13

BARD

FINAL REPORT

PROJECT NO. IS-2605-95

**Computerized Synthesis of Information on the
Scale Insects of the World**

Y. Ben-Dov, D.R. Miller, G. Gibson, M. Kosztarab, K. Veilleux

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Project Title: Computerized Synthesis of Information on the Scale Insects of the World

Address & e-mail of Investigators and Institutions:

Investigators

Institutions

Principal Investigator:

Yair Ben-Dov	Department of Entomology, Institute of Plant Protection, Agricultural Research Organization, The Volcani Center, Bet Dagan 50250, ISRAEL yairbd@netvision.net.il
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Douglass R. Miller	Systematic Entomology Laboratory, USDA, Beltsville Agricultural Research Center, Beltsville, Maryland 20705 U.S.A. dmiller@sel.barc.usda.gov
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Cooperating Investigators:

Gary Gibson	Biological Resources Program of the Eastern Cereal and Oilseed Research Centre, Agriculture and Agri-Food Canada, Ottawa, Ontario, Canada
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Michael Kosztarab Karen Veilleux	Virginia Polytechnic Institute and State University, Blacksburg, Virginia, U.S.A.
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Continuation of (Related to) Previous BARD Project: No XX

Keywords *not* appearing in the title and in order of importance. Avoid abbreviations.

Hemiptera, Coccoidea, Internet, ScaleNet, database

Abbreviations used in the report, in alphabetical order:

Publications & Patents Summary (following page)

Summary of Cooperation (following page):

Budget: IS: \$111,720 US: \$188,270 Total: \$300,000

y. Ben-Dov

Signature
Principal Investigator

y. Sigel

Signature
Research Authority, Principal Institution

630.72
BARD/KOM
gdc

Deputy Director for
Research & Development

Publication Summary (numbers)

	Joint IS/US authorship	US Authors only	Israeli Authors only	Total
Refereed (published, in press accepted)	2	4	3	9
Submitted, in review, in preparation	1			1
Invited review papers				
Book chapters				
Books	1			1
Master theses				
Ph.D. theses				
Abstracts				
Not refereed (proceedings, reports, etc.)	2			2

Patent Summary (numbers)

	Israeli inventor only	US inventor only	Joint IS/US inventors	Total
Submitted				
Issued (allowed)				
Licensed				

Cooperation Summary (numbers)

	From US to Israel	From Israel to US	Together, elsewhere	Total
Visits/Meetings		1		1
Sabbaticals				
Postdoctorates				

- **Cooperation**, briefly explain whether synergistic, complementary or supportive.

The teams from Israel and the U.S.A. are in daily communication, and provide each other with needed information on a regular basis.

Abstract

Background

Systematic information on all aspects of agriculture is a significant tool in finding solutions to various problems. This project was initiated to develop a searchable database on taxonomy, host plants, geographic distribution, economic importance and control of scale insects (Hemiptera: Coccoidea).

Achievements

A systematic database has been developed for 17 families of scale insects, namely, Acleridae, Asterolecaniidae, Beesoniidae, Carayonemidae, Cerococcidae, Coccidae, Conchaspidae, Dactylopiidae, Eriococcidae, Halimococcidae, Kerriidae, Lecanodiaspididae, Micrococcidae, Ortheziidae, Phenacoleachiidae, Phoenicococcidae and Pseudococcidae. These databases are now available on the Internet in **ScaleNet** – A Searchable Information System on Scale Insects - a Systematic Database of the Scale Insects of the World, (URL: <http://www.sel.barc.usda.gov/scalenet/scalenet.htm>).

Implications

Since 1997, the year in which ScaleNet was first placed on the Internet, this site became the best worldwide source of information on scale insects. The most reliable evaluation is that the site was 'visited' during 1999 by more than 50,000 users. Messages from the clientele of the site clearly indicate that it is widely used by researchers, applied entomologist, quarantine officers, students as well as the general public.

Achievements

1. The database in BASIS has been developed for 17 families (out of 20) of scale insects, namely: Aclerdidae, Asterolecaniidae, Beesoniidae, Carayonemidae, Cerococcidae, Coccidae, Conchaspidae, Dactylopiidae, Eriococcidae, Halimococcidae, Kermesidae, Kerriidae, Lecanodiaspididae, Micrococcidae, Ortheziidae, Phenacoleachiidae, Phoenicococcidae and Pseudococcidae; see Table 1.

Family	Number of Genera	Number of Species
Aclerdidae	3	51
Beesoniidae	3	9
Carayonemidae	1	1
Cerococcidae	3	71
Coccidae	163	1128
Conchaspidae	4	29
Dactylopiidae	1	9
Eriococcidae	67	551
Halimococcidae	5	21
Kermesidae	10	91
Kerriidae	9	96
Lecanodiaspididae	12	78
Micrococcidae	2	8
Ortheziidae	10	115
Phenacoleachiidae	1	2
Phoenicococcidae	1	1
Pseudococcidae	271	1987
Total	566	4248

Table 1. List of families, number of genera and species of scale insects processed in BASIS.

2. The database of the families listed in (1) has been placed on the Internet at the ScaleNet site (<http://www.sel.barc.usda.gov/scalenet/scalenet.htm>). The site is now available for search and query of all persons who require information on scale insects.

Background, scientific and agricultural relevance of the project

Information is the key to finding solutions to agricultural problems but too frequently the required information on poorly known groups of organisms is so scattered and disorganized that it is irretrievable. For this reason many major initiatives in sustainable agriculture, biodiversity, and ecology focus their resources on groups that are well known and have easily accessible information. The thrust of the project reported here was to provide a synthesis of the widely-scattered and fragmented information on a group of insects, and organize it in an easily accessible format. The focus of our studies are the scale insects (Insecta: Hemiptera: Coccoidea), a group that includes numerous agricultural pests throughout the world, including Israel and the USA.

We have developed a first-rate systematic database of the scale insects of the world that is accessible through a World Wide Web (WWW) node on Internet, and a series of publications. The database provides vitally important information in support of the programs of quarantine organizations, biodiversity initiatives, teachers, and pest management strategies. As an example, quarantine programs need a single, easily accessible source of information on the host plants, distribution, economic importance, and currently acceptable scientific names of scale insects when they are intercepted.

Literature on scale-insect systematics is scattered in more than 13,000 scientific articles and books and has been published in nearly every extinct and extant country in the world. Classification systems, the names of taxa, and taxon descriptions have changed dramatically since the early works in the middle 1700's and it often is difficult for persons interested in a particular species or group of species of scale insect to determine which concept is currently accepted by the scientific community. This situation results in frustration and confusion for individuals and organizations interested in finding information on scale insects, and it often is necessary for them to consult with a scale-insect systematist. In some situations direct contact with a coccidologist is a workable solution, but in most regions of the world there are few or no coccidologists available, and those who do exist could better serve humanity by developing more accurate information about scale insects rather than responding to inquiries prompted primarily because of difficulties in locating current, reliable, organized information on scale insects.

The project reported here was designed to alleviate some of these problems. Results of the project are available now in a queriable website, called **ScaleNet** (<http://www.sel.barc.usda.gov/scalenet/scalenet.htm>), that provides immediate access to systematic, biological, and bibliographic information on scale insects and is available to anyone who has access to the Internet. The query system is set up so that clients can discover the information needed in a matter of minutes without consultation with a scale-insect specialist. If additional consultation is still needed, ScaleNet allows clients to send questions to the developers of the system.

In comparison with other groups of insects, the information on scale insects is relatively well organized. There are more or less up-to-date systematic catalogues on most of the major families including the Coccidae (Ben-Dov 1993), Conchaspidae (Ben-Dov 1981), Diaspididae (Borchsenius 1966), Eriococcidae (Hoy 1963), Pseudococcidae (Ben-Dov 1994), and Tachardiidae (Kapur 1958). Bibliographies of

scale-insect literature have been published covering the period from 1758 to 1985 (Morrison & Renk 1957, Morrison & Morrison 1965, Russell et al. 1974, Kosztarab & Kosztarab 1988) and a bibliographic database is kept up-to-date by the Systematic Entomology Laboratory, US Department of Agriculture, Beltsville, Maryland, USA and the Virginia Polytechnic Institute and State University in Blacksburg, Virginia, USA. The genus-group names of all scale insects were compiled and updated to 1985 (Morrison & Morrison 1966, Russell 1970, Kosztarab & Russell 1974, Kosztarab et al. 1986). This information has served as the basis of the ScaleNet initiative.

Methodologies and materials

Software

We chose BASIS as the database program, since it is efficient, comprehensive and user friendly. For detailed information on this software see **Appendix 1 – BASIS**. It is written in FoxPro so that the software will have long-term, up-grade support. BASIS was designed as a system that would be used by many kinds of clientele with different levels of computer skills. It was developed by the Centre for Land and Biological Resources Research, Agriculture Canada, an organization that is committed to providing long-term support to the program.

The first step in starting the ScaleNet project was to enter as many references on scale insects into the BASIS system as possible, because bibliographic information is the keystone of the BASIS system. Concurrently we converted into BASIS, the database of the families Coccidae (Ben-Dov, 1993) and Pseudococcidae (Ben-Dov, 1994) that were resident in a database system developed in The Natural History Museum in London.

Once the bibliographic file was developed, and the scale insect family database was available the ScaleNet initiative was started. The process of developing ScaleNet was complicated and ultimately involved collaborators from industry and scientific organizations in Canada, Israel, and the United States. Contracts were written to input data from the published bibliographies, to move data in various bibliographic databases developed by cooperators (Karen Veilleux and Michael Kosztarab from Virginia Polytechnic Institute and State University, USA) into BASIS, and to update and keep the reference files current. The next step was to develop an interface between the BASIS database and the World Wide Web and to write programs for the query system. Richard Carson & Associates, Advanced Research Division, Reston, Virginia, USA was awarded the contract, and the system became available on the Internet in 1997. For detailed information on ScaleNet see **Appendix 2 & 3**.

Results

Application and Significance

Perhaps the most important evaluation that we can give is that during 1999 **ScaleNet** had more than 50,000 hits from users all over the world and it still is not well known. In a recent trip to Brazil the project was demonstrated to personnel of the Ministry of Agriculture and they were overwhelmingly enthusiastic. Everyone that has used the system is extremely complimentary and excited about how **ScaleNet** can provide information for him or her personally that they would not have been able to obtain in any other way.

Discussion

ScaleNet is a valuable and easily accessible information resource on 17 families of scale insects, out of 20 families in the Coccoidea. As the remaining three families are included in the system, it will become more and more comprehensive and thus more and more useful. Current (optimistic) plans are for the first round of data entry to be completed by the end of the year 2001. After that time, the system will be updated on an annual or more frequent basis as needed. Future enhancements of the system might involve additional query options; or increasing the information content of **ScaleNet** by including a companion database covering all of the natural enemies of scale insects; or a system of images with an illustration or photograph of each species and a description; or unpublished specimen-label information from all of the various museums with scale-insect holdings. There are numerous other possibilities. The primary issue, of course, is funding

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List of publications resulting from the project

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