Perspectives in Urban Entomology

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PERSPECTIVES IN URBAN ENTOMOLOGY

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FOREWORD: THE URBAN HABITAT

Urbanized areas are, by definition, environments dominated by the actions of man. Other organisms share urban habitats with human beings for a variety of reasons. Some are nurtured actively by people, because they give aesthetic pleasure or companionship or economic return—street trees, ornamental shrubs and herbs, and domestic pets are examples. Some wild creatures endure because the indoor or outdoor environmental characteristics of cities are within their ranges of environmental tolerance as long as no active human effort is expended to extinguish them, native plants on remnant undisturbed sites, migratory waterfowl. Others—weeds, pests, and parasites of many kinds—thrive even though unwanted and actively suppressed, because their own requirements are met by the environments people create. The quantity of information available concerning the nonhuman biota of urban areas rather closely reflects the perceived importance of several organisms to people. Species of economic significance have received the most attention.

Scholars in many disciplines have begun to study urbanized areas as habitats for humans and for other organisms. The growing literature is scattered widely. Urbanists in many fields will find the contributions by entomologists in this collection of value to their understanding of urban ecosystems. What insects can dwell in cities, and how to control those which become excessively abundant—without contaminating the rest of the environment with toxic chemicals—are questions of interest to contemporary society generally.

Several generalizations can be made concerning typical aspects of the urban habitat, although current knowledge is far from complete. Recurrent patterns of topography, soils, climate, vegetation, and biota are associated with urbanized areas. Exceptions to the generalizations also may be worth noting.

The landforms present in an urban region greatly affect the spatial arrangement of human activity that is undertaken there. Modern industrial societies can transform slopes and drainage radically if there is an economic or political incentive to do so. But the preurban topography almost everywhere influences the configuration of land that is built up first and of the intervening islands of more nearly natural vegetation associated with cliffsides, watercourses, and marshes. Over time such areas may be reduced by continuing urban growth, if

they are not protected by effective political land-use controls. The trend is toward ever smaller islands of urban land not given over to intensive human use.

When land is urbanized, its soils are altered radically. Erosion may precede urbanization on land that is farmed or cleared for fuel or timber. During urban construction, soils are drained and their structure is disturbed. Substantial erosion is typical. After construction the erosion slows. Hard pavements and buildings seal off great expanses of soil from the flux of energy, moisture, and biotic activity, and the habitat is essentially lost to most soil-dwelling organisms. Where soils are not covered, they may be packed hard by the constant passage of people or machines. In suburban areas around modern American or European cities, soils may be preserved beneath lawns and their biota may be stimulated by water and nutrients from septic tanks. Suburban soils may be unlike the natural soils of a region. Their structure may be altered greatly during development or may be changed by residents to accommodate cultivated plants. They may be treated with fertilizer and insecticides but are unlikely to accumulate leaf litter and its complex fauna.

Urban climate has two basic characteristics by which it differs from the climate of a city's hinterland. The first of these is the distinctive urban heat–water balance; the second is the air pollution endemic to the modern urban–industrial complex.

Cities outside the arid regions are warmer and less humid than their rural surroundings. They exhibit extensive stone and asphalt surfaces, and they require massive combustion of fuels. Hence cities have measurably warmer air than their surroundings, and the intensity of the difference tends to increase with the size of the urban agglomeration. Consequently, when the warm urban air rises, a mild local breeze blows inward toward the city from all compass directions when it is not overpowered by regional winds. The availability of the higher recorded precipitation in urban areas, however, is probably more than offset by rapid artificial drainage. Snow covers the ground for a shorter period than in surrounding rural areas. In desert or semidesert regions, cities may be oases where irrigation maintains more vegetation and a moister atmosphere than in the surrounding countryside. Indoors, of course, the range of variation in temperature and humidity generally is less than outdoors. Indoor climate is controlled to suit the preferences of the human inhabitants.

Air pollution is a much studied aspect of the urban climate. Emissions from stationary sources and from vehicles are greater than can be dispersed rapidly most of the time in many North American and European industrial cities. Thus concentrations of particulate matter and gases may reach levels unhealthy to people and other organisms. Spectacular episodes may result when stagnant air persists for a number of days. General atmospheric circulation patterns dictate the general frequency of stable, subsiding air masses; local topographic conditions also play a major role in the actual experience of air pollution incidents. The release of particulates into the atmosphere has been controlled

during recent decades, and progress is notable in cities with extensive heavy industry (e.g., Pittsburgh, Pennsylvania). Gaseous pollutants are less tractable generally than particulate matter, and those produced by motor vehicles are especially costly to control. Urban pollutant concentrations are measurable in the atmosphere for tens and hundreds of miles downwind from urban areas.

Vegetation in urban areas typically differs from that of surrounding regions in quantity, composition, and management practices. In cities, vegetation is consigned to the open space not occupied by buildings or hard surfaces. Near the center of an urban region most open space is publicly owned; in the suburbs it may be owned by many private individuals. Urbanized areas may have more forested land than surrounding agricultural regions from which forests have been cleared, as in eastern North America. Alternatively, urban areas may support more trees than the countryside in generally treeless regions such as the midlatitude grasslands or deserts. Vegetation beneath the tree canopy typically is less abundant in the managed landscapes of urban areas than in unmanaged ecosystems.

The kinds of plants found in cities may be quite distinct from those of non-urban regions. Relatively few native plant communities survive in urban areas; they are replaced by cultigens and weeds. The potential range of cultivated plants is vast, as demonstrated by the immense diversity of species displayed in botanic gardens and arboreta. But the actual diversity of commonly cultivated plants actually is far smaller than the potential, at least in American cities for which data are available. For trees, shrubs, and herbs a handful of species accounts for the overwhelming preponderance of individual plants.

Management of urban vegetation is fragmented among numerous agencies and private landowners, unlike forest, ranch, or farm regions where hundreds or thousands of acres may be under a single management. This means that the patches of vegetation across an urban region may be managed for diverse purposes and goals. One manager may control weeds and insects closely; another may allow both to develop without interference. In cities of the United States the central reason for vegetation is ornamental; some European cities, however, derive economic products from urban forests. The extent of human interference in biological processes may vary sharply over short distances, even in urban vegetation that presents a similar physiognomic appearance.

Animals that inhabit cities are those able to adjust their behavior patterns to human activity, to utilize patches of open or woodland-edge habitat, to avoid recognizable competition with people, or to attract human appreciation and esteem. Others, especially some insects, are able to thrive inside buildings and to tap man's own food supply surreptitiously. The diversity of wild species that can survive in urbanized areas may be surprising to urbanites who do not customarily study natural history. One compilation for London suggests that a substantial proportion of the British fauna can persist in the urban vicinity (Table I). There is no reason to regard Table I as an exhaustive list; it merely

Table I. The Biota of Contemporary London[a]

Kind	Number of species		London species as percentage of United Kingdom species
	Seen in London	Seen in the United Kingdom	
Higher Plants	1835	3000	61
Insects			
Hemiptera-Homoptera (bugs)	317	390	82
Coleoptera (beetles)	248	3700	7
Macro Lepidoptera (moths, butterflies)	728	930	78
Diptera (true flies)	2300	5200	44
Fishes (fresh and brackish water)	33	45	73
Amphibians	8	12	66
Reptiles	6	10	60
Birds	203	301	66
Terrestrial mammals			
Insectivora (shrews, moles, hedgehogs)	5	6	83
Chiroptera (bats)	10	15	66
Lagomorpha (hares, rabbits)	2	3	66
Rodentia (squirrels, voles, rats, mice)	8	17	47
Carnivora	4	11	36
Artiodactyla (deer)	3	9	33

[a]Compiled by Gill and Bonnett (1973) for London as defined by a circle of 32 km radius centered on St. Paul's Cathedral (about 3200 km^2).

reflects existing information on one urban region that has received a substantial amount of attention from local naturalists.

The biomass of urban animals in general can be hypothesized to be less than that of rural nature preserves, because the biomass of vegetation is relatively small in urban areas. Yet particular animals may become more abundant in urban areas than elsewhere. House sparrows, rock doves, rats, and feral dogs are a few examples. Formerly rare organisms may become more abundant as a result of urban and industrial growth. For example, after air pollution eliminated the lichens that camouflaged light-colored British moths from predators, the formerly rare, dark-colored mutants became abundant in the countryside downwind from heavy industrial districts.

It is up to entomologists to promote public understanding of the diverse and complex world of insects that persists in urban areas. At present few urbanites know or want to know about the insects that share their environment other than the simplest way to eradicate noxious pests. Urbanites understandably are reluctant to share their homes with pests or to see their scarce vegetation defoliated. But the simplest chemical means to exterminate a pest may affect

many species other than the target, and may contaminate the human environment as well. As the scientific understanding of insects and their management increases, urbanites can expect better methods to restrain overabundant insects, yet encourage those which provide economic benefit or aesthetic pleasure as part of the changing seasons. Entomologists must call upon other scientists to provide data useful to their work with insects, so that all can contribute ultimately to the survival of man in the urban milieu.

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PREFACE

Much has been said in recent years about the emerging field of urban entomology, yet there is less than complete agreement as to what is meant by the term. In conceptual terms, urban entomology should be antithetical to rural entomology but in strict terms it is not, as some chapters in this volume will verify. To most persons, urban entomology simply refers to the study of insects, including their management, in urban environments. Whatever definition is used, however—and several chapter authors have offered their perspectives on this point for their particular sphere of interest—most who have had contact with the field would agree that in no other area of entomology is man more involved with insects, and insects with man, in such a wide variety of ways. In this connection, at one extreme are those persons who recognize and appreciate the aesthetic value of selected insect species, while at the other end of the spectrum are those who fear the presence, or even the threat of the presence, of any insect. The opinion of the majority, however, would likely fall between these extremes.

The question of why urban entomology is finally emerging is an interesting one. For years entomologists have given attention to the applied problems of insects and associated organisms as they impact on man in urban environments. The early text and reference books on shade tree insects by Felt[1] and Herrick[2] certainly must be considered contributions to urban entomology although the term was not used then. Many of the contributions to our knowledge of pests of medical importance similarly fall into this category.

Very possibly economics is the root cause of the recognition urban entomology is accorded today. By virtue of employment of most of our entomologists in the public sector, with support provided from tax dollars, contributing service and information to those who provide this support can only help to preserve this relationship. In most developed countries such a small proportion of the population is now directly engaged in agricultural production that the tax support base resides principally in the urban sector. An associated factor contributing to the emergence of urban entomology is the ecology and environmental movement. People want to know more about the plants and animals

[1]Felt, E. P. (1924). "Manual of Tree and Shrub Insects." Macmillan, New York.
[2]Herrick, G. W. (1935). "Insect Enemies of Shade Trees." Comstock Publ., Ithaca, New York.

around them, and about the various options for improving or protecting their surroundings. Quite logically, insects and related organisms have been newly discovered by this more perceptive urban populace.

Quite apart from the question of why urban entomology is today gaining new prominence, many other questions of a practical and philosophical nature deserve attention. Do concepts, principles, and theory have a place in this field? Should urban entomologists be expected to make basic as well as practical contributions to science? What boundaries should limit the kinds of activities and problems with which urban entomologists become involved? Where is the "pulse" of the clientele group we are attempting to serve, and if found, should lay involvement be invited to participate in setting research or other priorities for the urban entomologist? What kinds of collaborative arrangements, if any, should the urban entomologist seek with those in other sciences, including the social sciences? How should the prospective urban entomologist be trained? How can the urban entomologist best communicate research findings to the general public?

In this volume, 17 chapters provide insight to some of these and other relevant questions. The contributions resulted largely as an outgrowth of a symposium entitled Ecology and Management of Insect Populations in Urban Environments, held during the Fifteenth International Congress of Entomology, 1976, in Washington, D.C. The contributors were requested to provide a broad account of their respective topics. Exploration of appropriate concepts and principles and speculation on future trends were encouraged. Each was requested to emphasize the relationship of man to his particular entomological topic. The topics represent the diverse characteristics of urban entomology; the book is not a catalog of all relevant subject areas. Examples of additional topics of interest to entomologists working in urban environments include endangered insect species, entomophobia and delusions of parasitosis, and insects associated with turfgrass and soil, with food processing plants and dining establishments, with stored products, and with urban aquatic habitats.

We fully expect additional coverage of the subjects of which urban entomology is composed to appear in the years ahead. It is hoped that the readers of these chapters will gain insight to the state of the science as of this year. For those readers who are or will become urban entomologists we earnestly seek answers to the questions raised earlier and to new questions yet to be asked.

We would like to acknowledge Jutta Frankie who typed and assisted in the copyediting of this volume.

The Editors

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