

INSECT VECTORS OF TROPICAL DISEASES

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Summary

Insects represent the most diverse group of animals, living in any kind of microhabitats and feeding on different foods. Parasitism is the symbiotic relationship that favored the interaction with vertebrates and with micro-organisms. There are some classifications of parasitism, but that which consider the period in which the insect lives as parasite in relation to the total life-cycle period is useful in the study of insects. The higher insect groups that include parasite species are denoted, and special emphasis is made in the separate origin of this type of symbiosis. The effects of parasitic insects on hosts are discussed considering the direct consequences of insect parasitism and the indirect damage by the transmission of pathogens. The general types of transmission, and the higher groups of micro-organisms transmitted by insects, are briefly documented. Summaries of the principal taxa of insect vectors of the most important tropical diseases are included.

1. Introduction

Class Insecta constitute the most diverse group of animals over the earth, not only in the sense of number of species, but in life styles, habitat and food resources they use. Almost 72 percent of all animals are insects, and they can be found in forests, grasslands, deserts, cultivated lands, urban areas, fresh and salt water collections, living in any kind of microhabitats and feeding on different foods during different stages of their lives. Some insects eat litter and dead plant matter, others on dung or carcasses,

others on green plants, and some more on most other kinds of terrestrial animals (Daly et al., 1978).

Trophic relationships of insects with other animals are the main reason by which insects interact with micro-organisms and vertebrates, and by which they acquired their importance as vehicles of pathogens to vertebrates, including man. In the sense of the symbiotic relationships, insects may be predators if they kill and consume more than one prey organism to reach maturity, parasitoids if they require only one host to reach maturity but result killed, or parasites if the insect feed on one or more hosts that may be damaged, but normally do not die by the interaction. This chapter deals with parasitic insects that associate in any time of their evolution not only with their vertebrate hosts but also with other parasitic micro-organisms that use insects as a mechanical vehicle or as one of their biological host as well as a vertebrate host.

2. Insects as Parasites

Although insects interact with man and other vertebrates in different manners, the most important type of interaction between them, which deserves special attention, is parasitism.

Parasitism is the symbiotic relation between two species or populations, in which one, known as parasite, obtain a benefit upon the other, named the host. This relation is a metabolic one because the parasites nourish or use enzymes from the host. As a consequence, there are some levels of damage of the host integrity, which in normal situations do not produce the death of the host, as it happens with predation or parasitoidism. In general, the body size of the parasite is considerably smaller than the host's body, usually this organism selects the host species and needs, if not one, just a few hosts to complete its life-cycle. Additionally, it is important to mention that the host abundance do not necessary needs to be higher than the parasite to hold up its population.

Insect parasitism occurs not only over vertebrate hosts, but on other invertebrates including insects. This interaction may exist before the appearance of terrestrial vertebrates, as can be interpreted from the fossil record, and the diversity of parasite-host interactions that can be seen today in nature. As an example, we can mention the case of sand-flies of the family Ceratopogonidae; females of the genus *Forcipomyia*, as well as of other related genera feed on the hemolymph of other insects, but other genera of the same family, as *Culicoides*, feed on the blood of vertebrates.

Insect parasitism arise independently in the major groups of insects, not from one stem ancestor, and for this reason, the morphological, physiological and ecological strategies to use the resource is considerably diverse. Nearly as a rule, the immunological response of the host to a new parasite is severe, whereas a parasite relationship established some time ago in the evolutionary scale usually produce null or light reactions in the host. Nevertheless in both cases parasites could produce severe effects in the host in the case of immuno-depression or if the parasite population increase above the normal number of individuals.

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Bibliography

Benenson, A. S. (Ed.) (1987) El control de las enfermedades transmisibles en el hombre. *Organización Panamericana de la Salud, Publicación científica* N° 507: 1-536. [An alphabetically organized abridged presentation of human infectious diseases, including description, distribution, incubation period, transmission mechanism, and control methods].

Biagi, F. (1982) *Enfermedades parasitarias*. 2nd Ed. Prensa Médica Mexicana, México, 376 pp. [A text book on human parasitology].

Borror, D. J., D. W. Delong and C. A. Triplehorn (1981) *An introduction to the study of insects*. 5th Ed. Saunders Coll. Publ. Philadelphia, 827 pp. [A text book on general entomology].

Daly, H. W., J. T. Doyen and P. R. Erlich (1978) *Introduction to Insect Biology and Diversity*. International Student Edition, McGraw-Hill Kogahusha, LTD., Tokyo, 564 pp. [A text book on general entomology].

David, W. A. L. (1975) The status of viruses pathogenic for insects and mites. *Annual Review of Entomology*, 20: 97-117. [Review essay of virus attacking insects and mites, with a good amount of references].

Faust, E. C., P. Rusell and R. C. Jung (1981) *Parasitología clínica de Craig y Faust*. Salvat, Mexico, 888 pp. [A text book on Medical Parasitology].

Galvao, C., R. Carcavallo, D. Da Silva Rocha & J. Jurberg (2003) A checklist of the current valid species of the subfamily Triatominae Jeannel, 1919 (Hemiptera, Reduviidae) and their geographical distribution, with nomenclatural and taxonomic notes. *Zootaxa* 202: 1-36. [An up to date list of the Triatomine species of the World and their classification].

Gilles, H. M. and D. A. Warrell (1993) *Bruce-Chwatt's Essential Malariology*. 3th ed. Edward Arnold, London. [An extensive treatise on all aspects concerning malaria].

Githeko A.k., S. W. Lindsay, U. E. Confalonieri, and J. A. Patz (2000) Climate change and vector-borne diseases: a regional analysis. *Bulletin of the World Health Organization*, 78: 1136-1147. [a good analysis on how the global climate change may affect the incidence and distribution of diseases transmitted by insects].

Gubler, D. J. (1991) Insects in disease transmission, pp. 981-1000. In: G.T. Strickland (Ed.). *Hunter Tropical Medicine*, 7th Ed. Philadelphia. [the role of insects in the transmission of disease].

Gubler, D. J. (1998) Resurgent vector-Borne diseases as a global health problem. *Emerging Infectious Diseases* 4 (3) (on line: <http://www.cdc.gov/ncidod/eid/vol4no3/gubler.htm>) [An analysis of the factors promoting diseases transmitted by insects].

Horsefall, F. L. and I. Tamm (1965) *Viral and rickettsial infections of man*. 4th Ed. Lippincott Co., Philadelphia, 1282 pp. [a text book of human diseases caused by these microorganisms].

Hunter, G. W., W. W. Frye and J. C. Swartzwelder (1973) *Manual de Medicina Tropical*. 3th Ed. Prensa Médica Mexicana, Mexico, 1072 pp. [Information on human diseases which are common in the tropical areas of the World, some of which are transmitted by insects].

Ibarra, J. (1993) Lice (Anoplura), Chapter 15, pp. 517-528. In: Lane, R. P. & R. W. Crosskey (Eds.).

Medical Insects and Arachnids. The Natural History Museum, Chapman & Hall, London. [An actualized basic information on lice, including morphology, taxonomy, distribution, importance, and basic control methods].

James, M. T. and R. F. Harwood (1969) *Herm's Medical Entomology*. 6th Ed. MacMillan Co., London, 484 pp. [A text book focused in those groups of insects with medical importance].

Knowlton, G. F. and J. A. Rowe (1934) Horseflies. *Utah Agriculture Experimental Station*, 48: 1-2. [A technical report on the importance of Tabanid horseflies].

LaPage, G. (1971) *Parasitología veterinaria*. CECSA, Mexico, 790 pp. [A text book on animal parasitology].

Lewis, R. E. (1993) Fleas (Siphonaptera), Chapter 16, pp. 529-575. In: Lane, R. P. & R. W. Crosskey (Eds.). *Medical Insects and Arachnids*. The Natural History Museum, Chapman & Hall, London. [An actualized basic information on fleas, including morphology, taxonomy, distribution, importance, and basic control methods].

Lyght, C. E. (Director) (1964) *Manual Merck*. Merck Sharp and Co., New Jersey, 1373 pp. [An abridged presentation of human diseases, including description, symptoms, distribution, incubation period, transmission mechanism, and treatment].

Malaria Foundation International, on line: <http://www.malaria.org/> (August, 2007). [notice and information on-line on this disease].

Manthei, C. A. and B. L. Deyoe (1970) Brucellosis, pp. 91-108. In: Gibbons, W. J., E. J. Catcot and J. F. Smithcors (Eds.). *Medicina y cirugía de bovinos*. La Prensa Médica Mexicana, Mexico, 877 pp. [A text book on cattle diseases].

Service, M. W. (1993) Mosquitoes (Culicidae), Chapter 5, pp. 120-240. In: Lane, R. P. & R. W. Crosskey (Eds.). *Medical Insects and Arachnids*. The Natural History Museum, Chapman & Hall, London. [An actualized basic information on mosquitoes, including morphology, taxonomy, distribution, importance, and basic control methods].

Strong, R. P. (1944) *Stitt's diagnosis, prevention and treatment of tropical diseases*. 7th Ed. Blakiston Co., Philadelphia, Vol. 1 & 2, 1747 pp. [Very useful information on exotique diseases, in spite of its antiquity].

TDR-WHO (Tropical Disease Research-World Health Organization). Chagas Disease, on line: <http://www.who.int/tdr/diseases/chagas/direction.htm> (August, 2007). [notice and information on-line on this disease].

Torre-Bueno, J. R. de la (1989) *The Torre-Bueno Glossary of Entomology*. The New Cork Entomological Society, New York, 840 pp.

Usinger, R. L. (1966) Monograph of Cimicidae (Hemiptera-Heteroptera). *Thomas Say Foundation*, 7: 1-585 pp. [A systematic study of World bed bugs].

Vargas, L. (1945) Simúlidos del Nuevo Mundo. *Revista del Instituto de Salubridad y Enfermedades Tropicales* (Mexico), Monograph 1: 241 pp. [An annotated list of New World black flies, with a good introduction of their importance].

Welch, H. E. (1965) Entomophilic nematodes. *Annual Review of Entomology*, 10: 275-302. [An essay on those worms that infect insects, with a discussion about their importance as bio-regulators of insect pests].

Biographical Sketch

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