

# **MEDICALLY IMPORTANT SYNANTHROPIC ARTHROPODS OF RUSSIA AND NEIGHBORING COUNTRIES**

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The processes of urbanization is accompanied by attraction to settlements, the synanthropization, of many systematic groups of animals including arthropods. Synanthropization of some vectors of diseases agents, means augmentation of their contacts to people and increase of epidemiological danger. The annotated ecological-faunistic list of the synanthropic species of arthropods dwelling in East Europe-Asian part of Palearctic region (territory of the former USSR) is presented. Data concerning to habitats of adult arthropods in premises or in the open territories or breeding places of larvae in settlements have been included in the list. It includes 432 species and subspecies from 48 families of 10 orders. For each species the urbanistic area of habitation is specified and data on ecological features of species in anthropogenic conditions are resulted. The most extensive collection of species belongs to order Diptera (242 species, or 54.5%) which show a wide range of variations of synanthropy. Dictyoptera are represented by 12 species, or 2.7%. Siphonaptera is represented by 55 species, or 12.4%, and Parasitiformes (class Arachnida) by 76 species, or 17.1%. On the basis of the ecological-faunistic list of synanthropic species of arthropods paths and stages of invasions by them of urbanocenoses are considered. Their classification based on extent of the injury caused to people, classification of ecological groups of the synanthropic arthropods based on character of their feeding, parasitizing on humans, features of a habitation in anthropogenic conditions is discussed.

Medical entomology, ecology, anthropogenic conditions

## **INTRODUCTION**

Last century is characterized by an intensive urbanization of human assemblage, concentration of the population in cities, augmentation of scales and complication of an infrastructure of settlements. The processes of urbanization is accompanied by attraction to settlements, the synanthropization of many taxons of animals including arthropods. Adaptable processes of their biological, ecological and behavioral features in anthropogenic conditions lead to enrichment of species composition of a complex of synanthropic arthropods, extension of geographic ranges of these species in urbanocenoses and to local increases of their number. Synanthropization of some vector species of diseases agents means increase of their contacts with people and epidemiological danger.

At present, over the world is noted the appearance so-called arising and renewing infections: 1) opened for the first time; 2) previously endemic but now extending in many regions, and 3) previously eliminated but now showing appreciable increase number of cases. These infections are Lyme disease, tick encephalitis, arboviral fevers, malaria, leishmaniasis, pediculosis and accompanying it diseases, etc (Rettich, 2002; Brown, 2004; Heymann, 2005; Gratz, 2005; Sergiev and Filatov, 2006). Among the factors causing these phenomena researchers note global warming, the ecological balance disruption, migratory processes, etc. Synanthropization processes of arthropods associated to agents of these diseases also play the important role in aggravation of above-mentioned problems.

The connatural loci of infections change under influence of anthropogenization processes. There are changes in a composition and number of species, geographic ranges of arthropod vectors, reservoirs and agents of many infections and in their epidemiological status that entails an approaching of the loci of diseases to anthropogenic territories and, accordingly, to augmentation of epidemiological intensity of many transmissible diseases. Changeable situation with the synanthropic arthropods having medical value, demands on studying features of their habitation in anthropogenic conditions and development of modern control system for synanthropic arthropods.

Basis for theoretical discussions of processes of synanthropization the arthropods dwelling constantly or getting for a while in settlements in this area became the annotated list of synanthropic species that be created by us for the first time to such large region as the part of the Euro-Asian continent occupied of these countries. The list is generated basically on literary data of numerous authors (more than 500 sources), and also on our data, and includes, behind some exceptions, the period from beginning of 20th century to present time.

Species of arthropods, which have been specified by authors as revealed on settlements, are included in the list. It contains 432 species and subspecies from 48 families of 9 orders registered in certain settlements. For each species the urbanistic geographic range is specified and data on ecological features of species in anthropogenic conditions are noted. Quantity of settlements in which each separate species was registered, types of settlements where species inhabit, and time of synanthropization, characterize substantially the level of synanthropization and features of their ecology in anthropogenic conditions.

The list of synanthropic species allows to receive general representation about a fauna of the arthropods dwelling in settlements of east Euro-Asian parts of Palearctic region. The most extensive collection of species belongs to order Diptera (242 species, or 54.5%) which representatives show a wide range of synanthropic variants. In comparison with dipterans, within the Dictyoptera there were only 12 species, or 2.7%, closely associated with peoples. In the Siphonaptera there were 55 species, or 12.4%, and order Parasitiformes (class Arachnida) there were 76 species, or 17.1%.

### PATHS OF INVADING URBANOCENOSIS BY ARTHROPODS

Consideration of whole fauna of synanthropic arthropods allows to pick out the one of their main characteristics — habitation in the settlements located within the borders of or outside of a connatural geographic range. If to consider the complex of arthropods dwelling in settlements as a whole it is possible to note, that they penetrate there by different paths: 1) introduction or migration of arthropods from other geographic or climatic regions; 2) synanthropization or penetration of arthropods into settlements from adjacent natural habitats and occupation by them anthropogenic biotopes; and 3) sojourn of separate development stages of arthropods from surrounding connatural habitats on terrain of settlements.

For whole complex of the arthropods living in the world these paths are, in our opinion, phases of one process. The species historically dwelling in natural conditions, primary passes (through sojourn to constant habitation) to existence in conditions of settlement — by synanthropization, and then they move to other regions or on other continents by introduction. The habitation in settlements increases opportunities of arthropods for expansion by migration directly on humans, with subjects and vehicles, on pets, agricultural and synanthropic animals.

**Stages of synanthropization:** The species dwells in connatural habitats → the species occupy the settlement biotopes → the species settle in settlements within the borders of the climate zone → species settle in settlements in other climatic zones or → species settle in settlements on other continents.

By consideration of the fauna of synanthropic arthropods of Palearctic region that includes the studied area it is possible to note, that the species which have introduced here, live in settlements outside of a connatural geographic range, inside of dwellings (for example, cockroaches: *Periplaneta spp.*, ants: *Monomorium pharaonis*). The basic limiting factor for such species is winter negative temperatures in which they can survive only in heated premises. Species which have assimilated the urbanocenoses during synanthropization in borders of the natural geographic range (for example, mosquitoes), can be meet in settlements, as inside of houses, and in the adjoining open terrain because their overwintering developmental stages have adapted for negative winter temperatures of a temperate climate.

Consideration of the complex of synanthropic arthropods and their negative influence on people has allowed to establish; that it varies depending on conditions of their habitation, development of medical and biologic sciences, and also on change of perception by people of this problem.

It is possible to note following tendencies in this problem:

1. For some species, early synanthropized, previously called “household pests of sanitary-hygienic value”, in last decades connection with conservation and mechanical transfer of agents of many diseases and other factors influencing negatively on human health has been established. Such species belong to polyphagous (cockroaches, ants) and waiting ectoparasites (bed bugs) (Jupp et al., 1990; Blow et al., 2001).

2. For other species, transmission of more agents of diseases than it was known previously, has established. So, for ticks *Ixodes spp.* it is revealed that they transfer, besides tick encephalitis, the Lyme disease, erlichiosis, anaplasmosis (Korenberg, 1992, 1999). Vectors of the virus of Western Nile fever are about 40 species of mosquitoes, at the first place, *Culex spp.*, and also ticks *Hyalomma marginatum* (L’vov et al., 2004).

3. Appearance of so-called, arising and renewing infections is often associated with synanthropization of their vectors — arthropods, and accordingly with transformation of the connatural loci of agents of diseases in urbanistic ones. Occupation by ticks *Ixodes persulcatus* Schulze and *I. ricinus* L. of settlement terrain leads to infestation of people with tick encephalitis and Lyme disease directly in cities (Bogdanova, 2006).

4. Synanthropization processes are accompanied by change of dominant species that also leads to changes in the epidemiological status of synanthropic arthropods. So, the mass distribution of cat fleas, *Ctenocephalides felis* (Bouché) in cities has drawn attention to their vector abilities. It is proved that this species is a vector of agents of the rat typhus, the pseudo-typhus of mice, and Lyme disease in the USA and Europe, and also the Marseilles fever in Italy (Farhang-Azad et al, 1984; Virga et al, 1991; Menier et al, 1999). In laboratory conditions, *C. felis* participated in transfer of agent of the “cat’s scratches’ illness (Higgins et al, 1996) and cestode *Dipylidium canicum* (Pugh, 1987).

The modern comprehension of negative influence of synanthropic arthropods on humans is much broader than that existed in the last century. The species composition of synanthropic arthropods has noticeably increased and features of their habitation in urbanocenosis have changed, and, accordingly, their medical value has altered. Number of species of the synanthropic arthropods of medical value has increased that is associated with change of people’s point of view on the factors accompanying with concept of «favorable life conditions». Demand to such factors accompanying with presence of synanthropic arthropods as allergic and disturbing influences, entomophobia, anti-sanitary and anti-aesthetic perception of their presence. The above-mentioned has demanded to development of complete, branched, detailed classification of synanthropic arthropods of medical value, which is presented in Table 1.

**Table 1.** Classification of synanthropic arthropods of medical value on character of the injury, caused to humans.

Having medical value	Vectors and reservoirs of agents of human diseases	Specific vectors, ectoparasites — lice, fleas, bloodsucking Diptera (mosquitoes, blackflies, gnats, sand flies, horse flies), mites (Trombiculidae, Gamasidae), ticks (Argasidae, Ixodidae)
		Mechanical vectors — cockroaches, bugs, ants, non-bloodsucking flies
	Agents of human diseases	Specific endoparasitic mites — <i>Sarcoptes</i> , <i>Demodex</i> , Gamasidae
	Causing myiasis	Non-specific (casual) endoparasites — non-bloodsucking flies, botflies
Causing disturbing influence	Causing allergies	Bloodsucking insects and mites, stinging Hymenoptera, Arachnida, house dust mites
	At bloodsucking	Bloodsucking insects and ticks
	Because of dimensions and appearance	Spiders, large cockroach species, crickets, bugs (Pentatomidae)
	Because of big number	Flies (Chloropidae, Drosophilidae, Psychodidae)

## ECOLOGICAL CLASSIFICATION OF SYNANTHROPIC SPECIES OF ARTHROPODS

The bio-diversity of a complex of synanthropic arthropods is reflected in their belonging to various systematic groups and in their biological and ecological characters. On the basis of several general ecological parameters the complex of synanthropic arthropods we divided it into 10 ecological groups. For this purpose following ecological-biological criteria — type of feeding, parasitizing on people or its absence, habitation in certain anthropogenic biotopes, in houses or in the open terrain of settlements are used (Table 2). Ecological groups of synanthropic arthropods associated with categories of terrains and buildings in settlements have become the basis for development of the integrated control system for synanthropic arthropods.

### CONCEPT OF THE MODERN INTEGRATED CONTROL SYSTEM FOR SYNANTHROPIC ARTHROPODS

Studying fauna of synanthropic arthropods in Russia and the adjacent countries and also perennial application of control tactics, means, and methods in different types of settlements have become the basis for development of this system.

Its basic positions the following:

1. Now, the main part of control measures is carried out in settlements and their vicinities. It is associated with the strongly pronounced tendency of attraction of arthropods of medical value to settlements.

2. The complex of synanthropic arthropods include introduced species dwelling directly on the humans and in premises, and synanthropized species from the local fauna, which have passed to constant or temporal habitation in settlements.

3. According to the basic biotopes of synanthropic arthropods city terrain and objects are grouped in separate categories: a) suburbs of settlements, forest and park areas; b) terrain adjoining to houses; c) houses and premises where people stay temporarily (offices, shops, amusement places etc.); d) houses and premises where people stay constantly; e) human bodies and clothes.

4. Categories of city terrain and objects define an interrelationship and structure of preventive, protective and control measures, their tactics and choice of effective pesticides and their preparations, the control equipment, frequency of pesticidal treatments carrying out during different seasons. Control measures in each category affect whole complex of arthropods typical for it (Table 2).

5. Requirements to efficacy of control measures should to be defined by the epidemiological, medical or disturbing value of arthropods. In the first case it is necessary to reach 100% control efficacy and in others cases decrease in number below disturbing level is possible.

**Table 2.** Ecological groups of synanthropic arthropods.

No	Ecological group	Taxonomic group	Anthropogenic biotopes
1	Keratophagous — human endoparasites	Mites: <i>Sarcoptes scabiei</i> , <i>Demodex</i> spp.	Human body
2	Bloodsucking — constant human ectoparasites	Lice: <i>Pediculus capitis</i> , <i>P. humanus</i> , <i>Phthirus pubis</i>	Human body
3	Keratophagous, eating organic particles of dust in premises	Mites: <i>Dermatophagoides pteronyssinus</i> , <i>D. farinae</i>	Dwellings, premises
4	Bloodsucking waiting ectoparasites (polyhostal)	Ticks: <i>Ornithonyssus bacoti</i> , <i>Dermanyssus gallinae</i> , <i>Argas persicus</i> , <i>Ornithodoros papillipes</i> . Bugs: <i>Cimex lectularius</i> Fleas: <i>Ctenocephalides felis</i> , <i>C. canis</i> , <i>Xenopsylla cheopis</i> , <i>Pulex irritans</i>	Dwellings, premises

5	Polyphagous — associated with refugees in buildings	Cockroaches: <i>Blattella germanica</i> , <i>Blatta orientalis</i> , <i>Periplaneta americana</i> , <i>Supella longipalpa</i> . Crickets: <i>Acheta domesticus</i> Ants: <i>Monomorium pharaonis</i>	Dwellings, premises
6	Polyphagous associated with soil	Ants: <i>Myrmica</i> , <i>Lasius</i> , <i>Formica</i>	Dwellings, premises
7	Polyphagous associated with breeding places near to buildings	Non-bloodsucking flies: <i>Musca domestica</i> , <i>Fannia canicularis</i> , <i>Muscina stabulans</i> Calliphoridae, Sarcophagidae Yellowjackets and hornets	Dwellings, premises
8	Bloodsucking — active-attacking ectoparasites (polyhostal)	Mosquitoes: <i>Culex pipiens</i> complex, <i>Anopheles</i> spp., <i>Culex</i> spp., <i>Aedes</i> spp. Blackflies, gnats, sand flies, horse flies, <i>Stomoxys calcitrans</i>	The open terrain of settlements
9	Bloodsucking waiting ectoparasites (polyhostal)	Ticks: <i>Ixodes ricinus</i> , <i>I. persulcatus</i> , <i>Haemaphysalis concinna</i> , <i>Dermacentor marginatus</i> , <i>Rhipicephalus sanguineus</i> , <i>R. pumilio</i>	The open terrain of settlements
10	Phytophagous, predators and entomophagous associated with agricultural landscapes	Bugs: Pentatomidae, Reduviidae Fleas, Chloropidae: <i>Thaumatomyia notata</i>	The open terrain of settlements

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