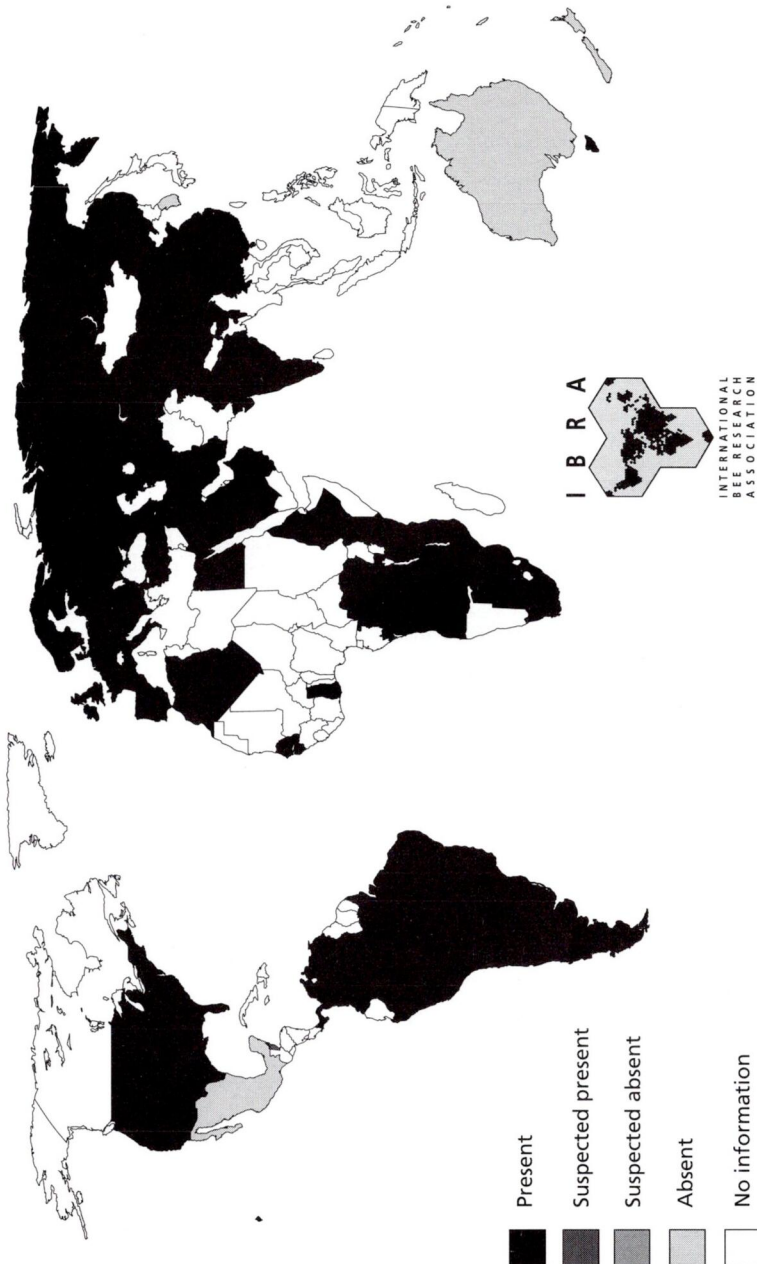


FIG. 10. Worldwide status of braula.

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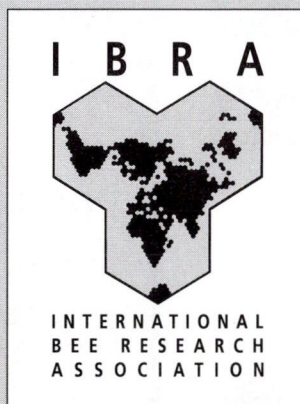
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