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URBAN ENTOMOLOGY – FIFTY YEARS IN THE MAKING

MICHAEL K. RUST
Department of Entomology, University of California, 900 University Avenue,
Riverside, CA 92507, USA

Abstract Fifty years have passed since Walter Ebeling published his seminal text on *Urban Entomology*. Many factors converged in the years following its publication to stimulate interest in the pests associated with urban environments and create the discipline of urban entomology. The rapid urbanization and increase in global trade, invasive pests, and demand for pest management services helped stimulate research and the extension of information on urban pests. Conferences such as the International Conference of Urban Pests highlighted the ongoing research and outreach efforts in urban pest management and helped urban entomology gain its recognition as a discipline. Increased urbanization, global trade, invasive pests, pesticide resistance, and funding for research and outreach activities are some of the major challenges facing urban entomology in the next fifty years.

Key Words invasive pests, urbanization, global trade, extension and outreach

INTRODUCTION

Fifty years have passed since the seminal publication of *Urban Entomology* by Walter Ebeling. In the preface, he outlined three main areas as the focus of the text: insect pests of man in and around his buildings, problems associated with urbanization, and insect pest problems in recreational areas (Ebeling 1975). The study of arthropod pests of plants in urban landscapes were not included and have largely remained a separate and distinct discipline. The title of Ebeling's text was the first use of the term "urban entomology" and now it is widely accepted as a discipline by one of the largest organizations of professional entomologists, The Entomological Society of America.

In 1975, factors such as the increase of urbanization worldwide, increased spread of invasive pests, increased demands for pest management services, and legislation collided along with the publication of *Urban Entomology* to stimulate research and outreach regarding urban pests. The following discussion will explore some of the events, conditions, and developments that lead to its acceptance. Many of the following comments and observations are contributions of my co-authors, Drs. Gary Bennet, William H. Robinson, and Chow-Yang Lee, to the *Annual Review of Entolomology* article, "The Emergence and Sustainability of Urban Entomology" (Rust et al. 2024).

EARLY CONTRIBUTIONS

Prior to 1975 numerous entomologists such as H. Hartnack, A. Mallis, N. Hickin, W.C. Harvey and A. Hill in the 1930's and 1940's made contributions that would later become the foundation of urban entomology. Probably the most important and significant publication for pest management professionals (PMPs) and academics was *The Handbook of Pest Control* by A. Mallis first published in 1945 (Mallis 1945). An important training manual was the *Scientific Guide to Pest Control Operations* (Truman and Butts 1962). They have had numerous revisions and may be the most widely circulated urban entomology texts worldwide.

Another early contributor was N. Hickin, Technical Manager and Scientific Director from 1944 to 1972 at Rentokil Limited pest control company, based in the United Kingdom. His series of books on pests of urban structures are collectively referred to as the Rentokil Library. In Australia, P. Hadlington published several books dealing with urban pests, and is probably best known for *Urban Pest Control in Australia* (Hadlington and Gerozisis 1985). He was a pioneer in the training of PMPs and a strong advocate of professionalism in the industry (Anon. 2017).

An extensive list of contributors and individuals conducting urban entomological research and outreach activities over the past century is provided by Rust et al. (2024).

URBANIZATION

The current estimate of the urban population in the world is approximately 4.5 billion (Ritchie and Roser 2018). By 2050, 68% of the estimated world's population will live in urbanized areas (UN 2008). The definition of what constitutes an urban area varies greatly. A new definition of urbanization is being adopted as the Degree of Urbanization (GHSL 2025). The entire area of a country is divided into cities, towns and semi-dense areas, and rural areas to which commuting zones are added around cities. The method is based on population grids. For our purposes, it monitors access to services and infrastructure in areas with different population sizes and densities. This approach may be useful in examining the spread of invasive pests.

The shift in human populations has created significant demands on pest management services, governmental agencies and institutions worldwide. Urban habits such as parks and green space, sanitary and sewer systems, solid waste disposals and landfills, and urban agriculture, provide harborage and food for pests. The lack of adequate housing and infrastructure promote conditions that contribute to the spread of vectors and disease (Knudson and Sloof 1992).

INVASIVE AND RESURGENT PESTS

Increasing global markets and rapid urbanization have helped spread pests of households and structures and those found in recreational areas. As international trade increases, the number of invasive alien pest species also increases (Westphal et al. 2008). It is not necessarily the type of trade that is important in the spread of invasive pests, but the volume of trade. Some species such as German cockroaches, *Blattella germanica* (L.), are highly adapted to human environments, whereas others like Argentine ants, *Linepithema humile* compete with native species to become established (McKinney 2001).

Of the 100 of the world's worst invasive species, nine insect species are important pests in urban settings (Lowe et al. 2004). The list includes *L. humile*, red imported fire ant, *Solenopsis Invicta* Buren, Formosan subterranean termite, *Copotermes formosanus* Shiraki, and yellow crazy ant, *Anoplolepis gracilipes* F. Smith. The numbers of invasive species have been increasing. Between 1969 and 2013, the number of invasive termites increased from 17 species to 28 species worldwide (Evans et al. 2013).

The bed bugs, *Cimex lectularius* L. and *Cimex hemipterus* (F.), are an example of a worldwide resurgence in pest status or increase their distribution because of high levels of resistance to previously effective insecticides (Dang et al. 2017).

DEMAND FOR PROFFESSIONAL PEST SERVICES

The demand for professional pest control services has increased dramatically since World War II. In 1965, the revenue of 6,000 pest control firms in the US was approximately US$350 million (US$3.3 billion in 2022) (Osmun and Butts 1968). In 2022, the structural pest control market in the United States surpassed US$11 billion (FBI 2020, PCT 2023).

An important piece of legislation that stimulated the demand for both research and outreach activities was the Federal Insecticide, Fungicide, and Rodenticide Act (1947). In 1972, the responsibility for the oversight of pesticides was transferred to United States Environmental Protection Agency. The act required private and commercial pesticide applicators to be certified as competent to apply pesticides. After certification continued training related to research and development of integrated pest management (IPM) strategies and practices were required (Snetsinger 1983). As a result, the professional pest management industry joined with federal and state regulatory agencies to develop standards for training. The training requirement was primarily the responsibility of the Cooperative Extension Service, the educational component of land grant universities. Additional personnel and faculty were hired to meet this new demand.

The focus of pest management has evolved dramatically over the past 50 years. Early efforts focused on the control of urban pests primarily with chemical approaches. This approach gave way to a more holistic approach and integrated pest management. In recent years, the concept of sustainable pest management (SPM) has gained traction. SPME is “a holistic, whole-system approach to managing pests in agricultural and other managed ecosystems and urban and rural communities that builds on the concept of integrated pest management (IPM) with broader consideration of human health and social equity, nvironmental protections and economic vitality.” (CDPR 2025).

CONFERENCES AND OUTREACH ACTIVITES

Two research-based conferences have been instrumental in promoting the discipline of urban entomology. In 1986, the National Conference on Urban Entomology held its first meeting. This Conference was important for gathering industry and academia, organizing support and gaining national recognition with the US. The Conference has been held every 2 years since. The papers from the presentations from these conferences are available online (https://ncue.tamu.edu/proceedings).

The National Conference on Urban Entomology was an important factor in the recognition of urban entomology as a discipline by the Entomological Society of America (ESA). In 1986, ESA was first petitioned to consider urban entomology as a section. Urban symposia were gradually incorporated into the subsection Crop and Urban Pest Management. Finally in 2010, urban entomology was granted full section status when ESA reorganized the Medical, Urban & Veterinary Entomology section.

The first International Conference on Urban Pests (ICUP), originally the International Conference on Insect Pests in the Urban Environment, was held in 1993 at Cambridge University, United Kingdom. Since then, conferences have been held in 10 different countries on four different continents. The conferences have typically 200-300 attendees from 20-30 countries. The permanent ICUP website (http://icup.org.uk) maintains a database of the

proceedings of all 10 conferences. It is the largest free-to-access online database on urban entomology. The current database has more than 1,300 documents.

OUTREACH AND EXTENSION ACTIVITIES

Over the last 50 years, the way in which research and pest control information has been extended to the public and industry has changed dramatically. In 1978, homeowners from two cities in Texas (Dallas and College Station) were surveyed regarding their attitudes and practices towards insect problems and insecticide use (Frankie and Levenson 1978). In Dallas and College Station, 40-45% and 38-51% of the respondents obtained information regarding the pest problem from PMPs, respectively. About 18-26% of the respondents near the campus of Texas A&M University contacted university sources. For non-chemical information 25-54% of respondents relied on intuition and 20-38% on friends. Only 4-20% relied on printed materials.

In an on-line survey with 263 Dutch respondents, participants were asked where they obtained information regarding pests in their structures. Twelve sources of information were considered, and the Likert scale was as follows: PMP websites > PMPs = label information or salesperson > family = science institution website = local gov. website = online forum = books > local gov. officials = neighbors = newspaper and TV = scientific institutions (Schoelitsz et al. 2018.). Clearly the respondents have a greater reliance on internet sources and social media than scientific institutions and written information. In recent years, webinars have become a popular method of extending information in the pest management industry. The social media platforms may become an important avenue for extending information to the public.

FUTURE DIRECTIONS

The next fifty years will see many significant challenges because of urbanization, global trade, invasive insect pests, and climate change. One of the major issues facing urban entomologists will be funding and support for the necessary research and outreach activities. Positions and resources devoted to urban activities have declined as the role of the research university changes. Industry and academia need to partner to gain the resources required in the next 50 years. Molecular research tools have allowed us to answer questions about the origins of invasive insects, the structure of termite colonies, and the development of pesticide resistance previously unavailable to us. However, these tools and research are expensive.

Sustainable Pest Management will gradually replace IPM as the primary focus of the research and extension agenda. The impact of pest management decisions on human health and environmental issues will become even more important in the next 50 years. Social and economic impacts will become more factors affecting pest management decisions.

The discipline of Urban Entomology has flourished since Walter Ebeling wrote *Urban Entomology*. The demands of the public and pest management industry for integrated and sustainable pest management have grown dramatically. The challenge for the future will be to meet that demand.

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