INSECTS

INSECTS. The insects of Persia and Afghanistan belong to the Palearctic fauna, although in the eastern and southeastern parts of the region there are representatives of the Oriental fauna characteristic of the Indian subcontinent. Afro-tropical groups make up a small part of the fauna of southern and southwestern Persia.

As elsewhere in the world, beetles (order Coleoptera) far outnumber all other species of insects and, indeed, all other animals. Other prominent orders include Orthoptera (grasshoppers, locusts, and crickets), Hemiptera (true bugs), Heteroptera (aphids, scale insects, cicadas), Diptera (flies, mosquitoes, midges), Lepidoptera (butterflies and moths), and Hymenoptera (bees, wasps, and ants), Siphonaptera (fleas), and Isoptera (termites). All of these orders have species that are of medical and/or agricultural importance (see below). Other orders, which have ecological, behavioral, biogeographical, and taxonomic interest for zoologists include Thysanura (bristletails, silverfish), Diplura, Collembola (springtails), soil and leaf-litter insects that are important in the cycles of decomposition, Ephemeroptera (mayflies), Odonata (dragonflies, damselflies), Plecoptera (stoneflies), Dermaptera (earwigs), Dictyoptera (cockroaches and mantids), Mallophaga (chewing lice, bird lice), Siphunculata or Anoplura (sucking lice), Thysanoptera (thrips), and Neuroptera (lacewings, ant lions, snake-flies).

Insects occur in all habitats from freshwater streams and ponds to the most arid deserts and salt pans (Wiltshire, 1940). They occur in and on animals and plants, in the soil, under rock and under bark of trees, and almost every imaginable place. They are part of every food chain and food web, from consumers of plant materials to predators, blood suckers, parasites, and parasitoids to consumers of decaying plant and animal matter. As carriers of human and animal diseases they are tremendously destructive and costly in terms of public health; they account for millions of dollars in crop damages and destruction of stored products; in places, termites are economically significant as destroyers of man-made structures. On the positive side, various insect species are of critical importance as pollinators of crops and for use in biological control of destructive species, while bees provide honey (q.v.) and silk moths produce valuable silk thread, both historically important products in Persia.

No brief article can do justice to the importance of insects, and even a list of all of the known species in Persia and Afghanistan would fill an encyclopedia. All that can be done here is to call attention to a few references in the vast entomological literature that address the major groups of insects and some of the problems associated with them in Persia and Afghanistan. Most papers in the literature concern individual species or genera, report on expedition collections, or discuss the species of some small area. Papers listed in the bibliography below are only those that deal with taxonomic groups above the generic level, review entire families or orders, provide lists of Persian and/or Afghan species, or contain keys for identification of important groups. This bibliography is by no means exhaustive and ignores many important synoptic studies that have appeared in multiple parts, often in several journals.

Fortunately, we now have the two-volume work of Cyrus Abivardi, which summarizes the history of entomology in Persia and provides an extended, annotated bibliography of the important entomological publications dealing with Persian insects. In addition, the author provides a list of Persian entomologists and their affiliations, a list of international scholars, past and present, who have contributed to Iranian entomology, and a guide to the periodical literature dealing with Persian insects. The second volume of this work introduces entomology of economic and medical importance. Most of the information in the current article is taken from this work.

History of insect studies in Persia. An interest in insects has doubtless prevailed since the dawn of human consciousness, first as food sources and as discomforts, and, since the beginning of agriculture, as competitors for crops. Any knowledge of insects during this prehistoric period was transmitted orally and so left no record. Although sophisticated agricultural civilizations prospered in Persia, many written records were systematically destroyed by succeeding regimes up to and including the Islamic conquest. Nevertheless, we can be certain that there was a practical knowledge of insects dating to prehistoric times, when beekeeping was practiced in Elam (q.v.) and cochineal dyes (derived from scale insects) were used by the Persians. A large number of unbaked clay tablets survive from the Sumerian and Akkadian cultures of Mesopotamia, including some that detail zoological knowledge of the time. Some 100 species of insects considered as vermin are mentioned on these tablets. Some of the few surviving fragments of the Avesta (ca. 10th and 6th cent. B.C.E.) that refer to animals mention locusts, bees, and ants (Pur-Dāwud, pp. 197-201). Houseflies were recognized as major sources of contagion during this period. The Talmud, important as a source of knowledge in western Persia among Orthodox Jews, contains instruction regarding managing various insect pests in agriculture and medicine. It probably reflects knowledge that was more general throughout Persia during the Parthian and Sasanian periods.

Few insects have had as profound an effect on international trade and cultural contact and exchange as the silkworm, *Bombyx mori*. Sericulture was introduced to Persia from China at least as early as the Sasanian period and is still an important industry in Gilān (see ABRĪŠAM). Silk production in Persia was so well developed and well regarded in the 7th century C.E. that silk products were even exported to China (Watson, pp. 549-50).

Mention should be made of Jondi-Šāpur/Gondēšāpur (q.v.) and its medical school, the first university in Persia. Founded by Šāpur I in the 3rd century C.E. near the present city of Ahvāz, it became a center of ancient sciences, and over the centuries of its existence a number of zoologists were associated with it. This center attracted scholars in many disciplines from many countries. Many books were produced there, of which few have survived. Only one of the surviving books, the *Warz-nāma*, which has reached us in New Persian translation, refers to agriculture (Abivardi, pp. 465-66). Although the university stagnated under the Omayyad caliphs following the Arab invasion, it subsequently became the locus of the Persian influence on Islamic science under the ʿAbbasids. Apparently, academic activities ended at Jondi-Šāpur in 869 C.E. with the publication of a pharmacopoeia (*al-Aqrābāḏin*) by the Persian scholar, Sābur b. Sahl (d. 869), which was adopted throughout the Eastern Caliphate (Abivardi, pp. 469-70).

From at least the 9th century, Islamic zoology was much influenced by the views of Greek philosophers, as reflected in medical and agricultural texts of the time. *Rasāʾel Eḵwān al-ṣafāʾ* was composed in the 10th century by a society of encyclopedists in Baṣra, who called themselves Eḵwān al-ṣafāʾ (q.v.); they attempted to sum up in fifty-two anonymous treatises the philosophical and scientific knowledge of the time. Sections covered zoology, agriculture, and animal husbandry. In this work, insects are distinguished, apparently for the first time, as a group separate from “noxious animals” (Abivardi, pp. 475-76). Among the many works of Avicenna (980-1037, q.v.) insects are considered, particularly in those sections of his medical writings that prescribe botanical toxins for killing or repelling medical and agricultural pests. The scientific literature of this period, even if written by Persian scholars, was written in Arabic and later translated into Persian and other languages (Abivardi, pp. 477 ff.).

The Mongol invasion was a scientific and cultural catastrophe as well as human tragedy in terms of loss of life. Libraries in all cultural centers were destroyed, and the last vestiges of Gondēšāpur were wiped out with the destruction of a large number of scientific books. However, as the conquerors began to be culturally assimilated, several important works on medicine, agriculture, and zoology were produced; and encyclopedic works with large sections on zoology appeared in the 13th and 14th centuries. In 1263 the Persian encyclopedist Zakariyāʾ b. Moḥammad Qazvini published a great compendium of scientific knowledge, *ʿAjāʾeb al-maḵluqāt wa ḡarāʾeb al-mawjudāt* (q.v.). A number of insects are described in this work, which is notable in that it concerns itself not only with species of medical or agricultural importance, but also with animals for general interest.

Under the Safavids, natural sciences stagnated, and encyclopedic works compiled during the two centuries of their reign were based on previous publications. These works included medical, pharmaceutical, and agricultural treatises. Abivardi (pp. 461 ff.) provides synopses of the entomological information in all of the works alluded to above and to many others.

The formal study of insects in Persia from a modern or scientific perspective began in the 19th century with publications in the 1830s on insects collected during Russian expeditions to northern Persia, particularly those of S. G. Gmelin and Peter Simon Pallas. Insects of southern Persia were first collected by the explorer Theodor Kotschy in the 1840s. The Dār al-Fonun (q.v.), a polytechnic school founded in 1852, included instruction in medicine and pharmacology but not agriculture. Zoological exploration of Persia by western travelers increased considerably during the second half of the 19th century, and publications on insects became more specialized. Some of these early expeditions have been mentioned in the articles on fauna (q.v.).

During the 20th century, faunal studies by Europeans expanded, and the first Persian entomologists began publishing. Jālāl Afšār (1894-1975), who was trained in Russia, was the first Persian scientific entomologist. Besides carrying out research into the major pest insects, locusts, the senn pest, a Hemipteran (*Eurygaster integriceps*), and many others, he educated the first generation of Persian specialists in agricultural entomology. He also founded a Museum of Zoology and Entomology at the Agricultural College in Karaj near Tehran, the first such facility in Persia. Both medical and economic entomology were recognized as being of critical importance and the training of Persian scientists in these fields began in earnest. He published the first modern book on entomology in Persian in 1937, and in 1952 he published a book on the medical and agricultural entomology of Persia (*Ḥašara-šenāsi-e pezeški wa kešāvarzi-e Irān*). There are, today, colleges of agriculture throughout Persia, most of them associated with universities (Abivardi, pp. 533-34, 553).

Bilateral agreements between Persia and the Soviet Union to work together to control the desert locust (*Schistocerca gregaria*) led to commissions representing the the Soviet Union, Persia, and Afghanistan working to control a host of agricultural pests common to the two countries (Abivardi, pp. 535 ff.). International cooperation continued and expanded, involving the governments of several European countries and the United States. During World War II, studies on malaria mosquitoes were carried out by American forces in Persia, and efforts to control lice-borne typhus were also carried out at that time.

In 1946 the “Journal of Applied Entomology and Plant Pathology” was established. It publishes primarily in Persian. The Entomological Society of Iran was established in 1968 and began publishing its own journal, The *Journal of the Entomological Society of Iran*, in 1973.

A number of European expeditions during the latter half of the 20th century made major contributions to faunal knowledge of most insect groups. Particularly noteworthy are the Austrian expeditions in 1949-50 and 1956, the expeditions of the German Willi Richter in 1954 and 1956, the Franco-Persian Mission of 1965, and the series of Czechoslovak-Iranian Expeditions of 1970, 1973, and 1977. In the 1990s Czech-Iranian cooperation in faunal studies was resumed. Many other expeditions concentrated on particular groups of insects, but those mentioned made large general collections and led to publications on many insect groups (Abivardi, pp. 30-40). The Plant Pest Diseases Research Institute of the Ministry of Agriculture began work in 1963 and now has branches in each province. For detailed accounts of the history of entomology in Persia see Bodenheimer and Abivardi.

Economic entomology. About 1,000 species of insects feed on economic crops and trees in Persia. About 200 of these have been listed as insect pests by the Ministry of Agriculture and only half of these cause serious damage. Most of the major insect orders contain species that cause agricultural damage. Some examples include: Orthoptera, the locusts and grasshoppers, including *Schistocerca gregaria*, the desert locust, *Dociostaurus maroccanus*, the Moroccan locust, and *Calliptamus italicus*, the Italian locust, all of which swarm periodically and cause catastrophic, widespread crop damage; Dermaptera, earwigs, which feed on a variety of field crops; Hemiptera, true bugs, including *Eurygaster integriceps*, the senn pest, which attacks cereal crops and is one of the most serious economic pests in Persia and Afghanistan; Homoptera (regarded as a suborder of Hemiptera by some authors), leafhoppers, aphids, cicadas, scale insects, particularly important as vectors of plant viruses, the many species of which inhabit virtually every species of crop and fruit plant.

Coleoptera (beetles), the largest insect order, contains a large number of pests on crops and stored products. Larvae of several scarab species are important crop pests, damaging the roots; buprestids, or metallic wood-borers, damage trees; dermestid larvae are destructive of wool and fur products, hides, cheeses, and other stored animal products; some tenebrionid beetles are among the most destructive stored-products pests, while others attack living trees. At least two species of Meloidea, blister beetles, are ectoparasites of honeybees. Curculionid beetles, or weevils, make up the largest family of animals in the world, and there are many serious economic pests among them, as various species feed on all parts and all stages of plants, including stored products. Diptera, flies and mosquitoes, include a number of species that are crop pests, and many more that are important medically and in biological control (see below). Lepidoptera, moths and butterflies, include many species that are significant agricultural pests in the larval stage, such as the grain moth, potato tuber moth, peach twig borer, pink bollworm, codling moth, striped rice borer, Indian meal moth, almond moth, Indian flour moth, leaf miners, spiny bollworm, beet armyworm, gypsy moth, and many others. Hymenoptera, ants, bees, and wasps, include many species beneficial to agriculture as pollinators, predators on pest insects, and parasitoids utilized in biological control (see below), as well as honeybees, while other species, such as sawflies, are pests.

Medical entomology. A number of insects in several orders are significant in human and veterinary medicine in Persia and Afghanistan. Most of these are intermediate hosts for pathogens or transmit bacteria and virus through contact. Dictyoptera (cockroaches and mantids): Blattodea (cockroaches): cockroaches that live in houses are mechanical vectors for various pathogens, as they feed on household food and garbage, as well as on human and animal excrement. Siphunculata (lice): small wingless flat-bodied, ectoparasitic insects with mouthparts adapted to piercing and sucking, live only on mammals. *Pediculus humanus* is the common body louse of humans; *Pediculus capitus* is the head louse and *Phthirus pubis* is the crab louse. These lice cause various skin diseases in humans, and various other species plague domestic stock. They have been implicated as vectors of more serious diseases, including typhus, relapsing fever, trench fever, and hemmorhagic fever. Siphonaptera (fleas): many flea species are restricted to a single host species, while others will feed on blood of other animals when their host is not available. The rat flea, *Xenopsylla cheopis*, is well known as the vector of bubonic plague, carrying the bacterium *Yersinia pestis*, but other species of fleas also transmit the disease. Diptera (flies and mosquitoes): Psychodidae (sandflies), vectors for leishmaniasis and kala-azar; Culicidae (mosquitoes), vectors for malaria, filariasis, African horse sickness, and numerous viruses. Most research in Persia has focused on malaria; eighteen species of mosquitoes are vectors for malaria in the eastern Mediterranean region, including Persia and Afghanistan. Tabanidae (horseflies) are vectors of surra disease in horses. Muscidae (houseflies stable flies): potential mechanical vectors for a great number of pathogens, such as communicable opthalmia, including trachoma. Oestridae (warble flies): larvae produce myiasis in domestic stock and occasionally in humans. Caliphoridae (flesh flies), Gesterophilidae (botflies), Glossinidae, and Hippoboscidae (forest fly, sheep ked) are important in medical and veterinary science.

Hemiptera: Reduviidae (kissing bugs, assassin bugs, bedbugs): Kissing bugs are carriers of epidemic typhus, trench fever, and epidemic relapsing fever; bedbugs cause irritation and discomfort, but are not human disease vectors.

Coleoptera: Staphylinidae: *Paederus* causes vesicular dermatitis. Scarabaeidae: dung beetles may play a role in human helminthiasis, as they carry ova of *Ascarus* and *Trichuris*. Meloidae: *Lytta vesicatoria*, Spanish fly, produces cantharidin, a pharmaceutical product prepared from dried insects. Because of its reputation as an aphrodisiac, it occasionally proves fatal, as a lethal dose is only a few milligrams per human body. (See Abivardi, pp. 837 ff., for an annotated bibliography of medical entomology in Persia.)

Biological control. Many insect orders contain species that are predaceous or parasitoid on pest species, and a growing number of these are used in biological control. There are, however, many more species which have not been studied adequately, and their economic significance has not been recognized. These include many species that are ecologically important in the aggregate, if not useful for commercial application. Maintaining adequate habitat for such insects, intermixed with agricultural areas, may prove far more important than currently recognized.

Predaceous insects used in biological control of pest insects include representatives of many orders. Dictyoptera (cockroaches and mantids): mantids are predatory on other insects, including plant pests and their egg cases (ootheca), and are sometimes provided to gardeners and farmers for pest control; apparently their economic significance in Persia and Afghanistan has not been studied. Coleoptera (beetles): probably the first insect to be used for biological control in Persia was the ladybird beetle, *Rodolia cardinalis*, a native of Australia, for the control of *Icerya purchasi*, cottony cushion scale, a pest on citrus trees; other coccinellid species are also important predators on aphids, scale, and small caterpillars. Carabid beetles, which are carnivorous in both the larval and adult stages, are undoubtedly important population controls on various pest insects. Neuroptera (lacewings, ant lions, snake flies): all members of this order are entomaphagous in both larval and adult stages, and lacewings are notably predaceous on aphids. Odonata (dragonflies and damselflies): both the aquatic larvae and the flying adults are predatory and devour many insects, especially Diptera, such as mosquitos, but their economic significance remains to be assessed. Hymenoptera: most important in commercial biological and integrated control has been the rearing and introduction of the tiny parasitoid braconid and chalcid wasps that lay their eggs in various stages of the life cycles of pest insects, particularly aphids and scale insects. Much of this biological control has been stimulated by researchers from the University of California's agricultural experiment stations, who searched Persia for control agents for such pests as the olive scale, the walnut aphid, spotted walnut aphid, and now many others. Encyrtid and scelionid wasps, egg parasitoids, have been used against the senn pest. An ichneumonid wasp proved an effective parasitoid of Egyptian alfalfa weevil. Diptera: Tachinid parasitoids have been used against larval beetles and moths. The parasitoids now in use or under investigation are far too numerous to catalogue here. Snail-killing flies, *Sepedon sphegea*, have been used against aquatic snails, the intermediate hosts of schistosomiasis. Various non-insect biological agents have been used in biological control, e.g., nematodes, mites, *Bacillus thuringiensis*, and fungal pathogens. The top-minnow, *Gambusia*, has been widely introduced throughout the world, including Persia and Afghanistan, to control mosquito larvae (for details, see Abivardi, pp. 563 ff.).

Insects have also been used in weed control, for example: the Persian species, *Phrydiuchus topiarus*, a weevil, for control of Mediterranean sage, *Salvia aethiopis*, a rangeland weed, in the western United States; Chondrilla crown moth, *Oporopsamma wertheimsteini*, on *Chondrilla juncea*, skeleton weed, introduced to Australia (see Abivardi, pp. 795 ff., for an annotated bibliography of biological control in Persia).

The prospects for discovering additional insect predators and parasitoids in Persia and Afghanistan are great. Biological control will become increasingly important as the ecological and public health problems caused by the application of chemical pesticides are more widely appreciated.

See also PESTS, AGRICULTURAL.

BIBLIOGRAPHY

Websites were accessed 15 October 2003. Abbrev.: *JESI—Journal of the Entomological Society of Iran*. M. Abai, “List of Cerambycidae Family in Iran,” *Entomologie et Phytopathologie Appliquées*, no. 28, 1969, pp. 47-54.

Idem, “List of pests of forest trees and shrubs of Iran,” Plant Pests and Diseases

Research Institute, Tehran, 1984 (in Persian).

R. Abbassian-Lintzen, “Tabanidae (Diptera) of Iran X. List, Keys and Distribution of Species Occurring in Iran,” *Annales de Parasitologie humaine et comparée* 39, 1964, pp. 285-327.

G. M. Abdurakhmanov, “The faunistic links of beetles (Coleoptera) of the arid regions of the eastern part of the Caucasus Major and Central Asia,” *Entomologicheskoe Obozrenie* 62, 1983, pp. 481-97.

Cyrus Abivardi, *Iranian Entomology, an Introduction* I: *Faunal Studies*Applied Entomology, Berlin, Heidelburg, and New York, 2001.

E. Adeli, “Beiträge zur Kenntnis der im Forst schädlichen Insekten des Iran I: Coleoptera,” *Zeitschrift für Angewandte Entomologie* 70, 1972, pp. 8-14.

Ö. K. Ahmet and M. Kemal, “Check-List of the Butterflies of Afghanistan: A Checklist with Vernacular Names in English, Turkish and Uighurian Language,” 1991-2001, at *www. members.tripod.com/entlep/Af.htm*.

Idem, “Check-List of the Butterflies of Iran: A Checklist with Vernacular Names in English, Turkish and Uighurian Language,” 1999-2001, at *www.members.tripod.com/entlep/Ir.htm*.

O. M. Alexandrov-Martynov, “Die Ascalaphiden von Turkestan, Persien und West-Himalaya,” *Russkoe Entomologicheskoe Obozrenie* 20, 1926, pp. 197-203.

Idem, “Zur Kenntnis der Nemopteriden Persiens und einiger Mittelmeerländer,” *Zoolgischer Anzeiger* 90, 1930, pp. 235-50.

H. A. Ali “Faunistic Study of the Cicindelidae (Coleoptera) of Iraq and Southwest Asia,” *Coleopterists Bulletin* 32/1, 1978, pp. 1-20.

S. Asahina, “The Blatteria from Iran and Afghanistan,” *Results of the Kyoto University Scientific Expedition to Karakoram and Hindukush 1955*, 1966, pp. 155-57.

Horst Aspöck, “The Raphidioptera of the Middle East: A Review (Insecta: Neuropteroidea),” in F. Krupp, W. Schneider, and R. Kizelbach, eds., *Proceedings of the Symposium on the Fauna and Zoogeography of the Middle East*, TAVO, Mainz, 1985, pp. 148-59.

Horst and Ulrike Aspöck. “Die Neuropteren Vorderasiens,” *Beiträge zur naturkundlichen Forschung in Südwestdeutschland* 24/2, 1965, pp. 159-81.

Horst and Urlike Aspöck. “Untersuchungen über die Raphidiopteren-Fauna des Iran,” *Zeitschrift der Arbeitsgemeinschaft Österreichischer Entomologen* 22, 1970, pp. 89-95.

J. Aubert, “Plécoptères du nord de l’Iran,” *Mitteilungen der Schweizerischen Entomologischen Gesellschaft* 37, 1964, pp. 69-80.

S. I. Axentiev, “Meloidae from Iran (Insecta: Coleoptera),” *Senckenbergiana Biologica* 65/3-6, 1984 [1985], pp. 245-50.

G. Ya. Bei-Bienko and L. L. Mishchenko, *Locusts and Grasshoppers of the USSR and the Adjacent Countries*, tr. Israel Program for Scientific Translations, 2 vols., Jerusalem, 1963-64.

Friedrich Simon Bodenheimer, *Materialien zur Geschichte der Entomologie bis Linné* I, Berlin, 1928.

Idem, *Insects as Human Food: A Chapter of the Ecology of Man*, The Hague, 1951.

D. Braasch, “Eintagsfliegen aus Anatolien und Iran” *Faunistische Abhandlungen Museum für Tierkunde Dresden* 8/6, 1981, pp. 75-79.

R. W. Brooks, “Systematics and Phylogeny of the Anthophorine Bees (Hymenoptera: Anthophoridae, Anthophorini),” *University of Kansas Science Bulletin* 53, 1988, pp. 436-575.

D. Burckhardt and P. Lauterer, “The Jumping Plant-lice of Iran (Homoptera, Psylloidea),” *Revue Suisse de Zoologie* 100/4, 1993, pp. 829-98.

A. Cejchan and J. Maran, “Results of the Czechoslovak-Iranian Entomological Expedition to Iran 1970 (together with Results of Collections Made in Anatolia), No. 8: Dermaptera,” *Acta Entomologica Musei Nationalis Pragae* 6, suppl., 1974, pp. 95-97.

L. Chopard, “Gryllides d’Iran (Ergebnisse der Entomologischen Reisen Willi Richter, Stuttgart, im Iran 1954 und 1956, no. 22),” *Stuttgart Beiträge zur Naturkunde*, no. 24, 1959, pp. 1-5.

M. Chvala, “Revision of Palaearctic Microphoridae (Diptera). 2: Schistostoma Beck,” *Acta Entomologica Bohemoslovaka* 84/2, 1987, pp. 133-55.

P. Cox, “The Collembola Fauna of North and North Western Iran,” *Entomologist’s Monthly Magazine* 118, Jan.-Apr. 1982, pp. 39-43.

V. N. Danilov, “On the fauna of mosquitoes (Diptera, Culicidae) of northwestern Iran,” *Meditsinskiĭ Parazit* 44, 1975, p. 732 (in Russian).

M. M. Daniyarova, “Distribution and characteristics of the zoogeography of aphids of the subtribe Anuraphidina in central Asia,” *Izvestiya Akademii Nauk Tadzhikskoĭ SSR Otdelenie Biologicheskikh Nauk* 1, 1981, pp. 37-42.

A. Davatchi, F. Taghi-Zadeh, and M. Safavi, “Contribution a l’étude biologique et économique des coléoptères phytophages et xylophages de l’Iran (première note),” *Revue de Pathologie Végétale et d’Entomologie Agricole de France* 38, 1959, pp. 235-52.

G. R. DeFoliart, “Southwestern Asia. Chapter 21,” in *The Human Use of Insects as A Food Resource: A Bibliographic Account in Progress*, pp. 1-23; posted on website, August, 2002: *www.Food-insects.com/book7-31/Chapter%2021Southwest%Asia.htm*.

V. F. Eastop and H. Hodjat, “Key to the genera of common aphids in Iran,” *Entomologie et Phytopathologie Appliqées* 49/1, 1981, pp. 45-64 (in Persian, separately paginated English summary, pp. 15-17).

E. Ebrāhimi, “The sphecid wasps of subfamily Sphecinae in Iran (Hymenoptera: Sphecidae),” *JESI*, 1993, pp. 87-104 (in Persian, English summary separately paginated, pp. 19-20).

W. Eckweiler and P. Hofmann, “Checklist of Iranian Butterflies,” *Nachrichten des Entomologischen Vereins*, Apollo Supplementum 1, 1980, pp. 1-27.

G. Farahbakhsh, *A Checklist of Economically Important Insects and Other Enemies of Plants and Agricultural Products in Iran*, Tehran, 1961 (Persian and English).

A. Farhang-Azad, “Data on the flea fauna of Iran,” *Parazitologiya* 6, 1972, pp. 513-21 (in Russian).

Michael Fibiger, *Noctuidae Europaeae* I: *Noctuinae*, Sorø, Denmark, 1990.

M. Goetghebuer, “Zur Erforschung des Persisches Golfes (Beitrag Nr. 152): Ceratopogonidae et Chironomidae,” *Arbeiten über morphologische und taxonomische Entomologie aus Berlin-Dahlem*, 1934, pp. 36-39.

L. Gozmany, *Microlepidoptera Palaearctica* V: *Lecithoceridae*, ed. H. G. Amsel, F. Gregor, and H. Reisser, Vienna. 1978; separate volume of 93 unpaginated plates.

T. Hardwick, “Description of a Substance Called Gez or Manna, and the Insect Producing It,” *Asiatic Researches* 14, 1822 [repr., 1980], pp. 182-86.

Idem, “Aphids of Salicaecae in Iran and Keys to Their Species, *Entomologie et Phytopathologie Appliqées* 52/1, 1984, pp. 13-41 (in Persian; separately paginated Eng. summary, pp. 5-6).

Idem, “Aphis Species of Iran,” in J. Holman et al., eds., *Population Structure, Genetics and Taxonomy of Aphids and Thysanoptera: Proceedings of International Symposia, Held at Smolenice, Czechoslovakia, September 9-14, 1985*, The Hague, 1987, pp 377-88.

E. Javadian and A. Meshghali, “Checklist of Phlebotamine Sandflies (Diptera: Pschodidae) of Iran,” *Bulletin de la Societe de Pathologie Exotique* 68, 1975, pp. 207-9.

J. Jezek, “Zoogeography of Some Iranian Species of Horseflies (Diptera: Tabanidae),” *Acta Universitatis Carolinae-Biologica* 1977, 5-6, 1980, pp. 317-23.

B. R. Jones et al., “Communicable Opthalmia: The Blinding Scourge of the Middle East, Yesterday, Today and Tomorrow,” *British Journal of Ophthalmology* 60, 1976, pp. 492-98.

K. Kaneko, “The Murine Lice (Anopleura) from Iran,” *Japanese Journal of Sanitary Zoology* 23/1, 1972, pp. 57-58.

K. C. Kim and K. C. Emerson, “Sucking Lice (Anopleura) from Iranian Mammals,” *Journal of Medical Entomology* 8, 1971, pp. 7-16.

D. Kock, “Fledermaus-Fliegen in Iran (Insecta: Diptera: Streblidae, Nycteribiidae),” *Senckenbergiana Biologica* 63/3-4, 1982 [1983], pp. 167-80.

M. Kosztarab, “Everything Unique or Unusual about Scale Insects (Homoptera: Coccoidae),” *Bulletin of the Entomological Society of America* 33, 1987, pp.

215-20.

F. Le Cerf, “Contribution à la faune lépidoptèrologique de la Perse: Dé-lègation en Perse,” *Annalles d’histoire naturelle de la Délègation en Perse*, Paris, 1913, pp. 1-88.

H. S. Leeson et al., “*Anopheles* and Malaria in the Near East,” *Memoir Series of the London School of Hygiene and Tropical Medicine*, no. 7, 1950.

A. S. Lelei, “Mutillidae (Hymenoptera) of the USSR and neighboring countries,” Leningrad, 1985 (in Russian).

R. Linnavuori, “Hemiptera of Israel. 3,” *Annales Zoologici Societatis Zoologicae-Botanicae Fennicae “Vanamo"* 24/3, 1962, pp. 1-108.

W. Linsenmaier, “The Chrysididae (Insecta: Hymenoptera) of the Arabian Peninsula,” *Fauna of Saudi Arabia* 14, 1994, pp. 145-206.

I. K. Lopatin, “Leaf-beetles (Coleoptera, Chrysomelidae) of Iran: Results of the Czechoslovak-Iranian Expeditions in 1973-1977. 3,” *Entomologicheskoe Obozrenie* 63/1, 1984, pp. 79-92 (in Russian); Eng. tr. in *Entomological Review* 65/1, 1987, pp. 123-36.

H. Malicky, “Die Kocherfliegen (Trichoptera) des Iran und Afghanistans,” *Zeitschrift der Arbeitsgemeinschaft Österreichischer Entomologen* 38/1-2, 1986, pp. 1-16.

Idem, “A Survey of the Caddisflies (Insecta: Trichoptera) of the Middle East,” in Friedhelm Krupp, Wolfgang Schneider, and Ragnar Kinzelbach, eds., *Proceedings of the Symposium on the Fauna and Zoogeography of the Middle East*, Mainz, 1985, pp. 174-77.

A. V. Manoucheri and B. Janbakhsh, “Malaria eradication and its technical, operational and administrational problems in Iran,” *Journal of Public Health* 6/2, 1977, pp. 56-59 (Persian, Eng. summary, pp. 77-78).

A. Mesghali, “Plebotiminae (Diptera) of Iran I: A Preliminary List, Description of Species and Their Distributional Data,” *Acta Medica Iranica* 4/1, 1961, pp. 20-73.

H. Mirzayans, “Liste des orthoptères et leur distribution en Iran,” *Entomologie et Phytopathologie Appliquées*, no. 18, 1959, pp. 10-23 (Persian with Fr.

summary).

Idem, “Fauna of Iranian cockroaches (Orthopteroidea: Blattaria),” *JESI*, Supplement 4, 1986, pp. 1-145 (in Persian, Eng. summary, 11 pp.).

Idem, *Insects of Iran. The List of Homoptera: Auchenorrhyncha in the Insect Collection of Plant Pests and Diseases Research Institute*, Plant Pests and Diseases Research Institute, Insects Taxonomy Research Department (Series), publ. no. 1. Tehran. 1995.

Idem, *Insects of Iran. The List of Orthoptera* . . . , publ. no. 3. Tehran. 1998.

A. Mortazawiha and R. Dern, “Ein Beitrag zur Thysanopteranfauna des Iran,” *Entomologie et Phytopathologie Appliquées*, no. 45, 1977 (Persian, Ger. summary, p. 8).

P. Morvan, “Contribution à la connaissance des coléoptères Carabidae de l’Iran,” *JESI* 6/1-2, 1981, pp. 9-46.

M. Motabar, I. Tabibzadeh, and A. V. Manoucheri, “Malaria and Its Control in Iran,” *Tropical and Geographical Medicine* 27, 1975, pp. 71-78.

A. Nadim et al., “Present Status of Kala-azar in Iran,” *American Journal of Tropical Medicine and Hygiene* 27, 1978, pp. 25-28.

A. Naim, “The Fauna of Iranian Coccinellidae (1),” *Entomologie et Phytopathologie Appliquées* 31, 1971, pp. 11-14.

W. Nassig, “Ein Beitrag zur Kenntnis der Saturniidae und Brahmaeidae der Iran und der Türkei (Lepidoptera) Teil 1: Brahmaeidae,” *Nachrichten des Entomologischen Vereins Apollo* 1/3-4, 1980, pp. 77-91.

Idem, “Ein Beitrag zur Kenntnis der Saturniidae und der Brahmaeidae des Iran und der Türkei (Lepidoptera) Teil 2: Saturniidae,” *Nachrichten des Entomologischen Vereins Apollo* 2/1, 1981, pp. 1-39.

O. P. Negrobov and L. Matile, “Contribution à la faune de l’Iran: Diptera, Dolichopodidae,” *Annales de la Société entomologique de France* 10, 1974, pp. 841-45.

A. Noori, “The Medical Sciences in the Avesta,” 2001-2003, at *http://www.iranchamber.com/culture/articles/medical_sciences_avesta.php*. M.

Olmi, “A Revision of the Dryinidae (Hymenoptera),” *Memoirs of the American Entomological Institute (Gainesville)*, no. 37/2, 1984, pp. 947-1913.

W. D. Pierce, “The Uses of Certain Weevils in Food and Medicine,” *Proceedings of the Entomological Society of Washington* 17, 1915, pp. 151-54.

V. B. Popov, “The bees (Hymenoptera: Apoidea) of Iran,” *Trudy Zoologicheskogo Instituta Leningrad* 43, 1967, pp. 184-215 (in Russian).

H. Priesner, “On Some Thysanoptera from Persia,” *Annals and Magazine of Natural History*, ser. 12, 7, 1954, pp. 49-57.

Ebrāhim Pur-Dāwud, *Farhang-e Irān-e bāstān*, Tehran, 1947.

G. Radjabi, “Liste supplementaire de buprestids de l’Iran,” *JESI* 2, 1974, pp. 37-40 (in Persian with Fr. summary).

A. Rezwani, “Identification key to the species of the family Lachnidae (Homoptera: Aphidoidea) from Iran,” *Journal of the JESI* 12-13, March 1993, pp. 45-51 (in Persian, Eng. summary separately paginated, pp. 10-11).

M. Safavi, 1973. “Key to the families of Hemiptera Heteroptera occurring in Iran,” *JESI* 1, 1973, pp. 3-13 (in Persian with Fr. summary).

Idem, “Key to the genera of the Cydnidae from Iran (6),” *JESI* 5/1-2, 1979, pp. 31-34 (in Persian, Eng. summary separately paginated, pp. 23-27).

Idem, “Key to the Genera of the Pentatominae from Iran,” *JESI* 5/1-2, 1979, pp. 23-29 (in Eng. and Persian, separately paginated; Eng., pp. 11-22).

K. Samet, A. Farzaneh, and M. Barkhordari, “Primary List of Diptera (Tachinidae) of Iran,” *JESI* 4, 1977, pp. 83-86.

H. Seghatoleslami, “Some complementary studies on San Jose scale in Bandar Anzali (Guilan Province),” *Entomologie et Phytopathologie Appliquées*. 48, 1980, 149-54 (in Persian, Eng. summary, p. 37).

M. I. Shahhosseini and H. Kamali. “A Checklist of Insects, Mites and Rodents Affecting Stored Products in Iran,” *JESI*, Supp. 5, pp. 1-47.

M. Šojāʿi/Chodjai, “Survey on Cynipid Wasps and Their Gall-Producing Species on Oak Trees,” *JESI*, Supp. 3, 1980, pp. 1-48 (in Persian with separately paginated English and French summaries, pp. 1-23).

Evgeniĭ Markovich Shumakov, “Acridoidea of Afghanistan and Iran,” in *Trudy Vsesoyuznogo Entomologicheskogo obshchestva* 49, 1963, 246 pp. (in Russian).

O. Theodor and A. Meshghali, “On the Phlebotominae of Iran,” *Journal of Medical Entomology* 1, 1964, pp. 285-300.

B. Theowald. “Tipuliden aus Iran und Afghanistan (Diptera, Tipulidae),” *Bulletin Zoologisch Museum, Universiteit van Amsterdam* 6/10, 1978, pp. 69-77.

S. Tirgari, “A Key to the Iranian Families of Odonata,” *JESI* 5/1-2, 1979, pp. 49-54 (in Persian with separately paginated Eng. summary, pp. 33-34).

William Watson, “Iran and China,” in *Camb. Hist. Iran* III, pp. 537-58.

Edward Parr Wiltshire, “Insect Biotopes in Syria, Iraq and Iran,” *The Entomological Record 1940* (Seventy-First Annual Report of the Entomological Society of Ontario, 1940), Toronto 1941, pp. 43-57.

Idem, *The Lepidoptera of Iraq*, London, 1957.

Walter Wittmer, “Beitrag zur Kenntnis der palaearktischen Fauna” *Mitteilungen der Entomologischen Gesellschaft Basel* 36/3, 1986, pp. 100-122.

M. Zaim, “The Distribution and Larval Habitat Characteristics of Iranian Culicinae,” *Journal of the American Mosquito Control Association* 3/4, 1987, pp. 568-73.

M. Zaim and P. S. Cranston, “Checklist and Keys to the Culicinae of Iran (Diptera: Culicidae),” *Mosquito Systematics* 18/3-4, 1986 [1987], pp. 233-45.

Lothar Zerche, *Monographie der palaarktischen Coryphiini (Coleoptera, Staphylinidae, Omaliinae)*, Akademie der Landwirtschaftswissenschaften der DDR, Berlin, 1990.

S. Zoia and M. Rampini, “Leptodirinae del Caucaso e dell’Iran settentrionale (Coleoptera Cholevidae),” *Revue Suisse de Zoologie* 101/3, 1994, pp. 771-827.