

URBAN ENTOMOLOGY – A WORLD VIEW

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Abstract—The current world-wide status of research into urban entomology is reviewed. Data were collected by a mailed survey, and telephone or e-mail interviews. Data are incomplete, but some trends do emerge. Most research in urban entomology has an applied orientation. Personnel in most research facilities is limited and nearly all seem understaffed given the diverse programs that are reported. Cockroach and termite research was reported by more laboratories than research on any other pest species. This was particularly true in North America, the United Kingdom, and Australia.

INTRODUCTION

Urban entomology is a rapidly growing discipline, encompassing efforts in teaching, research, and extension throughout the world. For the purposes of this paper, urban entomology is defined as the study of arthropods found in association with humans and their structures. The “urban entomology” perspective is highly variable depending upon geographic location. In developed countries the perspective is very much an “urban” one. Whether pest problems are found in the city or in a more rural environment; whether in a tropical, sub-tropical or temperate region, the focus of many applied research programs is management of a pest species in a modified and controlled environment, i.e., in or around a home or workplace. In the less developed regions of the world, the perspective of urban entomology takes on a more natural view, one of urban pests in relatively unchanged habitats, where the temperature and humidity of the environment in the home or work place is more similar to the ambient environment of pest species. The bridge between these two perspectives is basic research on arthropods affecting human populations that brings to light the behaviour, life histories and habitats of diverse pest species under varying environmental conditions. As the world population expands to 6 billion, it is reasonable to predict that the importance of urban entomology world-wide will grow at an equivalent pace.

The purpose of this paper was to provide a global view, essentially the who, what, and where of urban entomology. It falls well short of that goal, but my hope is to provide some insight on overall research directions.

MATERIALS AND METHODS

Data were collected by means of mailed surveys, e-mail, and telephone contact. The major thrust was to contact government and university laboratories conducting research on pests of urban importance. There was no attempt made to enumerate industry research facilities, although some are included in the data presented.

Survey questions requested information on numbers of employees assigned to urban entomology related activities, species of insect under investigation, the name of a contact at the research facility, and whether research projects were basic or applied. Some data were provided by third parties who were knowledgeable about a region, and some data were inferred directly from published literature. Third party sources and inferences from the literature often resulted in incomplete records for survey questions.

RESULTS

Survey response was low, especially outside the United States. There was nearly a 65% response rate in the United States and Canada, and nearly 20% for all other surveys mailed. Many phone calls

and faxes resulted in a greater return. What follows is a compilation and discussion of survey data organized by region. There is no assumption made that data are complete for any country.

North America

In North America, including Canada and the United States, many research facilities were engaged in research on two or more groups of pest species. Most laboratories reported research on either termites or cockroaches, or both (Table 1). Applied research was more prevalent than basic research, but many laboratories reported conducting both basic and applied research. Over one third of the laboratories also reported research on ants or flies. Ants, especially fire ants and carpenter ants, are major pest problems in certain regions of North America. Research efforts on ants seem under-represented in relation to their pest status, and economic importance.

The presence of research facilities dedicated to urban entomology is greater in North America than any other reporting region in the world. Urban entomologists are relatively well organized. Since 1986, the National Conference on Urban Entomology has been held as a bi-annual conference to promote communication and collaboration among university, government and industry researchers. Also, for the past ten years at the annual meeting of the Entomological Society of America, urban entomologists have held a Formal Conference covering applied and basic research topics.

Table 1. Urban entomology laboratories in the North America. Data reported includes personnel, target species, and type of research project.

Laboratory name and Addresses	Number and Type of Personnel ¹	Species Under Investigation (Basic or Applied)
Canada		
British Columbia Ministry of Agriculture, Fisheries and Food Suite 200, 1690 Powick Rd. Kelowna, BC V1X 7G5 (Contact: Hugh Philip)	1 R, 1 T	Isoptera: <i>Reticulitermes hesperus</i> (A)
University of Guelph - Ontario Department of Environmental Biology Guelph, ON N1G 2W1 (Contact: Gordon Surgoner)	unknown	Acari: <i>Ixodes</i> spp. (A), Diptera: <i>Haematobia irritans</i> (A), <i>Musca autumnalis</i> (A), <i>Tabanidae</i> , <i>Culicidae</i>
University of Toronto Urban Entomology Program 33 Willcocks Street Toronto, Ontario M5S 3B3 (Contact: Tim Myles)	1 D, 1 T	Isoptera: <i>Reticulitermes flavipes</i> (B/A)
City of Winnipeg Winnipeg, Manitoba R3T 2N2 (Contact: Randy Gadawski)	1 E	Diptera: <i>Culicidae</i> (A), Isoptera: <i>Reticulitermes</i> spp. (A)
United States		
University of Arizona 1109 E. Helen Street Tucson, AZ 85719 (Contact: Paul Baker)	1 T	Isoptera: <i>Heterotermes aureus</i> (A)
Auburn University Department of Entomology Auburn University, AL 36849 (Contact: Arthur Appel)	1 P, 2 ASTP, 1 T	Blattaria: <i>Blattella germanica</i> (B/A), <i>Periplaneta americana</i> (B/A), <i>P. fuliginosa</i> (B/A), soptera: <i>Reticulitermes</i> spp. (A), <i>Coptotermes formosanus</i> (A), Hymenoptera: <i>Solenopsis invicta</i> (A), <i>Monomorium pharaonis</i> (A), <i>Tapinoma melanocephalum</i> (A) <i>millipedes</i> (B/A)

Table 1 (continued)

University of California/ Berkeley ² Department of Entomology 201 Wellman Hall Berkeley, CA 94720 (Contact: Vernard Lewis)	unknown	termites
University of California/Riverside Department of Entomology Riverside, CA 92521 (Contact: Michael Rust)	3 P, 2 ASTP, 1 SRA	Blattaria: <i>Blattella germanica</i> (B/A), Siphonaptera: <i>Ctenocephalides felis</i> (B/A), Diptera: <i>Musca domestica</i> (B/A), <i>Fannia canicularis</i> (B/A), <i>Culex</i> spp. (B/A), <i>Psorophora columbiae</i> (B/A), <i>Hippelates</i> spp. (B/A), Chironomidae, (B/A) Hymenoptera: <i>Linepithema humile</i> (B/A), <i>amponotus</i> spp. (B/A), Isoptera: <i>Incisitermes minor</i> (B/A), <i>Reticulitermes hesperus</i> (B/A),
Clemson University Urban Entomology Res. Lab Box 340365, Cherry Farm Department of Entomology Clemson, SC 29634 (Contact: Pat Zungoli)	1 P, 1 P-TT	Blattaria: <i>Blattella germanica</i> (A), <i>Periplaneta americana</i> (A), <i>P. fuliginosa</i> (B/A), Isoptera: <i>Reticulitermes</i> spp. (B/A), <i>Coptotermes formosanus</i> (B/A), miscellaneous pests perimeter
University of Florida ² Florida Research & Educ. Ctr. 3205 College Ave. Ft. Lauderdale, FL 33314 (Contact: Nan-Yao Su)	2 P, 1 T	Isoptera: <i>Reticulitermes</i> spp. (B/A), <i>Coptotermes formosanus</i> (B/A) <i>Cryptotermes brevis</i> (B/A)
University of Florida ² Department of Entomol.& Nem. 214 Newell Hall Gainesville, FL 32611 (Contact: Phil Koehler)	unknown	cockroaches, fleas, ants
University of Georgia Department of Entomology Georgia Experiment Station Griffin, GA 30223 (Contact: Brian Forschler)	1 ASTP, 2 T	Isoptera: <i>Reticulitermes</i> spp. (B/A), Hymenoptera: <i>Linepithema humile</i> (A)
University of Georgia Department of Entomology Athens, GA 3060 (Contact: Beverly Sparks)	3 P, 1 RA, 1 T	Hymenoptera: <i>Solenopsis invicta</i> (A)
University of Hawaii at Manoa Department of Entomology Honolulu, HI 96822 (Contact: Kenneth Grace)	1 AP, 1 AEP, 1 EP, 2 RA,	<i>Coptotermes formosanus</i> (B/A), <i>Cryptotermes brevis</i> (B/A), <i>Incisitermes immigrans</i> (B/A), Formicidae: <i>Ochetellus glaber</i> (B/A), <i>Monomorium destructor</i> (B/A), <i>Camponotus variegatus</i> (B/A)
Louisiana State University Department of Entomology Baton Rouge, LA 70803 (Contact: Gregg Henderson)	1 AP, 1 T	Isoptera: <i>Coptotermes formosanus</i> (B/A)
University of Kentucky Department of Entomology Lexington, KY 40546 (Contact: Michael Potter)	1 ASTP,	Isoptera: <i>Reticulitermes flavipes</i> (A)
University of Maryland Department of Entomology College Park, MD 20742 (Contact: Barbara Thorne)	1 ASTP, 1 RA	Isoptera: <i>Reticulitermes flavipes</i> (B/A), <i>Reticulitermes virginicus</i> (B/A), <i>Zootermopsis nevadensis</i> (B)

Table 1 (continued)

University of Mississippi Department of Entomology and Plant Pathology Mississippi State, MS 39762 (Contact: James Jarrett)	1 P	Isoptera: <i>Reticulitermes</i> spp. (A)
University of Nebraska Urban Entomology Program Department of Entomology Lincoln, NE 68583 (Contact: Shripat Kamble)	1 P	Blattaria: <i>Blattella germanica</i> (B/A), Isoptera: <i>Reticulitermes flavipes</i> (B/A)
North Carolina State University ² Department of Entomology Raleigh, NC 27695 (Contact: Coby Schall)	unknown	Blattaria: <i>Supella longipalpa</i> (B/A)
Pacific Southwest Forest and Range Station ² USDA Forest Service Berkeley, CA 94701 (Contact: Michael Haverty)	unknown	termites (B/A)
Purdue University Center for Urban & Industrial Pest Management Department of Entomology West Lafayette, IN 47907 (Contact: Gary Bennett)	2 P, 1 RS, 2 RA 2 T	Blattaria: <i>Blattella germanica</i> (B/A), several ant species, stored products pests
Southern Forest Experiment Station ² USDA Forest Service Gulfport, MS 39503 (Contact: Brad Kard)	unknown	termites (B/A)
Spokane Falls Comm. College ² Department of Biology Spokane, WA 99204 (Contact: Laurel D. Hansen)	unknown	Hymenoptera: <i>Camponotus</i> spp. (B/A)
Texas A&M University Center for Urban and Structural Entomology College Station, TX 77843 (Contact: Roger Gold)	3 P, 1 ARS, 1 SRA, 5 T	Ants, Cockroaches, termites, fleas, mosquitoes, biting flies
USDA-ARS ² Med. & Vet. Ent. Res. Lab. 1600 23 Dr. Gainesville, FL 32604 (Contact: Richard Brenner)	unknown	Blattaria: <i>Blattella asahinai</i> (B/A), <i>Blattella</i> <i>germanica</i> (B/A), Siphonaptera: <i>Ctenocephalides</i> <i>felis</i> (B/A)
Virginia Polytechnic Institute & State University Urban Pest Control Res. Center Blacksburg, VA 24061 (Contact: William Robinson)	1 P, 1 T	Blattaria: <i>Blattella germanica</i> (B/A), <i>Periplaneta</i> <i>americana</i> (B/A), Diptera: <i>Aedes sollicitans</i> (A), <i>A.</i> <i>albopictus</i> (A)
Washington State University ² Department of Entomology Pullman, WA 99164	unknown	Formicidae: <i>Camponotus</i> spp. (A)

¹ AEP = Associate Extension Specialist, ARS = Assistant Research Scientist, ASTP = Assistant Professor, AP = Associate Professor, D = Director, E = Entomologist, EP = Emeritus Professor, P = Professor, P-TT = Part-time assistants, SRA = Senior Research Assistant, RA = Research Associate, RS = Research Scientist, T = Technician, TD = Tutor/demonstrator,

² Data inferred from literature, not based on survey results.

Central/South America

No laboratories conducting urban entomology research were identified in Central/South America, with the exception of one in Puerto Rico involved in vector control (Table 2). Urban entomology research efforts in this part of the world are largely conducted by industry representatives in conjunction with pest control operators and in-house pest control program managers (T. Granovsky, personal communication). The pest control industry has a large presence in Central and South America, and many pest control associations have regular meetings for their membership. These meetings are well-supported by the chemical industry. The major urban entomology pest problems in Central and South America, other than disease vectors, are cockroaches, termites, and ants (T. Granovsky, personal communication).

Australia and New Zealand

Survey response was low from laboratories contacted in Australia. However, all laboratories responding to the survey reported research projects that focused on applied knowledge, and this was also indicated for those labs identified through the literature (Table 3). Several termites species including those in the genera *Coptotermes*, *Mastotermes*, *Heterotermes*, *Nasutitermes*, and *Schedorhinotermes*, were identified as the target of many research programs, but projects were not limited to termites, and research projects on flies, mosquitoes, fleas, cockroaches and other urban pests were also identified. Data from New Zealand was sketchy and came from the literature. While only *Dermatophagoides* and scabies were identified as research species, in New Zealand, it is likely that other groups of urban pest species are under investigation.

Europe

Over 40% of all urban entomology laboratories in Europe responding to the survey were dedicated, at least in part, to cockroach research and over 45% investigate pest species of Diptera, including mosquitoes and house flies (Table 4). About 27% reported research on stored products pests, or pests of museums or libraries. Only two laboratories reported research on termites. It is assumed that a large portion of the European research on wood destroying pests such as termites and wood-boring beetles is conducted at industry research facilities. Other arthropod pest problems under investigation included species of medical and veterinary importance such as *Ctenocephalides spp.* and *Dermatophagoides spp.*

Asia

The presence of urban entomology research in Asia is steadily increasing (W. H. Robinson, personal communication). Chinese urban entomologists recently held their fourth National Urban Entomology Conference. While formal research efforts in urban entomology are limited in China, the Conference draws about 150 people who have pest control responsibilities and presumably

Table 2. Urban entomology laboratories in Central and South America. Data reported includes personnel, target species, and type of research project.

Laboratory name and Addresses	Number and Type of Personnel	Species Under Investigation (Basic or Applied) ¹
Puerto Rico Centers for Disease Control and Prevention Vector-borne Infectious Disease Dengue Branch 2 Calle Casa San Juan 00921-3200 (Contact: Paul Reiter)	unknown	mosquitoes

¹Data inferred from literature, not based on survey results.

Table 3. Urban entomology laboratories in Australia and New Zealand. Data reported includes personnel, target species, and type of research project.

Laboratory name and Addresses	Number and Type of Personnel ¹	Species Under Investigation (Basic or Applied)
Australia Centre for Entomological Res. and Insecticide Toxicology (CERIT) Biological Science The University of New South Wales N.S.W. 2052 Sydney (Contact: C. Orton)	2 SRE, 3 RE, 1 TD, TO, 2 HA	Acari: <i>Dermatophagoides</i> spp. Blattaria: <i>Blattella germanica</i> (A), <i>Periplaneta americana</i> (A), Coleoptera: <i>Tribolium castaneum</i> (A), <i>Anthrenus flavipes</i> (A), Diptera: <i>Musca domestica</i> (A), Calliphora dubia(A), <i>Chrysoma ruffiacis</i> (A), <i>Culex quinquefasciatus</i> (A), <i>C. annulirostris</i> (A), <i>Aedes vigilax</i> (A), <i>A. australis</i> (A), Hymenoptera: <i>Pheidole megacephala</i> (A), <i>Camponotus consobrinus</i> (A) <i>Iridomyrex</i> spp. (A), Isopoda: <i>Porcellio</i> spp. (A), Isoptera: <i>Coptotermes acinaciformis</i> (A), Lepidoptera: <i>Plodia interpunctella</i> (A), <i>Tineola bisselliella</i> (A), <i>Tinea translucens</i> (A), Siphonaptera: <i>Ctenocephalides felis</i> (A), Thysanura: <i>Ctenolepisma</i> spp. (A),
CSIRO Div of Forest Products ² Private Bag 10 Rosebank MDC Victoria 3169 (Contact: John French)	unknown	termites
Granitgard Pty Ltd. CSIRO Ian Wark Laboratory Bayview Ave, Clayton VIC 3168 (Contact: D. Ewart)	1 P, 1 TO, 2 P-TT	Isoptera: <i>Coptotermes acinaciformis</i> (A), <i>C.</i> (A), <i>C. spp.</i> (A), <i>Schedorhinotermes</i> spp. (A), <i>Heterotermes</i> spp. (A), <i>Mastotermes darwiniensis</i> (A), <i>Nasutitermes</i> spp. (A)
Social Insect Research Station Agri. Western Australia Baron-Hay Court South Perth 6151 Western Australia (Contact: J. van Schagen)	2 P, 2 TO	Hymenoptera: <i>Vespa germanica</i> (A), Isoptera: <i>Coptotermes acinaciformis</i> (A), <i>C. michaelsoni</i> (A), <i>Mastotermes darwiniensis</i> (A), <i>Linepithema humile</i> (A)
University of Sydney Department of Medical Entomology Westmead Hospital Westmead N.S.W. 2145 (Contact: Richard Russell)	1 D, 1STO,	Mosquitoes, Lice, Mites, Fleas, Biting and Stinging Arthropods
University of Technology Department of Health Sciences P.O. Box 123 Broadway N.S.W. Sydney 2007 (Contact: Peter Miller)	1 AP, 1 STO, 1 TO	Blattaria: <i>Blattella germanica</i> (A), <i>Periplaneta americana</i> (A) Siphonaptera: <i>Ctenocephalides felis</i> (A)
New Zealand Wellington School of Medicine ² Department of Medicine Wellington (Contact: Julian Crane)	unknown	Acari: <i>Dermatophagoides</i>
Victoria University of Wellington ² School of Biological Sciences Wellington (Contact: John Andrews)	unknown	Acari: <i>Dermatophagoides</i> , Scabies

¹AP = Associate Professor, D = Director, HA = Honorary Associate, P = Principal researcher, P-TT = Part-time assistants, RE = Research Entomologist, SRE = Senior Research Entomologist, STO = Senior Technical Officer, TO = Technical Officer, TD = Tutor/demonstrator,

²Data inferred from literature, not based on survey results.

Table 4. Urban entomology laboratories in Europe. Data reported includes personnel, target species, and type of research project.

Laboratory name and Addresses	Number and Type of Personnel ¹	Species Under Investigation (Basic or Applied)
Croatia		
Institute for Plant Protection in Agriculture and Forestry of Rep. of Croatia Svetošimunska 25 10 000 Zagreb (Contact: Darka Hamel)	1 E, 1 T	rats and mice, stored product pests, Culicidae
Institute for Public Health Mirogojska c 9 21 000 Split (Contact: Josip Bakić)	1 E, 1 T	Cockroaches, rats
Institute for Public Health Microgojska c 9 10 000 Zagreb	1 E, 1 T	Diptera: <i>Culicidae</i>
Pedagoški fakultet L. Jaegera 9 31 000 Osijek (Contact: Enrih Merdić)	1 E, 1 T	Diptera: <i>Aedes spp.</i> , <i>Culex spp.</i>
Czechoslovakia		
National Institute of Health Prague (Contact: František Rettich)	unknown	Blattaria: <i>Blattella germanica</i>
Denmark		
Danish Pest Infestation Laboratory Skovbrynet 14 DK-2800 Lyngby (Contact: K.-M. Vagn Jensen)	5 RS, 5 T	Blattaria: <i>Blattella germanica</i> (B/A), <i>Blatta orientalis</i> (B/A), <i>Periplaneta americana</i> (B/A), Coleoptera: <i>Anobium punctatum</i> (B/A), <i>Anthrenus verbasci</i> (A), <i>Attagenus unicolor</i> (A), <i>Trogoderma angustum</i> (A), Diptera: <i>Musca domestica</i> (B/A) Hymenoptera: <i>Lasius niger</i> (A), Siphonaptera: <i>Ctenocephalides felis</i> (B/A), <i>Xenopsylla cheopis</i> (B/A), Pulicidae: <i>Pediculus humanus capitus</i> (A), <i>P. h. corporis</i> (B/A), Lepidoptera: <i>Tineola bisselliella</i> (A), Thysanura: <i>Lepisma saccharina</i> (A)
France		
Université de Rennes I Campus de Beaulieu Laboratoire d' Ethologie 35042 Rennes Cedex (Contact: C. Rivault)	2 RS	Blattaria: <i>Blattella germanica</i> (B/A), <i>Supella longipalpa</i> (A), <i>Blatta orientalis</i> (A)
Germany		
German Mosquito Control (KABS) ² 6701 Waldsee. (Contact: Norbert Becker)	unknown	mosquitoes
Italy		
Universita' Milano Insituto Entomologia Via Celoria 2 I-20133 Milano (Contact: Luciano Süss)	3 P	Blattaria: <i>Blattella germanica</i> (A), Diptera: <i>Culex pipiens</i> (A) Lepidoptera: <i>Plodia interpunctella</i> (A), <i>Ephesttia kuehniella</i> (A)

Table 4 (continued)

The Netherlands		
University of Amsterdam Inst. Systematics & Population Biol. Section Population Biology Kruislaan 320 1098 SM Amsterdam (Contact: R. de Boer)	2 P	Acari: <i>Dermatophagoides</i> (B/A)
Eindhoven Univ. of Technology ² Biomedical and Health Technology P O Box 513, 5600 MB Eindhoven (Contact: H.S.M. Kort)	unknown	Acari: <i>Dermatophagoides</i>
Inspectorate for the Environment ² Department of Pest Control P.O. Box 350 6700 AJ Wageningen (Contact: J.T. de Jonge)	unknown	cockroaches
Plant Protection Service Section of Entomology P.O. Box 9102 6700 HC Wageningen (Contact: Ing. G. Vierbergen)	unknown	Ants (A), Mites (A)
Spain		
Unidad de Parasitologia Facultad de Veterinaria c/ Miguel Servet, 177 50013 Zaragoza (Contact: J. J. Osácar)	1 P, 2 RA, 4 RS	Siphonaptera: <i>wild rabbit fleas</i> (A), <i>Ctenocephalides felis</i> (A), <i>C. canis</i> (A), <i>Pulex irritans</i> (A)
Sweden		
Naturhistoriska Riksmuseet Box 50007, S-104 05 Stockholm (Contact: Monika Åkerlund)	unknown	pests of museums, archives, and libraries
United Kingdom		
AgriSense BCS Ltd. Treforest Industrial Estate Pontypridd Mid Glamorgan CF 37 5 SU (Contact: Owen Jones)	unknown	Blattaria: <i>Blattella germanica</i> , (A), Diptera: <i>Musca domestica</i> (A), Coleoptera: <i>Tribolium</i> spp. (A), <i>Lasioderma serricornes</i> (A), Lepidoptera: <i>Ephestia</i> spp. (A), <i>Plodia</i> spp. (A)
University of Birmingham School of Biological Sciences Birmingham (Contact: Moray Anderson)	1 SL	Diptera: <i>Musca domestica</i> (B/A), <i>Fannia canicularis</i> (B/A), Lepidoptera: <i>Ephestia castaneum</i> (B/A)
Building Research Establishment Watford, Garston Herts WD2 7JR (Contact: Geraldine Lea)	3 RS, 3 RA, 3 T	Acari: <i>Dermatophagoides</i> (A), Blattaria: <i>Blattella germanica</i> (A), Coleoptera: <i>Anobium punctatum</i> (A), <i>Lyctus brunnea</i> (A), <i>Hylotrupes bajulus</i> (A), Isoptera: <i>Reticulitermes santonensis</i> (A),
Central Science Laboratory Slough Laboratory London Road Slough, Berkshire SL3 7HJ (Contact: Kenneth Wildey)	1 SSO, 1 HSO, 1 SO, 2 ASO	Blattaria: <i>Blatta orientalis</i> (B/A), <i>Blattella germanica</i> . (B/A), <i>Periplaneta australasiae</i> (B/A), Diptera: <i>Musca domestica</i> (B/A) Acari: stored product, public health, animal health mites. All stored product pests including rats and mice

Table 4 (continued)

Imperial College of Science and Technology ² Department of Biology Silwood Park, Ascot Berkshire SL5 7PY (Contact: G.N.J Le Pastourel)	unknown	Blattaria: <i>Blatta orientalis</i>
King's College ² Life Sciences London (Contact: Bryan Turner)	unknown	Psocoptera: <i>Liposcelis bostrychophila</i>
University of Salford ² Department of Environmental Health and Housing Salford (Contact: R. G. Murphy)	unknown	pest elimination
National Museum of Wales Cardiff Contact: R.E. Childs)	unknown	pests of museums and historic houses
Rentokil Group PLC. Research and Development Div. Felcourt, East Grinstead West Sussex RH19 2JY (Contact: John Newton)	1 RS, 1 RA, 1 T,	Blattaria: <i>Blattella germanica</i> (A), <i>Blatta orientalis</i> (A), <i>Periplaneta americana</i> (A), Diptera: <i>Musca domestica</i> (A), <i>Drosophila spp.</i> (A), Coleoptera: <i>Anthrenus verbasci</i> (A), Isoptera: <i>Reticulitermes santonensis</i> (A), Lepidoptera: <i>Tinea pellionella</i> (A), <i>Tineola bisselliella</i> (A)
University of Wales, Cardiff Department of Pure & Applied Biology P.O. Box 915 Cardiff CF1 3TL (Contact: Janet Hemingway)	1 P, 1 T	Blattaria: <i>Blattella germanica</i> (A), Diptera: <i>Culex quinquefasciatus</i> (B/A)
University of Wales Insect Investigations Ltd. P.O. Box 915 Cardiff CF1 3TL (Contact: Peter Langley)	1 P, 3 P-TT	Blattaria: <i>Blattella germanica</i> (A), Diptera: <i>Musca domestica</i> (A)

¹E = Entomologist, P = Professor, P-TT = Part-time Technician, RS = Research Scientist, RA = Research Assistant, SL = Senior Lecturer, T = Technician, SSO/HSO/SO/ASO = Senior, Higher and Assistant Scientific Officers

²Data inferred from literature, not based on survey results.

conduct some small research projects to make informed treatment and management decisions. In research facilities where urban entomology research is conducted, research efforts concentrate on stored products pests, cockroaches, and termites (Table 5). An Urban Entomology Research Centre has been established at Zhejiang Agricultural University at which cockroach and termite research is conducted (W. H. Robinson personal communication).

In Japan and Korea, *Blattella germanica* and *Dermatophagoides* were the most common focus for research. However, in all parts of Asia, many resources are invested in vector control for mosquitoes (W. H. Robinson, personal communication).

Africa

Survey data from African countries are inadequate to allow for concrete discussion. A single lab in Kenya responded, reporting that their research efforts were aimed at basic and applied termite

Table 5. Urban entomology laboratories in Asia. Data reported includes personnel, target species, and type of research project.

Laboratory name and Addresses	Number and Type of Personnel ¹	Species Under Investigation (Basic or Applied)
Hong Kong		
Chinese University of Hong Kong ² Department of Biology Shatin, N.T. (Contact: Mike Crosland)	unknown	termites
Japan		
Fujita Health University ² Department of Medical Zoology Toyoake (Contact: K. Okamoto)	unknown	Blattaria: <i>Blattella germanica</i>
Japan Environmental Sanitation Ctr. ² Kawasaki 210 (Contact: Ikuo Tanaka)	unknown	Blattaria: <i>Blattella germanica</i>
Kyoto University Pesticides Research Institute Oiwake-cho, Kitahirakawa, Sakyo-ku Kyoto 606 (Contact: Yasumasa Kuwahara)	2 P	Blattaria: <i>Blattella germanica</i> , <i>Periplaneta fuliginosa</i>
Nagoya University ² School of Medicine Department of Medical Zoology Nagoya (Contact: I. Sakaki)	unknown	Acari: <i>Dermatophagoides</i>
Toyama Med. and Pharm. Univ. ² Laboratory of Parasitology Faculty of Medicine Toyama (Contact: R. Arakawa)	unknown	Hemiptera: House-invading stink bugs
University of Tsukuba ² Institute of Agriculture and Forestry Tsukuba (Contact: T. Shono)	unknown	Acari: <i>Dermatophagoides</i>
Yokohama City Institute of Health ² Yokohama (Contact: Akihiro Kanayama)	unknown	Blattaria: <i>Blattella germanica</i>
Korea		
Yonsei University ² Institute of Tropical Medicine Seoul (Contact: Han-II Ree)	unknown	Blattaria: <i>Blattella germanica</i>
Kyung-Hee University ² Medical College Department of Parasitology Seoul (Contact: Yong-han Park)	unknown	Acari: <i>Dermatophagoides</i>
Malaysia		
Universiti Sains Malaysia ² Vector Control Research Unit Penang (Contact: Yap Han-Heng)	unknown	Diptera: mosquitoes

Table 5 (continued)

People's Republic of China		
Huazhong Agricultural University ² Plant Protection Department Wuhan (Contact: Deng Wang-Xi)	unknown	stored products insects
Southeastern Agricultural University ² Plant Protection Dept. - Entomology Chengdu (Contact: Prof. Liu)	unknown	stored products pests
Zhejiang Agricultural University ² Urban Entomology Research Center Hangzhou (Contact: Prof. Lee)	1 P, 2 T	cockroaches (B/A), termites (B/A)

¹P = Professor, T = Technician²Data inferred from literature, not based on survey results.

Table 6. Urban entomology laboratories in Africa. Data reported includes personnel, target species, and type of research project.

Laboratory name and Addresses	Number and Type of Personnel ¹	Species Under Investigation (Basic or Applied)
Kenya Kenya Agricultural Res. Inst. National Agri. Res. Centr Muguga, P.O. Box 30148 Nairobi (Contact: Gerald Ochiel)	1 SRO	<i>Isoptera: Macrotermes subhyalinus (B/A), M. michaelsoni (B/A)</i>

¹SRO = Senior Research Officer

Table 7. Urban entomology laboratories in the Middle East. Data reported includes personnel, target species, and type of research project.

Laboratory name and Addresses	Number and Type of Personnel	Species Under Investigation (Basic or Applied)
Israel Hebrew University ¹ Department of Parasitology Hadassah Medical School Jerusalem (Contact: K. Y. Mumcuogla)	unknown	<i>Acari: Dermatophagoides</i>

¹Data inferred from literature, not based on survey results.

research (Table 6). It is expected that research efforts in urban entomology on the African continent would be dominated by the necessity of vector control.

Middle East

No survey responses were received from Middle Eastern countries. One laboratory in Israel was identified as investigating *Dermatophagoides* (Table 7). As with Asian and African countries, it is

assumed that those researchers involved in urban entomology are primarily putting their effort into either vector control or general pest elimination programs.

SUMMARY

While much information is lacking on laboratories involved in urban entomology research, it appears that with few exceptions, urban entomology is not well represented world-wide in the research arena. Research areas that are well represented are cockroaches and termites. In part, this may be due to grant support by the chemical industry, and in part to the ubiquitous distribution of these two groups of pest species. Research efforts are skewed in the direction of applied research and most of those laboratories that were represented in this paper appear to be under-staffed. Yet, there is an undeniable awareness of the growing need for increased efforts in urban entomology. The convening of the International Conference on Pests in the Urban Environment supports that premise. In the United States, despite declining budgets and constraints on hiring, university research positions in urban entomology have continued to increase over the past ten years. This same trend is seen in industry with an increase in the number of positions having a greater emphasis on "specialty products." In both university and industry arenas new positions in urban entomology are arising at a time when most other research areas are declining. If the United States is representative of world-wide trends, efforts in urban entomology research are increasing. However, many more programs are essential to adequately meet the demands of research needs for the abundance of urban pest species in a growing world.

ACKNOWLEDGMENTS

Many people provided valuable information for this paper. With thanks I acknowledge: In Africa: Gerald Ochiel; In Australia: Don Ewart, John Jennings, Peter Miller, Chris Orton, Richard Russell, and John van Schagen; In Canada: Tim Myles, Gordon Surgoner, Randy Gadawski, and Hugh Philip; In Croatia: Darka Hamel; In Denmark: Kim Søholt Larsen, K.-M. Vagn Jensen; In France: C. Rivault; In Germany: Deiter Rudolph; In Japan: Yasumasa Kuwahara; In Italy: Luciano Süss; The Netherlands: R. de BoerIng, and G. Vierbergen; In Puerto Rico: Paul Reiter; In Spain: J. Lucientes, Juan José Osácar; In Sweden: Monika Åkerlund; In the United Kingdom: Moray Anderson, Janet Hemingway, Owen T. Jones, Peter Langley, Geraldine Lea, John Newton, and Ken Wildey; In United States: Paul Baker, Gary Bennett, Brian Forschler, Ted Granovsky, Roger Gold, Ken Grace, Nancy Hinkle, James Jarrett, Shripat Kamble, John Klotz, Robert Kreiger, Mir Mulla, Brad Mullens, T. Michael Peters, Mike Potter, Bill Robinson, Mike Rust, Darryl Sanders, Beverly Sparks, Barbara Thorne, and John Wedberg. Bill Robinson provided most of the information reported for Asia, and Ted Granovsky was my primary resource on Central and South America. Their perspective was invaluable.