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Overview of Arachnids and Arachnology in Iran

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ABSTRACT. An overview of the Arachnida and their study in Iran is provided. Besides ancient poetry, relics (going back to 5,000 YBP), and early medical observations (at least 2,000 YBP), the first published taxonomical observations of arachnids from Iran were in 1807 about scorpions. The superorders Parasitiformes and Acariformes (mites and ticks) have received by far the most attention among all of the Arachnida thanks to their economic and medical/veterinary importance. Occurrences have been noted for over 1,733 species in four orders: Ixodida, Mesostigmata, Sarcoptiformes, and Trombidiformes. The first tick of the Ixodida was described in 1818. The first mite species described from Iran was of the Mesostigmata in 1982. The first member of the Sarcoptiformes named from Iran is uncertain, but the first Iranian species of the Suborder Oribatida was described in 1984 and was likely the first for the order. The first species described from Iran of the Order Trombidiformes were named in 1995. Studies on spiders started in 1874. Spiders are recorded by the occurrences of 764 species. Scorpions number 68 species in Iran and receive a lot of study and are better known compared to mites and spiders on a percentage basis, because scorpions have such a small diversity worldwide. The first Iranian species of Solifugae was described in 1895. The camel spiders are known from 67 species. Pseudoscorpions are recorded by 65 species. The Opiliones are known by 22 named species. The Amblypygi are recorded from Iran by one species described in 2018.

Key words: acarology, araneology, mites, opilionology, palaeoarachnology, pseudoscorpionology, scorpiology, scorpions, spiders, ticks

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Introduction

The depiction by the peoples, of what was to be Iran, of a scorpion (Fig. 1) is one of the oldest known (about 5,000 YBP). The two famous Scorpion Pharaohs of Egypt (Serket) lived about the same time 5,000 to 5,200 YBP (Wikipedia contributors, 2019a, 2019b). Despite the common occurrences of arachnids alongside civilizations of the region, the scientific observation or study of these animals did not occur until rather recently. Besides ancient poetry, relics, and early medical observations, there were also observations reported by foreign travelers. The first publication on arachnids from Iran

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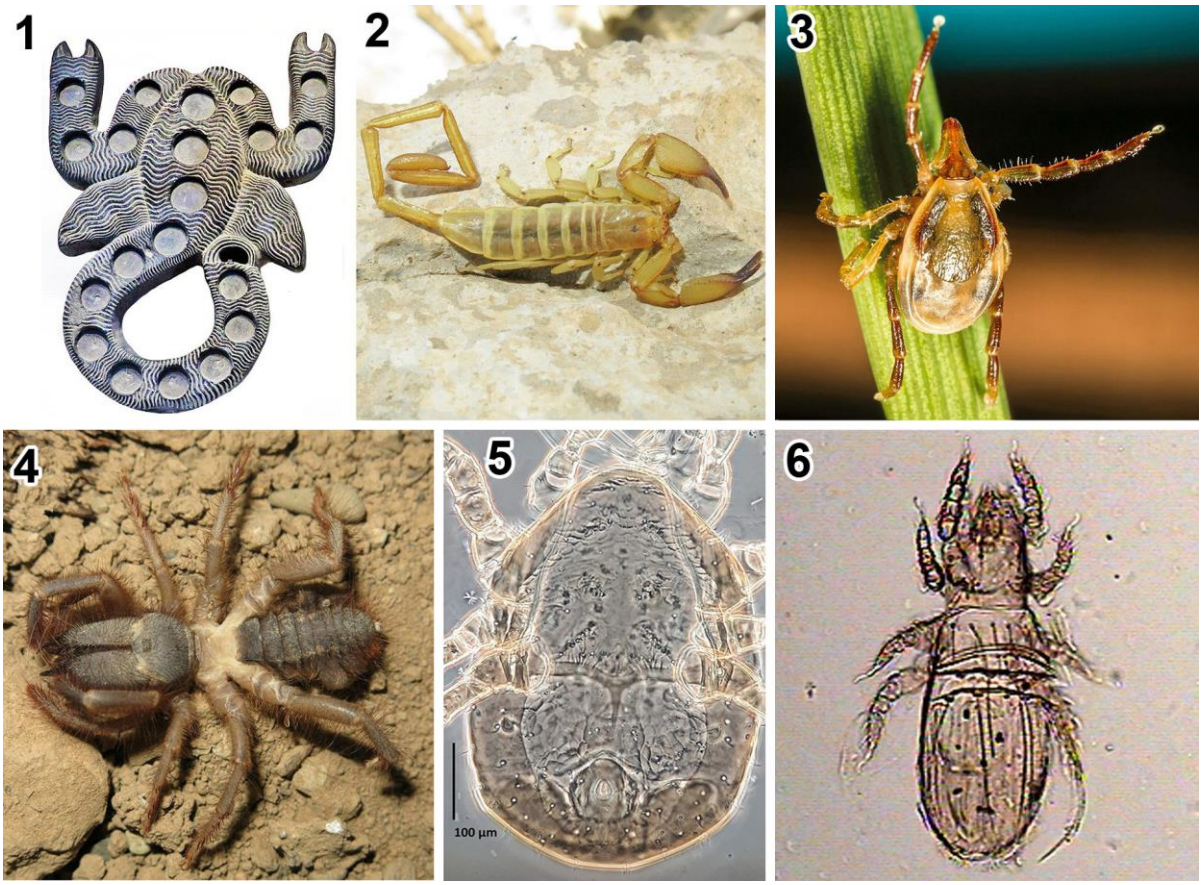
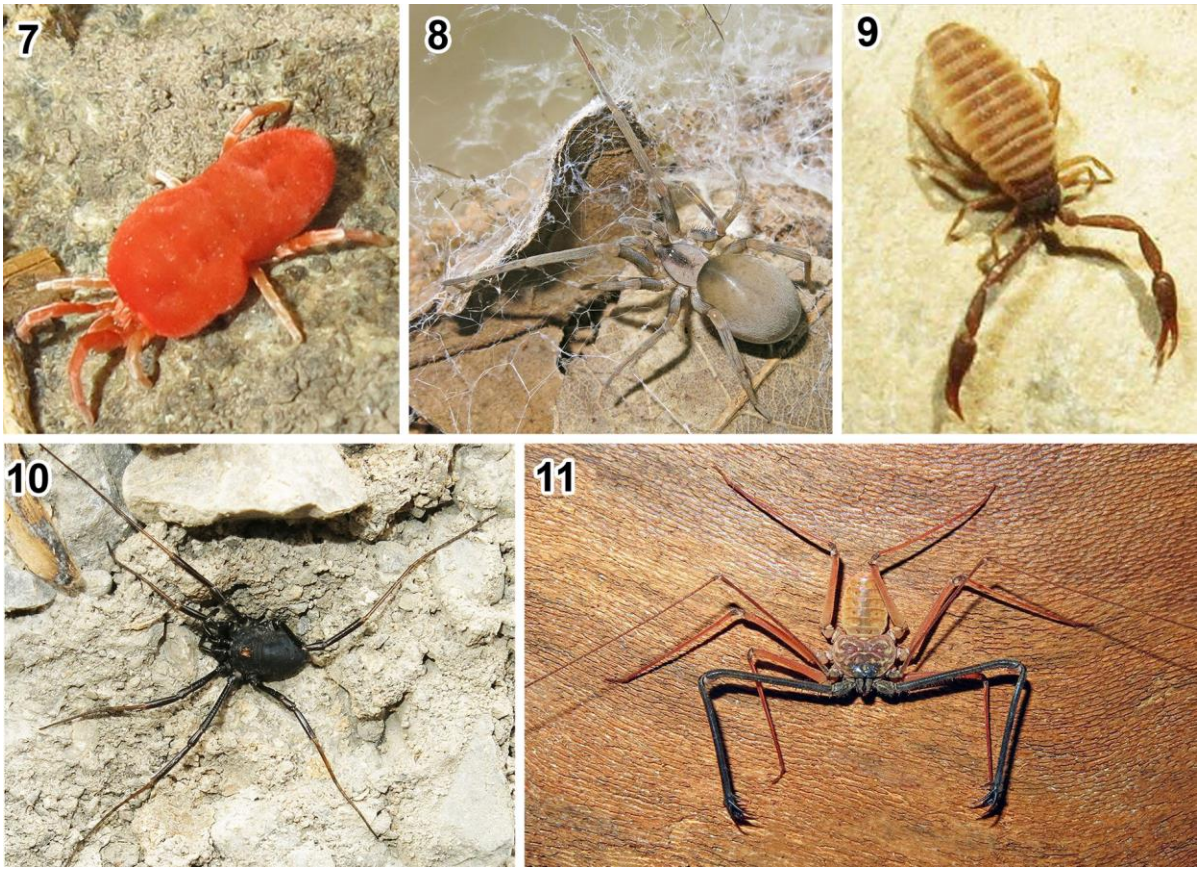
was by Olivier in 1807 on scorpions (Fig. 2). Shortly thereafter was the description of the first tick by Oken (1818) (Fig. 3). The start of studies on spiders was not for many decades later in 1874 by Simon. A publication by Pocock on Solifugae (Fig. 4) followed shortly in 1895a. During the 20th century, many other papers were published on Iranian arachnids by scientists from various countries in Europe and the Asian part of Russia. The 20th century was also the start of publications by Iranian authors on health and economic value of arachnids. Afshar (1936) presented the first scientific publication on Iranian mites, concerning pests of cotton. Veterinary acarology of Iran began in the early 1940's on ticks of livestock. About a decade later, a list of plant mites as agricultural pests of pear, apple and grapes was published by Davachi (1949). The first study on spiders in Iranian literature by an Iranian researcher was probably that published by Zini (1958) on the Mediterranean widow spider. Besides mites (Figs. 5–7), ticks, spiders (Fig. 8), solifuges, and scorpions, the other arachnids known from Iran include the pseudoscorpions (Pseudoscorpiones) (Fig. 9), harvestmen (Opiliones) (Fig. 10), and whip spiders (Amblypygi) (Fig. 11).



Figures 1–6. Artifact and living Arachnid orders of Iran. **1.** Picture of a scorpion plaque (game board? with 20 positions) that was found in an archaeology site in Jiroft, Kerman province, central to southern Iran (maybe 5,000 YBP); **2.** Scorpiones: Hemiscorpiidae: *Hemiscorpius lepturus* Peters, 1861; **3.** Ixodida: Ixodidae, questing tick; **4.** Solifugae: Rhagodidae: *Rhagodes melanogpygus* (Walter, 1889); **5.** Mesostigmata: Halolaelapidae: *Halolaelaps curvisetosus* (Leitner, 1946); **6.** Sarcoptiformes: Cosmochthoniidae: *Phyllozetes emmae* (Berlese, 1910) (pictures 1 by Muscarella (2001); 2, 4 by Alireza Zamani; 3 by Asadollah Hosseini-Chegeni; 5, 6 by Alireza Saboori).



Figures 7–11. Living Arachnid orders of Iran. **7.** Trombidiformes: Trombidiidae: *Allothrombium pulvinum* Ewing, 1917; **8.** Araneae: Filistatidae: *Filistata maguirei* Marusik & Zamani, 2015; **9**. Pseudoscorpiones: Cheliferidae: *Dactylochelifer latreillei* (Leach, 1817); **10**. Opiliones: Phalangiidae: *Rilaena pusilla* (Roewer, 1952); **11**. Amblypygi: Phrynichidae, *Phrynichus persicus* Miranda & Zamani, 2018 (pictures by Alireza Zamani).

Whipscorpions, "*ʿaqrab-e šallāqī*" (Order Thelyphonida) were mentioned by Aḥmadī & Tuck (2011) as occurring in southern Iran but this cannot be confirmed by any scientific publication or specimens. The otherwise nearest recorded occurrence of whipscorpions is in India. Two of the remaining four orders of non-fossil arachnids are not recorded from the country but are known from the region: Schizomida are known from Yemen and Oman, and the Palpigradi are known from Saudi Arabia. The orders Thelyphonida and Ricinulei are the only modern Arachnida orders not recorded from the region, but are instead found in the New and Old World tropics. Four other orders (Haptopoda, Phalangiotarbida, Trigonotarbida, Uraraneida) also not recorded from the region are only known from fossils. It is the goal of this publication to provide an overview of the records from the first scorpion scientifically described in 1807 to the first member of the Order Amblypygi which was recorded only this past year (Miranda & Zamani, 2018). Further, it is hoped by discussing the outdated catalog to the mites and ticks that it might encourage someone (or group) to start such a project on-line. A very nice catalog is already on-line for the spiders of Iran. Where possible and needed an updated list of taxa (smaller groupings) are presented here. It is hoped that the current publication will serve as a

guide, a starting point, to the history of arachnid studies of Iran. Although full biographies of the main researchers are often included in this type of publication, they are not treated in such great detail here. Instead, readers are directed to visit ResearchGate on the internet. ResearchGate was found to be a rich, and updated, source of information on researchers from Iran. Many of the researchers (foreign and domestic) are listed here and their birthdates and places of birth are also provided. Seeing a picture provides an opportunity for the reader to better know the individuals that have studied and reported upon arachnology in Iran. Although of limited use for the younger (without a large memory) researcher, knowing the age of former researchers gives one an idea of the state of research during that time period (i.e., varying degrees of optical instruments, development of digital cameras and computers).

Material and methods

Searching was limited to arachnology only and that which related directly with the physical environment of Iran, excluding study of effects of Iranians on education and research outside of Iran. Because of the great amount of information available on all arachnids and those that study them, only bits and pieces were selected for making an overview of the very broad field of organisms knowing that all would not receive an equal representation. Thus, a person publishing one paper on a very uncommon order or family might get mentioned whereas someone spending a lifetime on behavior or venoms does not. Taxonomy of a group of mites or spiders might not even be mentioned. Mites are more numerous in taxa and individual numbers, but representative information is provided about each order, thus making the more numerous taxa to be less well represented (which they certainly are not). Likewise, all groups are mentioned taxonomically and that receives the majority of attention, while poetry, medicine, and human wars, receive much less. Again this is not in an effort to suggest one form of study is more important than others but is simply an effort to try and touch on each topic. Because the authors live and work outside of Iran, writing was primarily limited to knowledge that is available in print and not personal stories shared by others in person. It is hoped that these efforts will record arachnology in the broadest sense to this time and place so that it can be built upon by others. Although many overviews do not list the citations to taxonomic names, it has been found here to be useful in better understanding history of research and list them in full here. When giving the scientific name of a genus or species, the name of the author and date will be cited in the references. If the listing name is a family or above, it will not be listed with author/date/citation; unless the name is the main subject of the sentence.

Citations with multiple authors are listed in the text with the primary author followed by "et al." in most cases. Under "Table 4. Scorpions recorded from Iran" this was not followed because there are many publications with a few authors given in changing orders so that it is confusing as to which authors make up the "et al.". Lower case a, b, c's listed after the year in a species name/author/date is to help the reader locate that citation in the references. It is of no value outside of this publication and should not be used when listing the name alone elsewhere.

Results

The arachnids or "*ʿankabūtīān*" are members of the Class Arachnida. Traditionally, the Acari have been treated as a separate order within the Arachnida. The phylogeny of the arachnid orders is far from being settled. In the past couple of

decades there has been growing evidence that the Acari are not monophyletic. The Superorder Acariformes (= Actinotrichida) and Superorder Parasitiformes (= Anactinotrichida) are generally found to be diphyletic, but different studies give different reasons for the support. Otherwise, the remaining arachnid orders seem to be monophyletic.

The most recent morphological evidence (Shultz, 2007) and molecular data (Sharma et al., 2014) showed that the only well supported relationships are those for the Tetrapulmonata = (Araneae (Amblypygi (Schizomida, Thelyphonida))). Shultz (2007) also proposed that the Acaromorpha contained the Ricinulei, Parasitiformes = "Anactinotrichida", and Acariformes. Using molecular data, Dabert et al. (2010) proposed the phylogenetic relationships with the Acariformes being next of kin to the Solifugae and the Parasitiformes being sister to the Pseudoscorpiones. Pepato et al. (2010) provided evidence further supporting the Solifugae + Acariformes linage. Recent research by Sanggaard et al. (2014) suggested that the ticks and spiders are more closely related to each other than the ticks are to mites. While research continues on phylogeny of the Class, a more traditional classification of the mites and ticks as a single group, the Acari, is presented here. The orders of Arachnida (in order of species abundance recorded in Iran and not phylogeny) are given with the "Acari" being used as a name for the subgroup.

Unfortunately, researchers on systematics of "Acari" and Arachnida "other orders" have not both used the same naming schemes so that the Acari have superorders and the others have traditionally not had this rank. Members of the Superorders Acariformes (sometimes known as Actinotrichida) are mites, as well as some of the Parasitiformes (sometimes known as Anactinotrichida). Relatively recent research on genetics has resulted in some researchers changing the upper level naming scheme for Acari with the Parasitiformes being moved down to an order (Barker & Murrell, 2004). The classification system used in Table 1 generally follows that of Zhang (2013), with the addition of some older names used to clarify groupings, especially those used in the textbook "*A Manual of Acarology*" (Krantz & Walter, 2009).

Although acarology is a branch of arachnology it has become separated and those that study them are considered a distinctly different group of researchers. The term arachnology has become, for the most part, used for a discipline separate from acarology and covers all the other orders of the Class Arachnida. Those studying fossilized material as paleontologists also tend to be isolated from the mainstream arachnologists and the branch they study is termed palaeoarachnology. The three have some different terminology, often attend separate meetings and mostly belong to separate professional societies. Each also has its own journal series and books. Only a few researchers now study all arachnid groups and those are usually comparative zoologists looking at genetics, fossils, and/or higher classifications. Only a few now train as "true" arachnologists studying all the modern groups. Other groups of researchers, not so isolated as acarologists, have been referred to in the literature as the branches of araneology and scorpiology. Less often used are the studies of opilionology and pseudoscorpionology. Thus far, there is not a term for an arachnologist that studies the lesser or smaller (in terms of number of taxa) orders. For the purpose of this review arachnology and arachnids can refer to all members of the class, but acarology and arachnology are used contrasting each other in some sections.

Table 1. Living species of the Class Arachnida (of the 20 known orders, four are only known from fossils and are not included here).

Superorder	Order	Suborder	No. of species (Iran)	No. of species (World-wide)
	Araneae		764 [a]	47,490 [b]
	Solifugae		67 [c]	1,113 [d]
	Scorpiones		68 [e]	1,988 [d]
	Pseudoscorpiones		65 [f]	3,533 [g]
	Opiliones		22 [h]	6,653 [i]
	Amblypygi		1 [j]	≈220 [j]
	Schizomida		0	267 [d]
	Thelyphonida		0	110 [d]
	Palpigradi		0	87 [d]
	Ricinulei		0	61 [d]
"Acari": Parasitiformes (=Anactinotrichida)	Mesostigmata		620 [m]	>11,419 [d]
	Ixodida		51 [k, n]	892 [d]
	Opilioacarida		0	35 [d]
	Holothyrida		0	27 [d]
"Acari": Acariformes (=Actinotrichida)	Trombidiformes (=Prostigmata, Actinedida)		>603 [k]	>25,766 [l]
	Sarcoptiformes	Endeostigmata	4 [k]	108 [d]
		Oribatida (=Cryptostigmata)	380 [o]	16,197 [d]
		Astigmatina (=Astigmata)	75 [p]	>3,400

[a] Zamani et al., 2019a; Table 5; [b] World Spider Catalog, 2018; [c] Table 7; [d] Zhang, 2013; [e] Table 4; [f] Table 6; [g] Harvey, 2013a; [h] Snegovaya et al., 2018; Table 8; [i] Kury, 2017; [j] Miranda & Zamani, 2018; [k] Table 3; [l] based on numbers within this table; [m] Nemati et al., 2018; [n] Table 2; [o] Akrami, 2015; [p] Kamali et al., 2001.

Mites, "*hīreh*", and ticks, "*kaneh*", "*mella*", "*ḡarībgaz*", or "*šabgaz*" (Subclass Acari = Acarina)

The classically used name Acari is no longer considered an order for the mites and ticks, but rather a higher level grouping (that maybe artificial—see text in previous paragraphs). The Acari now consists of two "superorders" Parasitiformes (= Anactinotrichida) and Acariformes (= Actinotrichida) and seven orders (Table 2). In the brief history of Arachnology in Iran, the Acari have received by far the most attention among all of the members of the class because of their great economic and medical/veterinary importance. Mites and ticks are of major significance as ecto- and endoparasites of invertebrates along with vertebrates. They are major pests of crops, ornamental and fruit trees, and stored products as well as being bio-control agents of insect and mite pests on the same and other plants and products. Their significance in breaking down the humus layer in soils is also a topic of considerable importance.

The only true parasitic members of the Arachnida are mites and ticks. Spiders can be kleptoparasitic but do not feed directly

on the host. These Acari parasites can be free-living in one or more life stages or remain parasitic their entire lives. The larvae have six legs and the nymphs and adults usually have eight legs, but some have six legs. The adults of the worm-like mites (Superfamily Eriophyoidea) only have two pair of legs as adults.

According to Persian folklore, ticks are evil omens, and their bites are associated with potentially fatal fevers (Aḥmadī & Tuck, 2011). Two families of ticks are recorded from Iran: the soft ticks or "*kaneh-ye narm*" (Argasidae) and the hard ticks or "*kaneh-ye sa̲kht*" (Ixodidae) (Tables 2 and 3).

Mites and ticks have been known from Iran for many centuries because of their parasitic nature on man and livestock. Crimean-Congo hemorrhagic fever associated with ticks may have been reported in Iran as early as 1110 AD (Askarian et al., 2012). This early report was compiled by the Iranian scholar Jorjani, on a hemorrhagic syndrome associated with ticks in the Persian medical encyclopedia "*Zakhīra-i Khwârazmshâhī*". The earliest scientific description of a species from the region that was found is that of the poultry tick or "*kaneh-ye morgī*" named *Rhynochoprion persicum* Oken, 1818 (now known as *Argas persicus*) from Miyaneh, Iran (see Fig. 12 for picture of Oken).

Unlike most other Iranian arachnid groups, ticks and mites were investigated originally by Iranian scientists, not just Europeans. A nice presentation on the "History of Acarology in Iran" was given by Alireza Saboori (Fig. 13) in 2013, but it was never published. The presentation was at the opening ceremony of the 2nd International Persian Congress of Acarology being held at the College of Agriculture and Natural Resources, University of Tehran, Karaj, Iran. A pdf copy of the visual portion of that presentation was provided to the authors of this publication and they have drawn from it in this publication.

Afshar (1936) (Fig. 14) presented the first scientific publication on Iranian Acari as pests of cotton. Veterinary acarology of Iran began in the early 1940's at the Razi Institute, Karaj, Iran, where researchers conducted studies on ectoparasitic ticks on livestock. About a decade later, a list of plant mites as agricultural pests of pear, apple and grapes was published by Davachi (1949).

In 1961, Farahbakhsh published the first checklist of mites recorded from Iran. Later, Khalil-Manesh (1969, 1973) reported on some phytophagous mites from the country. In 1971 (not published until 1973), Sepasgozarian (Fig. 15) presented a short paper at the International Congress of Acarology in Prague that noted:

"Until twenty years ago there was no problem of mites affecting our agricultural crops. Since then, the biological equilibrium has been disturbed and the population of useful predators decimated because of agricultural mechanization and the use of manufactured pesticides such as organochorides. The population of mites increased gradually and this caused problems in agricultural areas."

Of course, this observation has been repeated world-wide, especially the effects of DDT on the environment in the "Silent Spring" (Carson, 1962). Several years later, Sepasgozarian (1977) assembled the scattered references which had accumulated in the previous 20 years, about the Acari fauna of Iran in his next paper on researches on acarology in Iran.

During the 1970–1990's, there were many other papers and books published on Iranian acarology, with the following being the more noteworthy: Khalil-Manesh (1979), Daneshvar & Denmark (1982), Ostovan & Kamali (1994, 1995) (Fig. 16), Saboori (1998, 1999). Following them,

Haitlinger & Saboori (1996), Modarres Awal (1994, and subsequent editions), Mossadegh (1997), and Khosrowshahi & Arbabi (1997) each contributed to the growing knowledge of the Acari fauna of Iran by reporting new records and species from throughout the country.

The first species described from Iran of the Order Mesostigmata (= Gamasida) were in the Family Phytoseiidae. Daneshvar & Denmark (1982) described those phytoseiids as new species of *Amblydromella* (*A. iranensis*, *A. torbatejamae*, *A. neyshabouris*, and *A. rodriguezi*) and the species *Typhlodromips caspiansis*. The first new genus of Mesostigmata based on species from Iran was by Kazemi et al. (2008) (Fig. 17). The first member of the Sarcoptiformes named from Iran is not certain, but the first species described from Iran of the Suborder Oribatida was by Niedbała (1984) and was likely the first for the order. Niedbała (1984) described two ptyctimous mite species that were collected in 1972 from the northern provinces of Iran by Dominiak. Zhang & Saboori (1995) described a new species of *Ralphaudyna* (Chyzeriidae). Zhang in Zhang & Norbakhsh (1995) named the first species from Iran of the Order Trombidiformes (= Prostigmata, Actinedida). Zhang named one new genus and species (*Monotrombium simplicium*) and two other new species (*Allorthrombium triticium*, *A. mossi*). All three species are members of the Trombidiidae and have larvae that are ectoparasitic on aphids.

After 2000, two important publications were: "*A catalog of mites and ticks* (*Acari*) *of Iran*" by Kamali et al. (2001) and "*Injurious mites of agricultural crops in Iran*" by Khanjani & Haddad Irani-Nejad (2006). There are two well-known acarologists in Iran with the same surname: Karim Kamali (Fig. 18) and Hashem Kamali (Fig. 19). According to Kamali [Karim] et al. (2001) there were 268 scientific publications, six Ph.D. dissertations, and 29 M.S. theses concerning mites and ticks of this country up to and including the year 2000. Kamali et al. (2001) recorded more than 1,040 species and subspecies [we count only 1,027 in their publication and assume that the differences are due to undercounting of taxa listed as sp. and ssp.] of the Subclass Acari in their catalog (Table 2).

This publication treated the group as an order and is badly outdated now, but the best that is currently available for the entire assemblage. Many of the records in the catalog are based on undescribed species which were reported in the many listed dissertations and theses. Information and records were provided in the 2001 catalog for 430 genera in 159 families from the five major orders: Superorder Parasitiformes (= Anactinotrichida) [orders (1) Ixodida and (2) Mesostigmata]; Superorder Acariformes [Order (3) Prostigmata]; [Superorder Sarcoptiformes not used by Kamali et al. (2001)] [orders (4) Oribatida and (5) Astigmata]. For each species listed in the catalog, distribution within the provinces, habitats, association or plant and animal hosts were stated. Interestingly, no members of the very small Order Opilioacarida (= Notostigmata) nor Order Holothyrida have been recorded from Iran. The Opilioacarida are recorded from Yemen, Algeria, and Mediterranean countries as well as the New World, whereas the Holothyrida are from southeastern Asia and Australia.

Many new family and species records have been added in the past 18 years, since the 2001 publication by Kamali et al. Several large groups have also been updated and cataloged. Beyzavi et al. (2013) published a catalog to the Iranian prostigmatic mites of the superfamilies Raphignathoidea and Tetranychoidea.

Figures 12–20. European and Iranian Acarologists. **12.** Oken, Lorenz in 1819 (born 1 August 1779, Bohlsbach, Baden, Germany – died 11 August 1851, Zurich, Switzerland); **13.** Saboori, Alireza (born 5 September 1968, Nowshahr, Iran); **14.** Afshar, Jalal [born 1857, Urmia (= Orumieh), Iran – died 1934, Tehran, Iran]; **15.** Sepasgosarian, Hossein [spelled Sepasgozarian in publications] (born 11 November 1929, Tehran, Iran); **16.** Ostovan, Hadi (born 22 June 1967, Kazeroon, Iran); **17.** Kazemi, Shahrooz (born 20 March 1975, Kerman, Iran); **18.** Kamali, Karim (born 25 August 1941, Tabriz, Iran); **19.** Kamali, Hashem (born 6 April 1964, Mashhad, Iran); **20.** Hakimitabar, Masoud (born 14 April 1979, Mashhad, Iran).

Table 2. Outdated classification system of families and numbers of species/subspecies of "Subclass" Acari (= Acarina) recorded from Iran by Kamali et al. (2001) with literature up to and including 2000. Numbers of species per family counts were not previously listed by Kamali et al. (2001), but below are counts on 1,027 species.

Superorder	Order	Family	No. of species
Parasitiformes (= Anactinotrichida) 278 species	Mesostigmata (= Gamasida) 227 species	Ameroseiidae	9
		Ascidae	29
		Celaenopsidae	1
		Dermanyssidae	2
		Digamasellidae	3
		Eviphididae [misspelled "Eviphidae"]	1
		Haemogamasidae	1
		Halolaelapidae	2
		Laelapidae	39
		Leptolaelapidae	1
		Macrochelidae	12
		Macronyssidae	1
		Neoparasitidae	1
		Ologamasidae	1
		Pachylaelapidae	4
		Parasitidae	22
		Parholaspidae	3
		Phytoseiidae	70
		Podocinidae	1
		Polyaspididae	1
		Rhodacaridae	2
		Trachytidae	1
		Trachyuropodidae	2
		Urodinychidae	1
		Uropodidae	10
		Varroidae	3
		Veigaiidae	3
		Zerconidae	1
	Ixodida (= Metastigmata) 51 species	Argasidae	10
		Ixodidae	41
Acariformes (= Actinotrichida) 749 species	Astigmata (= Acaridida) 75 species	Acaridae	37
		Carpoglyphidae	1
		Chaetodactylidae	1
		Chortoglyphidae	1
		Epidermoptidae	1
		Glycyphagidae	9
		Hemisarcoptidae	1
		Histiostomatidae (Syn.: Anoetidae)	3

Table 2. Continued.

Superorder	Order	Family	No. of species
Acariformes	Astigmata	Myocoptidae	1
		Psoroptidae	6
		Pyroglyphidae	3
		Saproglyphidae	2
		Sarcoptidae	9
	Oribatida (= Cryptostigmata) 96 species	Achipteriidae	1
		Anderemaeidae	1
		Aphelacaridae	1
		Autognetidae	1
		Camisiidae	2
		Carabodidae	1
		Ceratozetidae	1
		Chamobatidae	1
		Cosmochthoniidae	2
		Ctenacaridae	2
		Cymbaeremaeidae	2
		Damaeidae	1
		Damaeolidae	2
		Epilohmannidae	5
		Eremellidae	1
		Eremobelbidae	1
		Euphthiracaridae	2
		Galumnidae	2
		Glanderemaeidae	1
		Gymnodamaeidae	1
		Haplochthoniidae	1
		Haplozetidae	1
		Hypochthonidae	1
		Idiozetidae	1
		Liacaridae	1
		Licneremaeidae	1
		Licnodamaeidae	1
		Liodidae	1
		Lohmannidae	3
		Malaconothridae	1
		Micreremidae	1
		Microzetidae	1
		Mochlozetidae	1
		Mycobatidae	2
		Nothridae	1
		Oppiidae	13
		Oribatulidae	15
		Oripodidae	1
		Passalozetidae	3
		Phthiracaridae	1
		Platermaeidae	1
		Protoribatidae	2
		Scheloribatidae	3

Table 2. Continued.

Superorder	Order	Family	No. of species
Acariformes	Oribatida	Scutoverticidae	1
		Sphaerochthoniidae	2
		Tectocepheidae	1
		Xylobatidae	3
		Zetomotrichidae	1
	Prostigmata (= Actinedida) 578 species	Acarophenacidae	1
		Anisitsiellidae (Syn.: Nilotonidae)	1
		Anystidae	13
		Arrenuridae	8
		Atracteidae	2
		Aturidae	2
		Axonopsidae	10
		Bdellidae	22
		Caeculidae	1
		Caligonellidae	10
		Camerobiidae (Syn.: Neophyllobiidae)	6
		Cheyletidae	27
		Chyzeriidae	1
		Cunaxidae	18
		Demodicidae	4
		Eriophyidae	46
		Erythraeidae	34
		Eupalopsellidae	1
		Eupodidae	6
		Eutrombidiidae	6
		Eylaidae	1
		Feltriidae	2
		Hungarohydracaridae	2
		Hydrachnidae	1
		Hydrodromidae	5
		Hydrovolziidae	3
		Hydryphantidae	2
		Hygrobatidae	6
		Iolinidae	2
		Krendowskiidae	1
		Lebertiidae	1
		Leeuwenhoekiidae	4
		Limnesiidae	1
		Linotetranidae	1
		Microtrombidiidae	4
		Mideopsidae	2
		Myobiidae	3
		Nalepellidae	1
		Nanorchestidae	2
		Pachygnathidae	1
		Pediculopsidae	1

Table 2. Continued.

Superorder	Order	Family	No. of species
Acariformes	Prostigmata	Penthaleidae	2
		Pionidae	2
		Podapolipidae	1
		Podothrombiidae	1
		Protziidae	2
		Pseudocheylidae	2
		Pterygosomatidae	1
		Pyemotidae	4
		Pygmephoridae	10
		Raphignathidae	9
		Rhagidiidae	4
		Rhyncaphytoptidae	2
		Scutacaridae	9
		Smarididae	4
		Sperchonidae	5
		Stigmaeidae	22
		Tarsonemidae	20
		Teneriffiidae	1
		Tenuipalpidae	48
		Tetranychidae	61
		Thyasidae	3
		Torrenticolidae	1
		Trombiculidae	52
		Trombidiidae	14
		Tuckerellidae	3
		Tydeidae	28
		Unionicolidae	2

Saboori & Hakimitabar (2013) (Fig. 20) published a checklist of the Trombidioidea. Darb Emamieh et al. (2013) provided a list of Iranian Eupodoidea (Prostigmata). Hajiqanbar & Sobhi (2018) (Fig. 21) provided a taxonomic key with details on the Microdispidae and Navabi et al. (2018) presented a list of the Neopygmephoridae of Iran. Pešić et al. (2014) published an updated checklist of the water mites (Hydrachnidia) of Iran which contained 145 species, in 38 genera, and 25 families. The Oribatida were cataloged by Akrami (2015) (Fig. 22).

Nemati et al. (2018) (Fig. 23) presented a catalog (to 371 species, belonging to 127 genera, and 39 families) of the Iranian Mesostigmata with additions and updates to the previous annotated checklist by Kazemi & Rajaei (2013). Neither of these catalogs included members of the large Family Phytoseiidae which was covered by Hajizadeh & Faraji (2016) (Figs. 24, 25). All totals combined the Mesostigmata now consist of 620 species, in 172 genera, and 47 families (Table 3).

Since the 2001 Kamali et al. catalog, numerous additions have been published, almost all by Iranian authors. Reviewing the literature on Iran, Lotfollahi et al. (2010) (Fig. 26) noted numerous faunistic studies that had been conducted by 16 authors. They also provided taxonomic keys to the prostigmatic mites (24 species, 26 genera, and 17 families) collected from soils of alfalfa fields in the northwest of Iran.

The mite Family Achaemenothrombiidae Saboori, Wohltmann & Hakimitabar, 2010 is noteworthy because the three described member species are all endemic to Iran (Saboori et al., 2013). Members of this family have larvae that are ectoparasitic on insects. The only other arthropod family that is also known only by an endemic species in Iran is a fossil decapod crustacean. This fossil lobster (Order Decapoda: Family Tricarinidae) is only reported from the Early Cretaceous of what is now in Fars province, Iran (Feldmann et al., 2007). Mortazavi et al. (2018) described three new species of water beetle (Dytiscidae) parasites from Iran and the U.S.A. These species are all members of a new genus and family (Dytiscacaridae) of trombidiform mites. These mites are highly specialized and unique for spending their entire life-cycle while inhabiting the space beneath the elytra of their hosts.

To better understand the large amount of literature pertaining to acarology of Iran since 2000, several computer database searches were undertaken. First, an OCLC WorldCat search was made. Searching online (Available from: https://www.worldcat.org/advancedsearch, [Accessed 05 May 2018]) for the years 2000 to 2018 with the search terms of "Acari" and "Iran" in only the titles recovered 933 publication citations. In these recovered citations, there were 739 names in the catalog of genera and species identified. In all there were 709 new species listed in titles (search also on abbreviated forms of the names "new genus" and "new species"). Publishing a single new species per publication was common with 487 articles describing a single new species. Unfortunately, it is unknown how many of these were previously recorded as undescribed in the acarology catalog by Kamali et al. (2001). Current journals not found in the searches of the OCLC catalog were found in Zhang (2014). A computer search of keywords (when possible), titles, and text resulted in the following additional titles: Acarina. Russian Journal of Acarology — 13 publications; Acarologia — 58 articles, many with descriptions or records of new species from Iran; Experimental and Applied Acarology — 60 articles, most on biological control and biology; International Journal of Acarology — 190 articles, most with new species descriptions; Persian Journal of Acarology (started 2012) — 20 publications, a few new species; Systematic and Applied Acarology — 129 citations, majority have at least one new species described.

A rich source of papers and abstracts of presentations from the International Persian Congresses of Acarology are found in three books. The first IPCA was held at the Graduate University of Advanced Technology in Kerman (Kazemi & Saboori, 2011) and the second was held at the College of Agriculture and Natural Resources, University of Tehran, in Karaj, Iran (Joharchi & Saboori, 2013). The third Persian Congress was held at the College of Science, University of Tehran, in Tehran, Iran (Hajiqanbar & Saboori, 2017). The results of the first Persian Congress were published in Persian and English with 111 abstracts and full articles. The latter two books are in English. The book on the second Persian Congress covered taxonomy and biodiversity with 45 abstracts; biocontrol with 11 abstracts; biology, ecology, and ethology with 25 abstracts; physiology and toxicology with 7 abstracts; and veterinary and medical acarology with a single abstract. The majority of abstracts are about acarology in Iran but a few are about this study in other Asian countries. Numerous new species and records are recorded first for Iran. The book on the third Persian Congress of Acarology is on taxonomy and biodiversity with 49 abstracts; biology, ecology, biocontrol, and toxicology with 22 abstracts.

Figures 21–29. Iranian Acarologists and European Arachnologists. **21.** Hajiqanbar, Hamidreza (born 17 August 1973, Mashhad, Iran); **22.** Akrami, Mohammad Ali (born 23 August 1975, Abarkooh, Iran); **23.** Nemati, Alireza (born 1973, Bagh-e Malek, Iran); **24.** Hajizadeh, Jalil (born 21 April 1964, Fasa, Iran); **25.** Faraji, Farid (born 31 December 1963, Sari, Iran); **26.** Lotfollahi, Parisa (born 20 September 1980, Jolfa, Iran); **27.** Olivier, Guillaume-Antoine (born 19 January 1756, Toulon, France – died 1 October 1814, Lyon, France); **28.** Pocock, Reginald Innes (born 4 March 1863, Clifton, Bristol, England – died 9 August 1947, London, England); **29.** Kovařík, František (from Czech Republic).

Table 3. Updated list of 244 families of "Acari" in Iran. This list was started by Kamali et al. (2001) and updated to include through 2018. Citations given are not necessarily the first reported in the literature for the region but are for revisions and reviews when possible. Total number of species >1,733 is based only on updated totals as well as totals of some subgroups from the original 2001 catalog.

Superorder	Order	Suborder	Family	References
Parasitiformes (= Anactinotrichida)[a]	Mesostigmata (= Gamasida)[b]		Ameroseiidae	Kamali et al., 2001
			Antennophoridae	Nemati et al., 2018
			Ascidae	Kamali et al., 2001
			Asternoseiidae	Nemati et al., 2018
			Blattisociidae	Arjomandi et al., 2013
			Celaenopsidae	Kamali et al., 2001
			Cercomegistidae	Nemati et al., 2018
			Dermanyssidae	Kamali et al., 2001
			Digamasellidae	Kamali et al., 2001
			Dinychidae	Nemati et al., 2018
			Diplogyniidae	Kazemi & Rajaei., 2013
			Dithinozerconidae	Kazemi & Rajaei., 2013
			Epicriidae	Nemati et al., 2018
			Eviphididae	Kamali et al., 2001
			Halolaelapidae	Kamali et al., 2001
			Ichtyostomatogasteridae	Kazemi & Rajaei., 2013
			Iphiopsididae	Kazemi & Rajaei., 2013
			Laelapidae [2]	Kamali et al., 2001 [3]
			Leptolaelapidae	Kamali et al., 2001
			Macrochelidae	Kamali et al., 2001
			Macrodinychidae	Kontschán & Hajizadeh, 2013
			Macronyssidae	Kamali et al., 2001
			Melicharidae	Nemati et al., 2018
			Metagynuridae	Kazemi & Rajaei., 2013
			Microgyniidae	Kazemi et al., 2011; Kazemi & Rajaei., 2013
			Ologamasidae	Kamali et al., 2001
			Oplitidae	Nemati et al., 2018
			Otopheidomenidae	Kazemi & Rajaei., 2013
			Pachylaelapidae	Kamali et al., 2001
			Parasitidae	Kamali et al., 2001
			Parholaspididae [3]	Kamali et al., 2001
			Phytoseiidae	Hajizadeh & Faraji, 2016
			Podocinidae	Kamali et al., 2001
			Polyaspididae	Kamali et al., 2001
			Pseudolaelapidae	Nemati et al., 2018
			Rhinonyssidae	Nemati et al., 2018
			Rhodacaridae	Kamali et al., 2001
			Schizogyniidae	Nemati et al., 2018
			Sejidae	Nemati et al., 2018
			Trachytidae	Kamali et al., 2001

Table 3. Continued.

Superorder	Order	Suborder	Family	References
Parasitiformes	Mesostigmata		Trachyuropodidae	Kamali et al., 2001
			Trematuridae [4]	Kazemi & Rajaei, 2013; Nemati et al., 2018
			Urodiaspididae	Nemati et al., 2018
			Uropodidae	Kamali et al., 2001
			Varroidae	Kamali et al., 2001
			Veigaiidae	Kamali et al., 2001
			Zerconidae	Kamali et al., 2001
	Ixodida (=Metastigmata)[c]		Argasidae	Kamali et al., 2001
			Ixodidae	Kamali et al., 2001
Acariformes (= Actinotrichida)[d]	Sarcoptiformes [rank not used by Kamali et al., 2001][e]	Endeostigmata [no members recorded by Kamali et al., 2001][f]	Alicorhagiidae	Bagheri, 2007
			Bimichaelidae	Bagheri, 2007
			Nanorchestidae	Lotfollahi et al., 2010
			Terpnacaridae	Hajiqanbar & Momen, 2006
		Astigmata (= Acaridida)[g]	Acaridae	Kamali et al., 2001
			Carpoglyphidae	Kamali et al., 2001
			Chaetodactylidae	Kamali et al., 2001
			Chortoglyphidae	Kamali et al., 2001
			Epidermoptidae	Kamali et al., 2001
			Glycyphagidae	Kamali et al., 2001
			Hemisarcoptidae	Kamali et al., 2001
			Histiostomatidae (Syn.: Anoetidae)	Kamali et al., 2001
			Myocoptidae	Kamali et al., 2001
			Psoroptidae	Kamali et al., 2001
			Pyroglyphidae	Kamali et al., 2001
			Saproglyphidae	Kamali et al., 2001
			Sarcoptidae	Kamali et al., 2001
			Winterschmidtiidae	Moradi Faradonbeh et al., 2017
		Oribatida (Syn.: Cryptostigmata)[h]	Achipteriidae	Kamali et al., 2001
			Aleurodamaeidae	Akrami, 2015
			Ameridae	Akrami, 2015
			Amerobelbidae	Akrami, 2015
			Anderemaeidae	Kamali et al., 2001
			Aphelacaridae	Kamali et al., 2001
			Astegistidae	Akrami, 2015
			Austrachipteriidae	Akrami, 2015
			Autognetidae	Kamali et al., 2001
			Brachychthoniidae	Akrami, 2015, 2016

Table 3. Continued.

Superorder	Order	Suborder	Family	References
Acariformes	Sarcoptiformes	Oribatida	Caleremaeidae	Akrami, 2015
			Camisiidae	Kamali et al., 2001
			Carabodidae	Kamali et al., 2001
			Ceratoppiidae	Akrami, 2015
			Ceratozetidae [1]	Kamali et al., 2001
			Chamobatidae	Kamali et al., 2001
			Compactozetidae	Akrami, 2015
			Cosmochthoniidae	Kamali et al., 2001
			Crotoniidae	Akrami, 2015
			Ctenacaridae	Kamali et al., 2001
			Ctenobelbidae	Akrami, 2015
			Cymbaeremaeidae	Kamali et al., 2001
			Damaeidae	Kamali et al., 2001
			Damaeolidae	Kamali et al., 2001
			Eniochthoniidae	Kamali et al., 2001
			Epilohmannidae	Kamali et al., 2001
			Epimerellidae	Akrami, 2015
			Eremaeidae	Akrami, 2015
			Eremellidae	Kamali et al., 2001
			Eremobelbidae	Kamali et al., 2001
			Eulohmanniidae	Akrami, 2015
			Euphthiracaridae	Kamali et al., 2001
			Galumnidae	Kamali et al., 2001
			Glanderemaeidae	Kamali et al., 2001
			Gustaviidae	Akrami, 2015
			Gymnodamaeidae	Kamali et al., 2001
			Haplochthoniidae	Kamali et al., 2001
			Haplozetidae	Kamali et al., 2001
			Hemileiidae	Akrami, 2015
			Hermanniellidae	Akrami, 2015
			Hermanniidae	Akrami, 2015
			Humerobatidae	Akrami, 2015
			Hydrozetidae	Akrami, 2015
			Hypochthonidae	Kamali et al., 2001
			Idiozetidae	Kamali et al., 2001
			Liacaridae	Kamali et al., 2001
			Licneremaeidae	Kamali et al., 2001
			Licnobelbidae	Akrami, 2015
			Licnodamaeidae	Kamali et al., 2001
			Liebstadiidae	Akrami, 2015
			Liodidae	Kamali et al., 2001
			Lohmanniidae [5]	Kamali et al., 2001
			Machuellidae	Akrami, 2015
			Malaconothridae	Kamali et al., 2001
			Mesoplophoridae	Akrami, 2015
			Micreremidae	Kamali et al., 2001
			Microzetidae	Kamali et al., 2001
			Mochlozetidae	Kamali et al., 2001
			Mycobatidae	Kamali et al., 2001
			Nanhermanniidae	Akrami, 2015

Table 3. Continued.

Superorder	Order	Suborder	Family	References
Acariformes	Sarcoptiformes	Oribatida	Neoliodidae	Akrami, 2015
			Nothridae	Kamali et al., 2001
			Oppiidae	Kamali et al., 2001
			Oribatellidae	Akrami, 2015
			Oribatulidae	Kamali et al., 2001
			Oribotritiidae	Akrami, 2015
			Oripodidae	Kamali et al., 2001
			Otocepheidae	Kamali et al., 2001
			Parakalummidae	Akrami, 2015
			Parhypochthoniidae	Akrami, 2015
			Passalozetidae	Kamali et al., 2001
			Perlohmanniidae	Akrami, 2015
			Phenopelopidae	Akrami, 2015
			Phthiracaridae	Kamali et al., 2001
			Platermaeidae	Kamali et al., 2001
			Protoplophoridae	Akrami, 2015
			Protoribatidae (Syn.: Xylobatidae)	Akrami, 2015
			Pseudoppiidae	Akrami, 2015
			Punctoribatidae	Akrami, 2015
			Quadroppiidae	Akrami, 2015
			Scheloribatidae	Kamali et al., 2001
			Scutoverticidae	Kamali et al., 2001
			Sphaerochthoniidae	Kamali et al., 2001
			Suctobelbidae	Akrami, 2015
			Tectocepheidae	Kamali et al., 2001
			Thyrisomidae	Akrami, 2015
			Trhypochthoniidae	Akrami, 2015
			Xenillidae	Akrami, 2015
			Zetomotrichidae	Kamali et al., 2001
			Zetorchestidae	Akrami, 2015
	Trombidiformes (= Prostigmata, Actinedida)[i]		Acarophenacidae	Kamali et al., 2001
			Achaemenothrombiidae	Saboori et al., 2010
			Anisitsiellidae (Syn.: Nilotonidae)	Kamali et al., 2001
			Anystidae	Kamali et al., 2001
			Arrenuridae	Kamali et al., 2001
			Atracteidae	Kamali et al., 2001
			Aturidae	Kamali et al., 2001
			Axonopsidae	Kamali et al., 2001
			Barbutiidae	Bagheri et al., 2010
			Bdellidae	Kamali et al., 2001
			Caeculidae	Kamali et al., 2001
			Caligonellidae	Kamali et al., 2001
			Camerobiidae (Syn.: Neophyllobiidae)	Kamali et al., 2001

Table 3. Continued.

Superorder	Order	Suborder	Family	References
Acariformes	Trombidiformes		Caraboacaridae	Mirjamali et al., 2008
			Cheyletidae	Kamali et al., 2001
			Chyzeriidae	Kamali et al., 2001
			Cryptognathidae	Beyzavi et al., 2013
			Cunaxidae	Kamali et al., 2001
			Demodicidae	Kamali et al., 2001
			Diptilomiopidae	Doryanizadeh et al., 2011
			Dolichocybidae	Katlav et al., 2014
			Dytiscacaridae	Mortazavi et al., 2018
			Ereynetidae	Bagheri, 2007
			Eriophyidae	Kamali et al., 2001
			Erythraeidae	Kamali et al., 2001
			Eupalopsellidae	Kamali et al., 2001
			Eupodidae	Kamali et al., 2001
			Eutrombidiidae	Kamali et al., 2001
			Eylaidae	Kamali et al., 2001
			Feltriidae	Kamali et al., 2001
			Frontipodopsidae	Pešić et al., 2014
			Hungarohydracaridae	Kamali et al., 2001
			Hydrachnidae	Kamali et al., 2001
			Hydrodromidae	Kamali et al., 2001
			Hydrovolziidae	Kamali et al., 2001
			Hydryphantidae	Kamali et al., 2001
			Hygrobatidae	Kamali et al., 2001
			Iolinidae	Kamali et al., 2001
			Johnstonianidae	Noei et al., 2014
			Krendowskiidae	Kamali et al., 2001
			Labidostomatidae	Bertrand et al., 2012; Jalaeian et al., 2013
			Lebertiidae	Kamali et al., 2001
			Leeuwenhoekiidae	Kamali et al., 2001
			Limnesiidae	Kamali et al., 2001
			Linotetranidae	Kamali et al., 2001
			Microdispidae	Hajiqanbar & Sobhi, 2018
			Microtrombidiidae	Zhang & Saboori, 1997; Saboori et al., 2009
			Mideopsidae	Kamali et al., 2001
			Momoniidae	Pešić et al., 2014
			Myobiidae	Kamali et al., 2001
			Nalepellidae	Kamali et al., 2001
			Neopygmephoridae	Hajiqanbar & Rakhshani, 2011; Zafari et al., 2017
			Neothrombiidae	Saboori & Ostovan., 2001; Tashakor et al., 2013
			Neotrombidiidae	Noei et al., 2017

Table 3. Continued.

Superorder	Order	Suborder	Family	References
Acariformes	Trombidiformes		Pachygnathidae	Kamali et al., 2001
			Pediculopsidae	Kamali et al., 2001
			Penthaleidae	Kamali et al., 2001
			Pionidae	Kamali et al., 2001
			Podapolipidae	Kamali et al., 2001
			Podothrombiidae	Kamali et al., 2001
			Pomerantziidae	Lotfollahi, 2017
			Protziidae	Kamali et al., 2001
			Pseudocheylidae	Kamali et al., 2001
			Pterygosomatidae	Kamali et al., 2001
			Pyemotidae	Kamali et al., 2001
			Pygmephoridae	Kamali et al., 2001
			Raphignathidae	Kamali et al., 2001
			Rhagidiidae	Kamali et al., 2001
			Rhyncaphytoptidae	Kamali et al., 2001
			Scutacaridae	Kamali et al., 2001
			Smarididae	Kamali et al., 2001
			Sperchontidae (not Sperchonidae)	Kamali et al., 2001; Pešić et al., 2014
			Sphaerolichidae	Beyzavi & Ostovan, 2011
			Stigmaeidae	Kamali et al., 2001
			Tarsocheylidae	Amin et al., 2014
			Tarsonemidae	Kamali et al., 2001
			Teneriffiidae	Kamali et al., 2001
			Tenuipalpidae	Kamali et al., 2001
			Tetranychidae	Kamali et al., 2001
			Thyasidae	Kamali et al., 2001
			Torrenticolidae	Kamali et al., 2001
			Trochometridiidae	Hajiqanbar et al., 2009
			Trombiculidae	Kamali et al., 2001
			Trombidiidae	Kamali et al., 2001
			Tuckerellidae	Kamali et al., 2001
			Tydeidae	Kamali et al., 2001
			Unionicolidae	Kamali et al., 2001

[1] Ceratozetidae incorrectly reported in the Mesostigmata by Kamali et al. (2001). [2] Kamali et al. (2001) listed species in the Haemogamasidae and Neoparasitidae that were later transferred to Laelapidae by Kazemi & Rajaei (2013). [3] Parholaspididae was misspelled as Parholaspidae by Kamali et al. (2001). [4] Kamali et al. (2001) misplaced a Trematuridae species in the Urodinychidae. [5] Lohmanni[i]dae was incorrectly spelled with one "i" by Kamali et al. (2001).

[a] 49 families, 671 species; [b] 47 families, Kazemi & Rajaei (2013), Hajizadeh & Faraji (2016), Nemati et al. (2018) listed 172 genera and 620 species [Kamali et al. (2001) listed only 228 species]; [c] 2 families, 51 species; [d] 195 families, 1,062+ species; [e] 108 families, 459+ species; [f] 4 families, 4 species; [g] 14 families, 75+ species; [h] 90 families, Akrami (2015) listed 380 species [Kamali et al.(2001) listed 96 species]; [i] 87 families, 603+ species.

Our estimate of the total number of Acari species (= 1,733+) is based only on updated totals of two orders as well as totals from the original 2001 catalog. Newly described or collected families of Acari from Iran were added to Table 3, resulting in the current list of 244 families.

The Acarological Society of Iran (available from: http://www.acarology.ir [Accessed 4 April 2018]) was established in 2008. At the moment the group has more than 120 members from around the world and publishes four issues of the "Persian Journal of Acarology" every year. Contact details and current list of members: http://www.acarology.ir/en/list-of-members.html [Accessed 7 August 2019]. See also https://ipca.ut.ac.ir/ [Accessed 11 August 2019] for information about meetings, pictures, and previous International Persian Congress of Acarology meetings.

There are numerous books and a thesis published in Persian and in one case Persian with English translation (Bartsch & Sepasgozarian, 1977).

- The books are on Acarology in general:

[*Acarology* (*morphology, biology & systematics*)] (Rahmani et al., 2011); [*Acarology* (*external & internal morphology*)] (Hajizadeh & Akrami, 2010); [*An illustrated glossary of acarology terminology*] (Lotfollahi & Khanjani, 2013); [*An introduction to morphology, anatomy, biology and distribution of Halacaridae* (*Acari*)] (Bartsch & Sepasgozarian, 1977).

- Topics covered also include diseases to man and plants as well as other agricultural damage:

[*Tick, a vector of piroplasmose and its control*] (Ezzatpour, 1987); [*Relapsing fever and its epidemiology*] (Karimi, 1981); [*Mites injurious to agricultural products*] (Khanjani & Haddad Irani-Nejad, 2006), a Ph.D. thesis (Akrami, 2006) [*Biodiversity of oribatid mites* (*Acari: Oribatida*), *and survey of important species as vectors of* Moniezia *spp.* (*Cestoda*) *in Mazandaran Province*].

- Identification and systematics are also covered:

[*Acari of Iran, Vol. 1, Parasitengone mites of Iran*] (Saboori et al., 2007); [*Acari of Iran, Vol. 2, Oribatid mites of Iran*] (Akrami & Saboori, 2012); [*An illustrated guide to the Ixodidae ticks of Iran*] (Hashemi-Fesharaki et al., 2002); [*Identification guide and diagnosis key for predatory mites of the family Phytoseiidae of Iran*] (Hajizadeh & Faraji, 2016).

Few Iranian arachnids inflict a significantly toxic bite (stings are of course a different matter). *Latrodectus* and *Loxosceles* are recorded from Iran and are known to have medically important bites (see below under spiders). Tick paralysis is a potentially fatal, but easily cured disease, caused by injection of a neurotoxin(s) found in tick saliva. Tick paralysis is present but not routinely found in Iran (Abdigoudarzi et al., 2006). However, economically and medically, parasitic mites and ticks surpass all other arthropods (except possibly mosquitoes and flies) in the number of diseases they transmit to humans, as well as in the widespread infestation of domestic stock and native wildlife. Robbins & Spradling (2006) cited the important tick-borne diseases transmitted by ticks in Iran as Bunya Fever, Crimean-Congo Hemorrhagic Fever, Dhori Virus Fever, Uukuniemi Virus Encephalitis, Boutanneuse Fever, Astrakan Fever, Tick-Borne Relapsing Fever, and Lyme Disease. Human scabies and Sarcoptic mange are both common in Iran (Seyedi Arani et al., 2016) and are caused by different subspecies/varieties of the sarcoptid mite *Sarcoptes scabiei* (De Geer, 1778).

Scorpions, "ʿ*aqrab*" or "*každom*" (Order Scorpiones = Scorpionida)

Because of the presence of large deserts and semi-arid areas in Iran, scorpions have always played a significant role in the life and the culture of the people.

Stinging as a feature of the scorpion's nature and not because of it being hateful is a famous concept in a poem by Saadi, the great Iranian poet (1210 to 1291 AD). A scorpion plaque (game board? with 20 positions) (Fig. 1) found in an archaeology site in Jiroft, Kerman province (Muscarella, 2001), southern Iran, was the logo of the now disbanded (2019) Arachnological Society of Iran (see comments under second paragraph in section Arachnology below). The civilization of ancient Jiroft is thought to be about 5,000 YBP, which is even more ancient than the Sumerian. The objects of this historical region are related to Aratta, a mysterious civilization mentioned in Sumerian's literature, which flourished more than 4,000 years ago.

A short review of the history of study of scorpions of Iran was published by Mirshamsi et al. (2011b). Olivier (1807) (Fig. 27), while writing in France, was the first to publish on Iranian scorpions. This study was followed by works of some other scorpiologists from Europe and Russia, namely Pocock (1900a) (Fig. 28), Birula (1900, 1903, 1905a, 1917), Werner (1936), and Vachon (1958). Habibi (1971) and Farzanpay (1987, 1988) (Fig. 34) were the first Iranian publications which contributed to the study of scorpions of Iran. Since then, research on the fauna, biology, ethology, and other aspects of scorpions has been performed in veterinary, medical, and science faculties in Iranian universities. The studies are being continued by the collaboration of scientists from Iran and other parts of the world: Vignoli et al. (2003), Kovařík & Fet (2006) (Figs. 29, 30), Navidpour (2008a, 2008b) (Fig. 31), Navidpour & Lowe (2010), Navidpour & Masihipour (2009), Navidpour et al. (2008a, 2008b, 2008c, 2008d, 2010, 2011, 2012, 2013), Pirali-Kheirabadi et al. (2009), Kovařík (2013), Mirshamsi (2013) (Fig. 32), Mirshamsi et al. (2010, 2011a, 2011b, 2013a), Teruel et al. (2014), Gharakhloo et al. (2018), etc. Mirshamsi et al. (2011b) recorded 51 species (30 endemics) of scorpions in Iran belonging to 18 genera and four families (Buthidae with 45 species, Hemiscorpiidae with six species, and a single species each of Diplocentridae and Scorpionidae). More recently, Yağmur et al. (2016) stated that there were 53 species with 32 endemics.

Navidpour et al. and Pirali-Kheirabadi et al. have published a series of articles entitled: "Scorpions of Iran (Arachnida, Scorpiones). Part" I–X. The last issue (part X) stated:

"This paper continues a comprehensive province-by-province field study of the scorpion fauna of Iran by the RRLS [Razi Reference Laboratory of Scorpion Research] team under Shahrokh Navidpour. The study includes documentation of biotope diversity, revisitation of previously known sites, some of them type localities, and sampling of all the encountered scorpion species. All specimens are collected with the help of UV light (night catch)."

They have completed studies of about a third of the provinces primarily in the western portions of the country.

Dehghani et al. (2016) recorded the occurrence of 59 species of 19 genera and the same three families [*Nebo* is currently classified in Scorpionidae and not the Diplocentridae, Soleglad & Fet, 2003 (Fig. 33)]. Kovařík et al. (2017) described a new species, *Hemiscorpius shahii*. Fet et al. (2018) named a new species of *Mesobuthus*. Fet et al. (2018) also provided a taxonomic key to the *Mesobuthus* complexes and species from the region. Kovařík et al. (2018) described two new *Hottentotta* species from Iran. Yağmur et al. (2016) recorded *Androctonus*

robustus Kovařík & Ahmed, 2013 from Iran for the first time. The record of *Androctonus baluchicus* (Pocock, 1900a) from Iran by Kovařík (1997) was rejected by Vignoli et al. (2003) and assigned to *A. crassicauda*. Possibly the specimens recorded from Iran as *Androctonus finitimus* (Pocock, 1897) were misidentified or the country locality data are incorrect. Only some old references listed this species from Iran and that species has not been recollected in that country (according to more recent literature). Kovařík & Ahmed (2013) only reported specimens (including all the types) of this species from Pakistan. Even so, we are keeping this species on the list of taxa from Iran until this is resolved by recollection or reexamination of those earlier recorded specimens. Kovařík et al. (2019b) described two new species of *Orthochirus* from Iran and Kovařík (2019) revised the taxonomy of *Mesobuthus* and *Olivierus* of Asia, including those from Iran. *Olivierus caucasicus* (Nordmann, 1840) was recorded under the name *Mesobuthus caucasicus* when Gantenbein et al. (2003) synonymized the genera, but Kovařík (2019) restored the two genera as being valid and resurrected the name *Olivierus caucasicus*. Kovařík (2019) also elevated the subspecies *Mesobuthus eupeus afghanus* (Pocock, 1889) to full species and noted that the nominal species (*Mesobuthus eupeus*) was also present in Iran and therefore it remains on the list.

Within the last decade, as late as 2018, there have been several errors listing synonyms on checklist as valid species. These junior synonyms are not entered in Table 4:

– *Buthacus tadmorensis* (Simon, 1892) was synonymized with *Buthacus macrocentrus* (Ehrenberg in Hemprich & Ehrenberg, 1828);

– *Buthus zarudnyi sarghadensis* Birula, 1903 = *Buthus zarudnianus* Birula, 1905a = *Compsobuthus kafkai* Kovařík, 2003 = *Compsobuthus sobotniki* Kovařík, 2003 were all synonymized with *Sassanidotus gracilis* (Birula, 1900);

– both *Orthochirus sobotniki* Kovařík, 2004 and *Paraorthochirus goyffoni* Lourenço & Vachon, 1995 were synonymized with *Orthochirus farzanpayi* (Vachon & Farzanpay in Farzanpay, 1987) = *Simonoides farzanpayi* Vachon & Farzanpay in Farzanpay, 1987;

– *Mesobuthus agnetis* (Werner, 1936) from Iran remains a dubious taxon, possibly a synonym of *Sassanidotus zarudnyi* (Birula, 1903) (Fet & Lowe, 2000) [not *Sassanidothus zarudnyi* (incorrect subsequent spelling of genus)]. In the meantime, Kovařík (2019) list it as valid in his reassessment of the genus and therefore we are keeping it in Table 4.

There are three books in Persian written about scorpions of Iran: Farzanpay (1987) [*Knowing Scorpions*] (Fig. 34), Navidpour et al. (2016) [*Applied procedures in Scorpiology*], and Zamani (2016b) (Fig. 35) [*The field guide of spiders and scorpions of Iran*].

Three recent publications by Dehghani et al. (2016), Motevalli Haghi & Dehghani (2017), and Dehghani & Kassiri (2018) primarily intended for the medical field contain numerous errors with the scientific names and author listings [all authors' names in parentheses- according to the (International Code of Zoological Nomenclature, ICZN) this is reserved for scientific names which were described originally in combination with another genus]. Those authors also listed species names with "sp. n." when they were already described and with taxa that are either misidentified or recorded from other countries. As noted by those authors correct identification could be of medical importance and therefore they are recorded here with notes on the other species listed in error. ICZN Recommendation 51E, citation of contributors was followed here: "If a scientific name and the conditions other than publication that make it available are

the responsibility … of less than all of joint authors, the authorship of the name, if cited, should be stated as … "B in A & B", or in whatever form is appropriate to facilitate information retrieval (normally the date should also be cited)." Thus, the use of (Ehrenberg in Hemprich & Ehrenberg, 1828) and (Ehrenberg in Hemprich & Ehrenberg, 1829). See also remarks in Methods about names and dates used in this publication.

The total number of scorpions from Iran currently is 68 species (Table 4). The following current list (prepared with the guidance of Kovařík, personal communication 11 July 2018; and updated with new information in the publication *Euscorpius* for 2019) of scorpions recorded from Iran. Because so many of the species are named by the same authors in different combinations, et al. is not used in the list below for clarity. This publication lists the names, authors, years, and citations correctly for all future researchers, not just those in the medical field. While preparing this list and citations to the original publications some discrepancies in years and spellings of names were corrected.

Motevalli-Haghi & Dehghani (2017) listed numerous subspecies which are not reviewed here. Those same authors also listed numerous species from Iran that are otherwise not known to occur in that country. There are numerous citations (some papers in Persian) given in that paper which might be the original source of some of those records. Some of the identifications are questioned with the suggestion that these records be further studied. Kovařík (personal communication 2 July 2018) was extremely helpful with these record comments: *Apistobuthus pterygocercus* (Finnegan, 1932) was listed from Khuzestan province, but is otherwise known only from the Arabian Peninsula; *Buthacus leptochelys* (Ehrehnberg in Hemprich & Ehrenberg, 1829) was listed from Khuzestan, Bushehr and Hormozgan provinces and is likely a misidentification of *B. macrocentrus* (Ehrenberg in Hemprich & Ehrenberg, 1828) [see Kovařík, 2005 for differences]; *Compsobuthus acutecarinatus* (Simon, 1882) was listed from Fars and Bushehr provinces, but otherwise known only from Oman and Yemen; *Compsobuthus rugosulus* (Pocock, 1900a) was listed from Fars and Bushehr provinces, but is otherwise known only from India; *Hottentotta alticola* (Pocock, 1895b) was listed from Khuzestan, Lorestan, Hormozgan, Sistan & Baluchistan, and Kermanshah provinces, but otherwise known only from Pakistan. *Hottentotta jayakari* (Pocock, 1895b) was listed from Qom, Hormozgan, and Fars provinces based on misidentified specimens by Motevalli-Haghi & Dehghani (2017) but more recently unpublished collections from Hormozgan and southern Sistan & Baluchistan provinces reveal the true *H. jayakari* outside of the Arabian Peninsula. Zamani (2016b) collected and reported *H. jayakari* in Iran, but only on some islands of the Persian Gulf. *Odontobuthus odonturus* (Pocock, 1897) was listed from Khuzestan, Fars, Bushehr, Kermanshah, Ilam, and Yazd provinces, but was otherwise known only from India and Pakistan. A *Nebo* sp. was collected/reported by Dehghani et al. (2008) from Kerman province but further details are still unpublished. Because of their economic and medical importance, scorpions should continue to be a popular subject for study. Scorpion envenomation is of considerable health concern in subtropical and tropical regions like Iran, with many cases of human death occurring annually (Farzanpay, 1987; Dehghani & Fathi, 2012; Dehghani et al., 2016; Dehghani & Kassiri, 2018 and citations therein). Fifty thousand scorpion stings per year have been reported from Iran, most cases being in Khuzestan and Hormozgan provinces (Farzanpay, 1987; Dehghani & Fathi, 2012; Fekri et al., 2012; Kassiri et al., 2012; Dehghani et al., 2016; Sanaei-Zadeh et al., 2017).

Figures 30–36. American, European, and Iranian Arachnologists. **30**. Fet, Victor (born 9 May 1955, Krivy Rih, Ukraine); **31**. Navidpour, Shahrokh (born 13 January 1967, Ahvaz, Iran); **32**. Mirshamsi, Omid (born 13 January 1975, Sari, Iran); **33**. Soleglad, Michael E. (born 9 November 1941, Minneapolis, U.S.A.); **34**. Farzanpay, Reza (born 1934); **35**. Zamani, Alireza (born 11 January 1994, Tehran, Iran); **36**. **Left**: Senglet, Antoine (died 29 March 2015, Vich, Switzerland). **Right**: Tanasevitch, Andrei Victorovitch [born 8 August 1956, Moscow, the U.S.S.R. (now Russia = Russian Federation)].

Table 4. Scorpions recorded from Iran (68 species, 3 families).

Family	Species	Count
Buthidae	*Androctonus crassicauda* (Olivier, 1807)	1
	Androctonus finitimus (Pocock, 1897)	2
	Androctonus robustus Kovařík & Ahmed, 2013	3
	Anomalobuthus talebii Teruel, Kovařík, Navidpour & Fet, 2014	4
	Apistobuthus susanae Lourenço, 1998	5
	Buthacus macrocentrus (Ehrenberg in Hemprich & Ehrenberg, 1828)	6
	Compsobuthus garyi Lourenço & Vachon, 2001	7
	Compsobuthus jakesi Kovařík, 2003	8
	Compsobuthus kaftani Kovařík, 2003	9
	Compsobuthus matthiesseni (Birula, 1905a)	10
	Compsobuthus persicus Navidpour, Soleglad, Fet & Kovařík, 2008d	11
	Compsobuthus petriolii Vignoli, 2005	12
	Compsobuthus plutenkoi Kovařík, 2003	13
	Hottentotta jayakari (Pocock, 1895b)	14
	Hottentotta juliae Kovařík, Yağmur & Fet, 2019a	15
	Hottentotta khoozestanus Navidpour, Kovařík, Soleglad & Fet, 2008b	16
	Hottentotta lorestanus Navidpour, Nayebzadeh, Soleglad, Fet, Kovařík & Kayedi, 2010	17
	Hottentotta navidpouri Kovařík, Yağmur & Moradi, 2018	18
	Hottentotta saulcyi (Simon, 1880)	19
	Hottentotta schach (Birula, 1905a)	20
	Hottentotta sistanensis Kovařík, Yağmur & Moradi, 2018	21
	Hottentotta zagrosensis Kovařík, 1997	22
	Iranobuthus krali Kovařík, 1997	23
	Kraepelinia palpator (Birula, 1903)	24
	Liobuthus kessleri Birula, 1898	25
	Mesobuthus agnetis (Werner, 1936)	26
	Mesobuthus afghanus (Pocock, 1889)	27
	Mesobuthus eupeus (C.L. Koch, 1839)	28
	Mesobuthus iranus (Birula, 1917)	29
	Mesobuthus macmahoni (Pocock, 1900a)	30
	Mesobuthus persicus (Pocock, 1899)	31
	Mesobuthus phillipsii (Pocock, 1889b)	32
	Mesobuthus thersites (C.L. Koch, 1839)	33
	Mesobuthus vesiculatus (Pocock, 1899)	34
	Odontobuthus bidentatus Lourenço & Pézier, 2002	35
	Odontobuthus doriae (Thorell, 1876)	36
	Odontobuthus tavighiae Navidpour, Soleglad, Fet & Kovařík, 2013	37
	Odontobuthus tirgari Mirshamsi, Azghadi, Navidpour, Aliabadian & Kovařík, 2013	38
	Olivierus brutus (Fet, Kovařík, Gantenbein, Kaiser, Stewart & Graham, 2018)	39
	Olivierus caucasicus (Nordmann, 1840)	40
	Olivierus parthorum (Pocock, 1889a)	41
	Orthochirus carinatus Navidpour, Kovařík, Soleglad & Fet, 2019	42
	Orthochirus farzanpayi (Vachon & Farzanpay in Farzanpay, 1987)	43
	Orthochirus fuscipes (Pocock, 1900a)	44
	Orthochirus gantenbeini Kovařík, Yağmur, Fet & Hussen, 2019b	45
	Orthochirus gruberi Kovařík & Fet, 2006	46
	Orthochirus iranus Kovařík, 2004	47

Table 4. Continued.

Family	Species	Count
Buthidae	*Orthochirus mesopotamicus* Birula, 1918	48
	Orthochirus navidpouri Kovařík, Yağmur, Fet & Hussen, 2019b	49
	Orthochirus scrobiculosus (Grube, 1873)	50
	Orthochirus stockwelli (Lourenço & Vachon, 1995)	51
	Orthochirus varius Kovařík, 2004	52
	Orthochirus zagrosensis Kovařík, 2004	53
	Polisius persicus Fet, Capes & Sissom, 2001	54
	Razianus zarudnyi (Birula, 1903)	55
	Sassanidotus gracilis (Birula, 1900)	56
	Sassanidotus zarudnyi (Birula, 1903)	57
	Vachoniolus iranus Navidpour, Kovařík, Soleglad & Fet, 2008b	58
Scorpionidae	*Nebo henjamicus* Francke, 1980	59
	Scorpio kruglovi Birula, 1910	60
	Scorpio maurus Linnaeus, 1758	61
Hemiscorpiidae	*Hemiscorpius acanthocercus* Monod & Lourenço, 2005	62
	Hemiscorpius enischnochela Monod & Lourenço, 2005	63
	Hemiscorpius gaillardi (Vachon, 1974)	64
	Hemiscorpius kashkayi Karataş & Gharkheloo, 2013	65
	Hemiscorpius lepturus Peters, 1861	66
	Hemiscorpius persicus Birula, 1903	67
	Hemiscorpius shahii Kovařík, Navidpour & Soleglad, 2017	68

The text by Dehghani & Arani (2015) brings together the legends and stories of scorpion stings and treatments in ancient through modern times in Iran. Although the stories are often terrible, scorpions have certainly played a significant role in Iranian history. Scorpions were also involved in the fate of wars in Iran according to Dehghani & Arani (2015):

"In the late Sassanid period, Kashan was so famous and thriving that it sent an army of warriors headed by Shirzad to fight with the Arabs. The army of Abu Musa Ashari, the Arabian commander was encountered with persistence and tenacity. Abu Musa Ashari, who was disappointed to not capture Kashan, distributed pitchers of scorpions throughout the city. The people stung by the scorpions gave up and were soon surrounded. The Arabs soon after killed the people, looted properties and animals, and took the soldiers captive."

Those authors related that Ibn Sina (Avicenna), the well-known Persian physician, … "described a scorpion that can undoubtedly be attributed to the *H*[*emiscorpius*] *lepturus* based on the clinical signs given in the famous *Canon of Medicine*" (*Qanun fi al-tibb*) published in 1025 AD: where Avicenna described that "Their poison is very strong … If one is stung by them, one does not feel anything immediately. The day after or on the person feels the pain. The person gets depressed, their complexion gets pale and may take jaundice. After being stung, the tongue is inflamed, site of sting is infected, urinates blood and sometimes dies." See a picture of this scorpion in Fig. 2.

Spiders, "*ʿankabūt*" (Order Araneae = Aranei)

Members of this order were the next group of Iranian Arachnida which attracted most people's attention. Although spiders have usually been considered as a simile of not being an ambitious person in Iranian cultural literature (sitting in a corner on their web's waiting for food, and not flying

high for making great wishes come true), their morphology, biology, and behavior have been used frequently as metaphors by Iranian (Persian) poets. When in this publication it is written "Iran" in reference to poetry and culture, it is meant "Greater Iran" which consists of the lands which were parts of the ancient Iranian empire where the Persian language had been common there such as Afghanistan, some parts of central Asia, Caucasus, and eastern Turkey. Translating poetry of different cultures is not easy and much is lost in meter and rhyme. Some systems in Persian poems may be impossible to translate because of removing some beautiful hints which were carefully established by the poet. Here a few translations are provided just to record these observations and the times from which they were produced (Dehkhoda, 1931). Spider morphology, by Saadi (1210–1291 AD): "Why do you have lean arms and legs?" The fly said to the spider. "If you get stuck in my web, the world would be darkened in front of your eyes" the spider (probably a pholcid) replied. Biology and behavior, by Sanaei (1080–?1131 or 1141 AD): Mystic people [i.e., people who think beyond the limitations and frames of any religion or belief. They are in love with God but their definition of God may be different from those of the common people] celebrate twice in one second [i.e., they do not wait for any event to be happy because their happiness, in other words, their God, is in their heart], but spiders [referred to as a metaphor for the common people] wrap flies [i.e., make so much effort for terrestrial achievements]. Molavi (Rumi) (1207–1273 AD): If the spider had the nature of Phoenix, it would never have made a tent by gossamer. Shahid Balkhi (died in 936 or 937 AD): My love to my beloved is similar to a spider, making a net around my heart.

There are also some records of using these animals and their silk in ancient medicine (Moin, 1972). The first recorded observations on spiders from Iran probably was by Olearius (1656), where he reported his observations on "tarantulas" in the area around Kashan, Isfahan province (from a translation by John Davies of 1662): "… Kaschan [*sic*] is a place excellently well seated, but the air must be somewhat unwholesome, when they want fresh water thereabouts, and that it is here the tarantulas and the most dangerous scorpions of all Persia are most rife." Later, another such observation was reported by Schöngast (1668) from Kerman province. This was a work dealing with an unknown poisonous tarantula named in the literature as "Enkurek Persarum". These early references to tarantulas were almost certainly in reference to large wolf spiders known in Medieval Latin as *tarantula*. *Latrodectus* (widow spiders) and *Loxosceles* (recluse spiders) are recorded from Iran and are known to have medically important bites (Sanaei-Zadeh, 2017).

It is recorded that one of the first known scientific collection of Iranian spiders was made by Eugen von Keyserling and Theophil Bienert during 1859. Keyserling was born in the Russian Empire and Bienert acted as a member of the Russian Academy of Sciences, and specimens from this trip are stored in the Zoological Institute, St. Petersburg (Logunov & Marusik, 1999; Mozaffarian & Marusik, 2001). Recently Azarkina & Zamani (2019) described a new species of jumping spider that was from that first 1859 collection. The taxonomic work on the spider fauna of Iran was not made for another couple of decades and was published by the Frenchman Eugène Simon (1874) (Fig. 37). In this publication, Simon described "*Sparassus doriae*" (Sparassidae) from Tehran, based on material collected during 1862 to 1863 by the Italian naturalist Giacomo Doria. The other main collection from the country was conducted in 1973–

1975 by the Swiss arachnologist, Antoine Senglet (Fig. 36-left). His material is housed in the Muséum d'histoire naturelle, Genève.

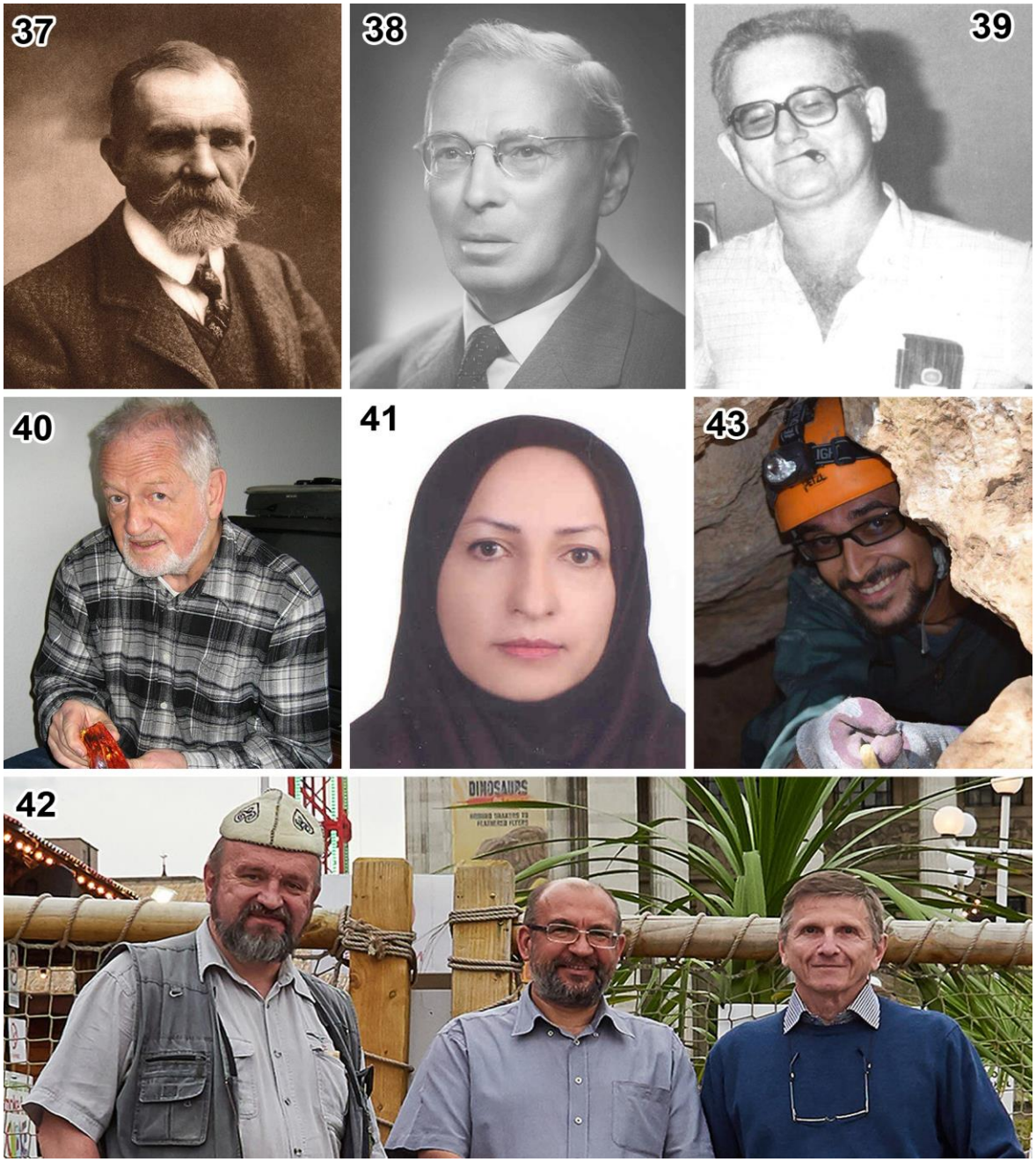
During the 20th century, many other papers were published on Iranian spiders by scientists from several countries in Europe and Russia, e.g., Pocock (1899, 1903), Werner (1936), Pavlovsky (1942) and Roewer (1955, 1959) (Fig. 38).

The first study on spiders in the Iranian literature was published by Zini (1958) on the biology and distribution of the Mediterranean widow spider, *Latrodectus tredecimguttatus* (Rossi, 1790), in the northeast of Iran. Brignoli (1972, 1979, 1980, 1982) (Fig. 39), Senglet (1974, 2008), Wesołowska (1986), Prószyński (1992), Ovtsharenko et al. (1994), Saaristo & Tanasevitch (1996), Wunderlich (1995a, 1995b) (Fig. 40), Logunov (1999, 2001a, 2001b), Logunov & Marusik (1999, 2000), Ono & Martens (2005) and Tanasevitch (2017) (Figs. 36-right, 42-right) are other important araneological studies made by scientists from different parts of the world. The study of spiders has continued by some Iranian students and researchers, sometimes in cooperation with international scientists, e.g. Mozaffarian (2000) (Fig. 41), Mozaffarian & Tirgari (2000), Mozaffarian et al. (2000), Mozaffarian & Marusik (2001) (Fig. 42-left), Logunov et al. (2001, 2013) (Fig. 42-center), Ghahari & Marusik (2009), Moradmand & Jäger (2011, 2012) (Figs. 43, 44), Mirshamsi et al. (2013b, 2015, 2016), Moradmand (2013), Sadeghi et al. (2016), Shalchian Tabrizi et al. (2015), Zamani (2014, 2015, 2016a, 2016b), Kiany et al. (2017), Zamani & Marusik (2018) and Zamani et al. (2016b, 2017a, 2017b, 2019a). There are many publications on spiders of Iran; 245 are listed in the bibliography by Zamani et al. (2019a). There is a nice book in Persian with many colored photographs entitled "*The field guide of spiders and scorpions of Iran*" by Zamani (2016b).

Currently 764 species and subspecies of spiders from 297 genera in 52 families have been recorded from Iran (Zamani et al., 2019a, Table 5). All the spiders from Iran are members of the Suborder Opisthothelae.

Some interesting spiders of Iran include *Iraponia scutata* Kranz-Baltensperger, Platnick & Dupérré, 2009, the only species of the genus (Caponiidae), endemic to Iran. This family is otherwise known in Eurasia by only two other species, from Laos, China, and Vietnam. *Spariolenus iranomaximus* Moradmand & Jäger, 2011, is a sparassid with a leg span of about 15 cm. It is the largest spider in the Middle East. The Oonopidae spider *Trilacuna qarzi* Grismado & Malek-Hosseini in Malek-Hosseini et al. (2015) is the only cave dwelling species of the genus, endemic to Iran, and the only Iranian spider known to show troglomorphism. The other species of the genus are from the Oriental region. *Paratheuma enigmatica* Zamani, Marusik & Berry, 2016a, an intertidal spider, is known from the shores of the Persian Gulf in Iran from more than 6,000 km away from the closest recorded occurrence of the genus. Members of the genus are otherwise only known from Korea, Pacific islands, and the U.S.A.

There are also two popularly-recognized filistatid spiders named from Iran with very non-classical names by Marusik & Zamani (2015). *Filistata maguirei* was named after the actor Tobey Maguire, who played Spider-Man in Sam Raimi's trilogy and *Pritha garfieldi* was named after the actor Andrew Garfield, who played the role of comic book superhero Spider-Man in two movies. Following these, there was the description of a wolf spider named *Lycosa aragogi* Nadolny & Zamani, 2017. Because the authors felt like that lycosid looks so much like Aragog, the giant, fictional spider from the "Harry Potter" series, that the species was named after it.



Figures 37–43. European and Iranian Arachnologists. **37**. Simon, Eugène Louis (born 30 April 1848, Paris, France – died 17 November 1924, Paris, France); **38**. Roewer, Carl Friedrich (born 12 October 1881, Neustrelitz, Germany – died 17 June 1963, Bremen, Germany); **39**. Brignoli, Paolo Marcello (born 25 April 1942, Rome, Italy – died 8 July 1986, L'Aquila, Italy); **40**. Wunderlich, Jörg (born 19 December 1939, Berlin, Germany); **41**. Mozaffarian, Fariba (born 23 August 1970, Kazeroun, Iran); **42**. **Left**: Marusik, Yuri Mikhailovich [born 13 May 1962, Sarny, Rovno Region, Ukraine Soviet Socialist Republic (in former U.S.S.R.)]. **Center**: Logunov, Dmitri Viktorovich [born 25 May 1962, Volgograd, the U.S.S.R. (now Russia = Russian Federation)]. **Right**: Tanasevitch, Andrei Victorovitch [born 8 August 1956, Moscow, the U.S.S.R. (now Russia = Russian Federation)]; **43**. Moradmand, Majid (born 11 September 1982, Isfahan, Iran).

Table 5. Spider families recorded from Iran (764 species, 52 families).

Infraorder	Clade	Family	No. of genera	No. of species/sub-species
Mygalomorphae		Atypidae	1	2
		Cyrtaucheniidae	1	1
		Dipluridae	1	2
		Nemesiidae	1	5
		Theraphosidae	1	1
Araneomorphae	Haplogynae	Caponiidae	1	1
		Dysderidae	4	7
		Filistatidae	5	15
		Leptonetidae	1	1
		Oonopidae	4	6
		Pholcidae	6	20
		Scytodidae	1	6
		Segestriidae	1	2
		Sicariidae	1	2
	Entelegynae	Agelenidae	5	18
		Anyphaenidae	1	1
		Araneidae	20	46
		Cheiracanthiidae	1	7
		Cithaeronidae	1	1
		Clubionidae	2	7
		Corinnidae	1	1
		Cybaeidae	2	4
		Dictynidae	12	16
		Eresidae	2	3
		Gnaphosidae	32	90
		Hahniidae	1	1
		Hersiliidae	4	12
		Linyphiidae	46	80
		Liocranidae	2	2
		Lycosidae	18	73
		Mimetidae	2	3
		Miturgidae	2	3
		Mysmenidae	1	1
		Oecobiidae	2	10
		Oxyopidae	2	8
		Palpimanidae	1	2
		Philodromidae	5	27
		Phrurolithidae	1	1
		Pisauridae	1	2
		Salticidae	40	108
		Selenopidae	1	1
		Sparassidae	6	19
		Synaphridae	1	1
		Tetragnathidae	4	16
		Theridiidae	20	48
		Theridiosomatidae	1	1
		Thomisidae	17	63
		Titanoecidae	2	6

Table 5. Continued.

Infraorder	Clade	Family	No. of genera	No. of species/sub-species
Araneomorphae	Entelegynae	Trachelidae	2	2
		Uloboridae	2	3
		Zodariidae	4	5
		Zoropsidae	1	1
Totals		52	297	764

A siltstone slab showing three sets of arthropod tracks (trace fossils trackways) was reported from the Middle Jurassic Dansirit Formation (170 MBP), Mazandaran province, Iran (Abbassi & Mustoe, 2018). The maker of these trace fossils was named (as a new ichnogenus and species) *Porpaichnus dansiritensis*. The environment of the track-bearing stratum is unknown. If the origin of the sediment is littoral, the tracks were likely made by a decapod crustacean. If a terrestrial deposit, the tracks are possibly representative of an arachnid that used its pedipalps to supplement four pairs of walking legs when moving. The morphological characteristics presented by Abbassi & Mustoe (2018) suggest that the tracks may have been made by an early Mygalomorphae. If so, these trackways are the earliest known evidence of a large mygalomorphic spider. More research is obviously needed to determine the depositional environment and until that time this ichnospecies is not considered and listed here as an arachnid.

Pseudoscorpions, "*šebh-e ʿaqrab*" (Order Pseudoscorpiones = Pseudoscorpionida, Chelonethida)

Members of this order have achieved less attention in Iran due to their small sizes, secretive habits, hidden habitats, and the general lack of significant economic importance. They were recorded from Iran for the first time by the European scientist Redikorzev (1918). He described the new species, *Chelifer spinipalpis* which is now recognized in the combination of *Strobilochelifer spinipalpis* (Redikorzev, 1918). The study of this order was continued by European scientists. Substantial contributions were made by Beier (1951, 1971). Following was Mahnert (1974, 1980), Schawaller (1983), Mirmoayedi et al. (2000), and then by Iranian arachnologists. Nassirkhani is the most prolific researcher on this group and has published many papers: Nassirkhani & Takalloo zadeh (2012, 2013a, 2013b), Nassirkhani (2014a, 2014b, 2014c, 2015, 2016a, 2016b, 2016c, 2016d, 2016e, 2016f, 2018a, 2018b), Nassirkhani & Vafai Shoushtari (2014a, 2014b, 2015a, 2015b, 2015c, 2016), Nassirkhani & Hamidi (2015), Nassirkhani et al. (2015, 2016a, 2016b, 2017), Nassirkhani & Zamani (2017, 2018), Nassirkhani & Doustaresharaf (2018, 2019), Nassirkhani & Mumladze (2019), Zamani et al. (2019b). Nassirkhani also published one paper with an Australian researcher (Nassirkhani & Harvey, 2013). The first pseudoscorpion found in an Iranian cave was *Megachernes pavlovskyi* Redikorzev, 1949 by Christophoryová et al. (2013). Interestingly, this species had only been recorded first for the country by Mirmoayedi et al. (2000).

Although not publishing papers dedicated to just species from Iran, Beier published 12 papers (in 1928, 1931, 1935, 1949, 1952, 1959, 1962, 1963, 1966, 1969, 1973, 1976) naming species from Iran and region that were later recognized as occurring in Iran. Mahnert (1991, 2007), many additional European authors, and one American in the 1930's also described further species from surrounding countries which were later recognized from Iran. These include (ordered by year): Preyssler (1790), Schrank (1803), Hermann (1804), Leach (1817), Koch (1837, 1839, 1843,

1873), Simon (1878, 1879), Daday (1889), Redikorzev (1918, 1922, 1930, 1949), Chamberlin (1930, 1933), Hewitt & Godfrey (1929), Krumpál (1984), and Dashdamirov (1991, 2005).

Besides the recognition of new records for described species and new species descriptions relatively few publications have changed the taxonomy of the pseudoscorpions listed by Harvey (2013b) from Iran. Notable are: (1) four *Chthonius* spp. (*C. anatolicus*, *C. iranicus*, *C. romanicus*, and *C. tetrachelatus*) were transferred when the Subgenus *Ephippiochthonius* was raised to full genus by Zaragoza (2017) and all listed in such combination by Nassirkhani et al. (2019); (2) *Rhacochelifer iranicus* Beier, 1971 was synonymized under *Diplotemnus insolitus* by Dashdamirov (2005); (3) Novák & Harvey (2015) then synonomized *D. insolitus* with *Chelifer balcanicus* Redikorzev, 1928, and created the new combination of *Diplotemnus balcanicus* (Redikorzev, 1928); (4) *Strobilochelifer grandimanus* Beier, 1943 was synonymized under *Strobilochelifer spinipalpis* by Mahnert (1980). Likewise, *Minniza syriaca* Beier, 1951 was synonymized under *Minniza babylonica* by Mahnert (1991).

Malek-Hosseini & Zamani, A. (2017) reported that there were 56 species from 12 families known from Iran but they did not provide a list of taxa. Details on 49 species can be located in Harvey (2013b). The year before, Nassirkhani & Takalloo zadeh (2012) published a very detailed and nicely illustrated book in Persian about all aspects of Pseudoscorpiones and their study in Iran. This book along with an article by Nassirkhani & Harvey (2013) on the external anatomy of the different postlarval life stages of the Iranian pseudoscorpion *Dactylochelifer gracilis* are the only publications not extensively aimed at distribution and taxonomy of pseudoscorpions of the country. In the book by Nassirkhani & Takalloo zadeh (2012) they provided a listing of the taxa that is essentially the same as Harvey's list. Since then changes in published species can be found in the later works by Nassirkhani and numerous coworkers (all listed above and in references). Nassirkhani kindly allowed us to see an "in preparation" manuscript on an identification key to the pseudoscorpion species of Iran. In this work he probably will alter the number of species known from Iran, but otherwise it has served as a starting point for our list of the 68 currently recognized species (Table 6).

Camel spiders, sun spiders, windscorpions, or solifuges, "*roteyl*" (= *rotayl*) (Order Solifugae = Solpugida)

With their speed and often ferocious appearance, it is odd that camel spiders have not been of greater interest to publishing scientists. Local folklore often attributes malevolent powers to these common creatures (Aḥmadī & Tuck, 2011). They are not directly of medical or economic importance. Their bite is non-venomous and they have no venom glands or stingers, but they might inflict secondary infections from their bites. Zamani (2016b) noted that it is a common misbelief in Iran that solifuges are highly venomous and that their bite is lethal, but they are only capable of inflicting a bite upon "jumping" on the person beneath them, as their "stingers" are located under their abdomens. What people consider as "stingers" are in fact Racquet organs or Malleoli. Their occasional abundance in arid and semi-arid lands would suggest more interest should have been noted in the literature. Perhaps their primarily nocturnal behavior has hidden them from most observers. The misleading photograph (the proximity of the camel spiders to the camera with the soldiers in the foreground exaggerated their size) and the text about two camel spiders being held by an American soldier from neighboring Iraq started circulating the internet in 2004 (Walker, 2004). The sensationalism of this posting caught the attention of the public but frustrated arachnologists with this misconception of this interesting group of arachnids.

Table 6. Pseudoscorpions recorded from Iran (65 species, 12 families).

Family	Species	Count
Atemnidae	*Atemnus politus* (Simon, 1878)	1
	Diplotemnus balcanicus (Redikorzev, 1928)	2
Cheiridiidae	*Apocheiridium ferum* (Simon, 1879)	3
	Cheiridium museorum (Leach, 1817)	4
Cheliferidae	*Dactylochelifer brachialis* Beier, 1952	5
	Dactylochelifer gracilis Beier, 1951	6
	Dactylochelifer intermedius Redikorzev, 1949	7
	Dactylochelifer kussariensis (Daday, 1889)	8
	Dactylochelifer latreillii (Leach, 1817)	9
	Dactylochelifer mrciaki Krumpál, 1984	10
	Dactylochelifer spasskyi Redikorzev, 1949	11
	Ellingsenius fulleri (Hewitt & Godfrey, 1929)	12
	Gobichelifer chelanops (Redikorzev, 1922)	13
	Hysterochelifer afghanicus Beier, 1966	14
	Rhacochelifer melanopygus (Redikorzev, 1949)	15
	Strobilochelifer spinipalpis (Redikorzev, 1918)	16
Chernetidae	*Allochernes elbursensis* Beier, 1969	17
	Allochernes fusimensis Nassirkhani, 2016a	18
	Allochernes microti Beier, 1962	19
	Allochernes wideri (C.L. Koch, 1843)	20
	Chernes hahni C.L. Koch, 1839	21
	Dinocheirus panzeri (C.L. Koch, 1837)	22
	Lamprochernes muscivorus Redikorzev, 1949	23
	Lamprochernes nodosus (Schrank, 1803)	24
	Megachernes pavlovskyi Redikorzev, 1949	25
	Pselaphochernes anachoreta (Simon, 1878)	26
	Pselaphochernes scorpioides (Hermann, 1804)	27
Chthoniidae	*Chthonius shelkovnikovi* Redikorzev, 1930	28
	Ephippiochthonius anatolicus (Beier, 1969)	29
	Ephippiochthonius iranicus (Beier, 1971)	30
	Ephippiochthonius negarinae (Nassirkhani & Vafai Shoushtari, 2015b)	31
	Ephippiochthonius romanicus (Beier, 1935)	32
	Ephippiochthonius tetrachelatus (Preyssler, 1790)	33
Garypinidae	*Amblyolpium bellum* Chamberlin, 1930	34
	Amblyolpium goldastehae Nassirkhani, Vafai Shoushtari & Abadi, 2016a	35
	Amblyolpium atropatesi Nassirkhani & Doustaresharaf, 2019	36
	Garypinus afghanicus Beier, 1959	37
	Serianus validus (Beier, 1971)	38
Geogarypidae	*Geogarypus harveyi* Nassirkhani, 2014b	39
	Geogarypus shulovi Beier, 1963	40
Ideoroncidae	*Shravana latens* Harvey, 2016	41
Menthidae	*Paramenthus nanus* Mahnert, 2007	42
Neobisiidae	*Acanthocreagris caspica* (Beier, 1971)	43
	Acanthocreagris iranica Beier, 1976	44
	Acanthocreagris ronciformis (Redikorzev, 1949)	45
	Neobisium alticola Beier, 1973	46

Table 6. Continued.

Family	Species	Count
Neobisiidae	*Neobisium anatolicum* Beier, 1949	47
	Neobisium crassifemoratum (Beier, 1928)	48
	Neobisium erythrodactylum (L. Koch, 1873)	49
	Neobisium fuscimanum (C.L. Koch, 1843)	50
	Neobisium validum (L. Koch, 1873)	51
	Roncus corimanus Beier, 1951	52
	Roncus microphthalmus (Daday, 1889)	53
	Roncus viti Mahnert, 1974	54
Olpiidae	*Calocheiridius centralis* (Beier, 1952)	55
	Cardiolpium asiaticum (Dashdamirov, 1991)	56
	Cardiolpium bisetosum Nassirkhani, 2015	57
	Minniza babylonica Beier, 1931	58
	Minniza gallagheri Mahnert, 1991	59
	Minniza nigrimanus Mahnert, 1991	60
	Minniza persica Beier, 1951	61
	Olpium lindbergi Beier, 1959	62
	Olpium omanense Mahnert, 1991	63
	Parolpium litoreum Nassirkhani & Zamani, A., 2018	64
Withiidae	*Withius nanus* Mahnert, 1988	65

The Solifugae of Iran were first mentioned in the literature by Pocock (1895a); when he described the new species, *Galeodes citrinus* from Jāsk, Hormozgan province. There was a much earlier report by Kitto (1838) on the "tarantulas" all over the country, but according to Zamani et al. (2019a) (based on brief morphological description and common occurrence), Kitto was most likely referring to members of the Order Solifugae. According to Zamani (2016b), tarantulas are popularly (and mistakenly) known as "*rotayl*" in Iran, since most of the people in Iran do not consider tarantulas as spiders due to their large size. The first publication on camel spiders by Iranian authors was by Maddahi et al. (2015). Maddahi et al. (2017) published the first report of a Mitochondrial DNA study of camel spiders from Iran. Khazanehdari et al. (2016) prepared a list of about 20 publications of Iranian records from five families. Khazanehdari et al. (2016) reported the number of known taxa as 75 species and subspecies. A catalog to 67 species was published by Harvey (2013c). Since that time several species have been added and others subtracted for a total of 67 species. Two synonyms are listed here because the names have appeared in checklist by other researchers within the last decade: *Galeodes bacillatus* Birula, 1905b was synonymized with *Galeodes caspius* Birula, 1890 and *Rhagodes melanochaetus* Heymons, 1902 was synonymized with *Rhagodes eylandti* (Walter, 1889). A third species was removed from the list: *Galeodes turcmenicus* Birula, 1937 recorded from Iran by Maddahi et al. (2017, 2019), was based on a misidentification (Maddahi, personal communication 7 September 2019) of what is correctly *Galeodes araneoides* (Pallas, 1772); a species already recorded from Iran. An unidentified Gnosippinae sp. (Khorasan-e-Razavi province, Mashhad) was listed by Maddahi et al. (2017), but not counted here because it is still unidentified/undescribed. Similarly, no subspecies are counted in Table 7.

Table 7. Solifuges recorded from Iran (67 species, 5 families). The species listed in Harvey (2013c) are listed below with the changes being noted by Koç et al. (2015), Khazanehdari et al. (2016), and Maddahi et al. (2017, 2019).

Family	Species	Reference	Count
Daesiidae	*Biton persicus* (Birula, 1905b)	Harvey, 2013c	1
	Biton rossicus (Birula, 1905b)	Harvey, 2013c	2
	Biton xerxes (Roewer, 1933)	Harvey, 2013c	3
	Daesiola zarudnyi (Birula, 1905b)	Harvey, 2013c	4
	Gluviola armata (Birula, 1905b)	Harvey, 2013c	5
	Gluviopsis nigrocinctus Birula, 1905b	Harvey, 2013c	6
	Gluviopsona persica (Birula, 1905b)	Harvey, 2013c	7
Galeodidae	*Galeodes arabs* C.L. Koch, 1842	Harvey, 2013c	8
	Galeodes araneoides (Pallas, 1772)	Harvey, 2013c	9
	Galeodes atriceps Roewer, 1934	Harvey, 2013c	10
	Galeodes aulicus Hirst, 1908	Harvey, 2013c	11
	Galeodes auronitens Birula, 1905b	Harvey, 2013c	12
	Galeodes bacilliferoides Roewer, 1934	Harvey, 2013c	13
	Galeodes caspius Birula, 1890	Harvey, 2013c	14
	Galeodes citrinus Pocock, 1895a	Harvey, 2013c	15
	Galeodes claviger Kraus, 1959	Harvey, 2013c	16
	Galeodes ctenoides Roewer, 1934	Harvey, 2013c	17
	Galeodes discolor Kraepelin, 1899	Harvey, 2013c	18
	Galeodes ephippiatus Roewer, 1941	Harvey, 2013c	19
	Galeodes festivus Hirst, 1908	Harvey, 2013c	20
	Galeodes franki (Kraus, 1959)	Harvey, 2013c	21
	Galeodes fumigatus Walter, 1889	Harvey, 2013c	22
	Galeodes interritus Roewer, 1934	Harvey, 2013c	23
	Galeodes karunensis Birula, 1905b	Harvey, 2013c	24
	Galeodes kermanensis Birula, 1905b	Harvey, 2013c	25
	Galeodes krausi Harvey, 2002	Harvey, 2013c	26
	Galeodes loeffleri Roewer, 1952	Harvey, 2013c	27
	Galeodes macmahoni Pocock, 1900b	Harvey, 2013c	28
	Galeodes pococki Birula, 1905b	Harvey, 2013c	29
	Galeodes schach Birula, 1905b	Harvey, 2013c	30
	Galeodes starmuehlneri Roewer, 1952	Harvey, 2013c	31
	Galeodes trichotichnus (Roewer, 1934)	Harvey, 2013c	32
	Galeodes truculentus Pocock, 1899	Harvey, 2013c	33
	Galeodes vittatus (Roewer, 1941)	Harvey, 2013c	34
	Galeodopsis cyrus (Pocock, 1895a)	Harvey, 2013c	35
	Paragaleodes fulvipes Birula, 1905b	Harvey, 2013c	36
	Paragaleodes melanopygus Birula, 1905b	Harvey, 2013c	37
	Paragaleodes unicolor (Birula, 1905b)	Harvey, 2013c	38
	Roeweriscus paradoxus Birula, 1937	Harvey, 2013c	39
Gylippidae	*Gylippus lamelliger* Birula, 1906	Harvey, 2013c	40
	Gylippus quaestiunculoides Birula, 1907	Harvey, 2013c	41
	Gylippus spinimanus Birula, 1905c	Harvey, 2013c	42
Karschiidae	*Eusimonia divina* Birula, 1935a	Harvey, 2013c	43
	Eusimonia seistanica Roewer, 1933	Harvey, 2013c	44
	Eusimonia serrifera Birula, 1905c	Harvey, 2013c	45
	Karschia kiritshenkoi Birula, 1922	Harvey, 2013c	46
	Karschia kurdistanica Birula, 1935b	Harvey, 2013c	47

Table 7. Continued.

Family	Species	Reference	Count
Karschiidae	*Karschia mastigofera* Birula, 1890	Harvey, 2013c; Khazanehdari et al., 2016; Maddahi et al., 2017, 2019	48
	Karschia persica Kraepelin, 1899	Harvey, 2013c	49
Rhagodidae	*Rhagodes ahwazensis* Kraus, 1959	Harvey, 2013c	50
	Rhagodes aureus (Pocock, 1889a)	Harvey, 2013c	51
	Rhagodes caucasicus Birula, 1905c	Harvey, 2013c; Koç et al., 2015	52
	Rhagodes eylandti (Walter, 1889)	Harvey, 2013c	53
	Rhagodes leucopygus Birula, 1905b	Harvey, 2013c	54
	Rhagodes melanopygus (Walter, 1889)	Harvey, 2013c	55
	Rhagodes persica Kraepelin, 1899	Harvey, 2013c; Koç et al., 2015; Khazanehdari et al., 2016	56
	Rhagodia persica Roewer, 1941	Harvey, 2013c	57
	Rhagodista diabolica Kraus, 1959	Harvey, 2013c	58
	Rhagoditta nigra Roewer, 1933	Harvey, 2013c; Koç et al., 2015	59
	Rhagoditta susa Roewer, 1933	Harvey, 2013c	60
	Rhagodixa hirsti Roewer, 1933	Harvey, 2013c; Koç et al., 2015	61
	Rhagodoca longispina Roewer, 1933	Harvey, 2013c; Koç et al., 2015	62
	Rhagodoca magna Roewer, 1933	Harvey, 2013c; Koç et al., 2015	63
	Rhagodopa setipes (Birula, 1905b)	Harvey, 2013c; Koç et al., 2015	64
	Rhagodorta zorab (Birula, 1905c)	Harvey, 2013c	65
	Rhagoduja finnegani Roewer, 1933	Harvey, 2013c	66
	Rhagoduna kambyses Roewer, 1933	Harvey, 2013c	67

Harvestmen or daddy-longlegs, "*derāzpā*" or "*ʿankabūt-e pāderāz*" (Order Opiliones = Phalangida)

The harvestmen are another group of Arachnida known to occur in Iran. They have not achieved significant attention in the Iranian publications and collections. This is likely explained by the lack of economic and medical importance to be applied for justifying the projects. Snegovaya et al. (2018) (Fig. 47) presented an updated survey of the 22 species of harvestmen of Iran (Table 8). Another species was mentioned only identified to Genus *Rilaena* sp. by Komposch (2002) and one more unstudied Laniatores species is noted below, but so far they are not added to the list of species of Iran because of their unidentified/undescribed state.

The first harvestmen named from Iran were by Thorell in 1876 (Fig. 48). His two species were both discovered in the province of Tehran. It was another 76 years before three other species were described from Iran by Roewer (1952). Another four species were then recognized from Iran by Martens (2006) (Fig. 46-right) and a further two species and one new genus were described by Snegovaya et al. (2018) (Figs. 41 Mozaffarian, 47 Snegovaya, 49 Cokendolpher). The

remaining species now known from Iran were described from other countries and then more recently recorded from Iran. Opiliones are relatively unstudied in Iran as well as in Armenia, east Turkey, Iraq, Turkmenistan, and Afghanistan. The number of specimens in university and other regional educational collections is uncertain.

Thus far, no Cyphophthalmi or Laniatores has been described from Iran (or the nearby region of Central Asia). However, a single Laniatores specimen has recently been discovered in Iran. It is a female (Biantidae) from Hormozgan province, collected by A. Zamani, from beneath a large stone. Males are essential for diagnostic comparisons. Hopefully, a male specimen can be obtained for further study and description. Named biantids are recorded from the Indian subcontinent, China, Africa, and the West Indies. Except for the wide-ranging (North America, Europe, Asia, and Tasmania) *Opilio parietinus* (De Geer, 1778), most of the species are either endemic to Iran or the surrounding region. The other better-known synanthropic species (tramp) of the Phalangiidae known from throughout the Northern Hemisphere and New Zealand, *Phalangium opilio* Linnaeus, 1758 is remarkably not recorded from Iran.

Whip spiders or tailless whipscorpions, "*ʿankabūt-e šallāqī*" or "*tāžak pā*" (Order Amblypygi)

The first member of this order was discovered in a cave in western Iran (Ilam province) during 2013 and then named *Phrynichus persicus* Miranda & Zamani, 2018 (Fig. 50). The common name is the Persian Whip Spider or "*ʿankabūt-e šallāqī-ye pārsi*". This species is a member of the Family Phrynichidae and at this time the only recorded member of the order in the country. Further collections of *P. persicus* from Iran in Khuzestan province are known. The authors of this species noted that other Phrynichidae are known from the region in northeastern Africa, Arabia (nearest locality about 1,200 km away in United Arab Emirates) and India. There are also two Charinidae species (both members of the Genus *Charinus*) that are known to occur in the region. One occurs in the Arabian Peninsula, while the other is in Pakistan, suggesting that a species of this genus might also occur somewhere in southern Iran (Miranda & Zamani, 2018).

Arachnology

The International Society of Arachnology (ISA) promotes the study of arachnids (excluding "Acari") and the exchange of information among researchers in this field. In 1965, the Centre International de Documentation Arachnologique (C.I.D.A.) based at the Muséum national d'Histoire naturelle in Paris was formed (Kraus, 1999). A series of national correspondents were appointed as local representatives of the emerging society. In the earlier years there was no correspondent for Iran, but later the scorpiologist Reza Farzanpay (Fig. 34) was the contact member. Even later, since 2000, Fariba Mozaffarian (Fig. 41) served as the C.I.D.A. correspondent. Every three years, an Annuaire des Arachnologistes Mondiaux (list of active workers in the field of arachnology, cross-referenced by country and research interests) and a Liste des Travaux Arachnologiques (annual list of recent scientific publications in this field) were published. It was the correspondent's duty to assemble this information for the country. C.I.D.A. is no longer active and all spider publications (taxonomic citations and data) are now available at the World Spider Catalog (2018).

Figures 44–50. Foreign (non-Iranian) and Iranian Arachnologists. **44**. Jäger, Peter (born 26 February 1968, Paderborn, Germany); **45**. Nassirkhani, Mahrad (born 6 June 1984, Tehran, Iran); **46**. **Left**: Ono, Hirotsugu (born 9 February 1954, Tokyo, Japan). **Right**: Martens, Jochen (born 10 June 1941, Jena, Germany); **47**. Snegovaya, Nataly [born 25 April 1972, Baku, then USSR (now Azerbaijan)]; **48**. Thorell, Tord Tamerlan Teodor (born 3 May 1830, Göteborg, Sweden – died 22 December 1901, Hälsingborg, Sweden); **49**. Cokendolpher, James Craig (born 6 September 1953, San Angelo, U.S.A.); **50**. Miranda, Gustavo Silva de (born 5 December 1987, Rondônia, Brazil).

Table 8. Harvestmen recorded from Iran (22 species, 4 families).

Family	Species	Count
Dicranolasmatidae	*Dicranolasma ponticum* Gruber, 1998	1
Nemastomatidae	*Mediostoma armatum* Martens, 2006	2
	Mediostoma nigrum Martens, 2006	3
	Mediostoma variabile Martens, 2006	4
	Paranemastoma filipes (Roewer, 1919)	5
	Paranemastoma iranicum Martens, 2006	6
Phalangiidae	*Egaenus oedipus* (Thorell, 1876)	7
	Graecophalangium karakalensis Tchemeris & Snegovaya, 2010	8
	Opilio afghanus Roewer, 1960	9
	Opilio ejuncidus (Thorell, 1876)	10
	Opilio hemseni Roewer, 1952	11
	Opilio lederi Roewer, 1911	12
	Opilio kakunini Snegovaya et al., 2018	13
	Opilio nabozhenkoi Snegovaya, 2010	14
	Opilio parietinus (De Geer, 1778)	15
	Phalangium armatum Snegovaya, 2005	16
	Phalangium kopetdaghensis Tchemeris & Snegovaya, 2010	17
	Rilaena atrolutea (Roewer, 1915)	18
	Rilaena kasatkini Snegovaya et al., 2018	19
	Rilaena lenkoranica Snegovaya, 2007	20
	Rilaena pusilla (Roewer, 1952)	21
Sclerosomatidae	*Goasheer iranus* (Roewer, 1952)	22

The Arachnological 'Society' of Iran was founded in 2010 and short lived on the internet (http://www.arachnology.ir/ [Accessed 7 June 2018; removed in 2019). Such a society could not exist in Iran because they had not obtained a license [scientific societies should obtain a license from Ministry of Science, Research and Technology and should be officially registered. Please see: https://tinyurl.com/y2sgonox]. This group was an academic society for amateur and professional arachnologists and individuals interested in arachnids. Its goal was to promote arachnological studies in Iran and facilitate the collaborations between Iranian and international arachnologists, researchers and institutions around the world.

There are numerous books in Persian on Iranian arachnids. Most of these deal with one or two orders of arachnids in Iran, but one covers all groups: Mohammadian (2008) [*List of arachnids of Iran / Spiders, Scorpions and Solifuges of Iran* (*with Acarines, Pseudoscorpions and Harvestmen*)]. The list includes 240 species of spiders, 50 species of Solifugae, 50 species of scorpions, 40 species of pseudoscorpions, 600 species of Acari, and 6 species of Opiliones.

All the books and book-sized theses, currently known to the authors of this publication, published in Persian are listed below, arranged alphabetically by authors: Akrami (2006), Akrami & Saboori (2012), Bartsch & Sepasgozarian (1977), Ezzatpour (1987), Farzanpay (1987), Hajizadeh & Akrami (2010), Hajizadeh & Faraji (2016), Hashemi-Fesharaki et al. (2002), Karimi (1981), Khanjani & Haddad Irani-Nejad (2006), Lotfollahi & Khanjani (2013), Mohammadian (2008), Nassirkhani & Takalloo zade (2012), Navidpour et al. (2016),

Rahmani et al. (2011), Saboori et al. (2007), and Zamani (2016b). The titles of these books are listed under the appropriate sections within the text of this article as well as the references.

Discussion

Thanks to a wide variety of topological and climatological features, Iran houses a great assemblage of biodiversity. Judging from the geographic size and great variation in habitats, ranging from sandy deserts, mountains, forests, and vast shorelines of the Caspian Sea and the Persian Gulf, many arachnid species are still to be discovered in this country. Continued study of previously preserved museum collections is still a valuable source of unreported records; some first reported in recent publications on Opiliones date back to 1914 and the types of a new species of jumping spider from 1859 housed in the Zoological Institute, St. Petersburg, Russia.

In the case of arachnids, more than 2,750 species are currently known from this country. Even though there is an interesting pattern of diversity occurring in the region, including representative elements of three biogeographic realms (Palaearctic, Oriental, Afrotropical), the number of known species is quite low, especially when comparing to some smaller in area adjacent countries, e.g. Azerbaijan and Turkey (Table 9). Perhaps, the main reason behind this dramatic lack of records is due to the low accessibility to foreigner naturalists during past centuries and more recently foreign zoologists to this area (same with Iraq, Turkmenistan, and Afghanistan). The lack of proper funding for taxonomic research in Iran, resulting in only a few groups (mostly those with economical, medical or veterinary relevance) receiving proper attention by local experts. Low funding outside of Iran has also not bolstered the attention for graduate student theses dealing with the arachnid fauna or study of smaller elements of Iran and surrounding countries. Like so many arid regions of the world, much of the fauna occurring under rocks, close to the ground vegetation, and in soils are drab yellows to black in color and are small and difficult to study. Larger, brightly colored arachnids from tropical regions have always attracted more attention from arachnologists. Even so there are still many collections of Iranian Arachnida in foreign (mostly European) museums and institutes waiting to be studied.

Globally, animal and plant species and their environments need more protection, as there is consensus within researchers that we are today facing the largest biodiversity loss ever recorded in the Earth's history including the last ice age and death of the non-avian dinosaurs. Habitat protection relates to species protection and knowledge about species diversity and distribution provides critical data for priority decisions. Thus, a first step towards conservation of biodiversity includes taxonomic research to document species and to better define hotspots of species diversity and endemism. Iranian arachnids are threatened by many different factors. Perhaps the most important one is habitat degradation: annually, about 25,000 hectares of Hyrcanian Forests in northern Iran, now a part of UNESCO World Heritage Centre, undergoes fragmentation, mostly due to land use changes for agricultural and residential purposes, wood smuggling, and overgrazing. Anthropogenic fires in the oak-dominated forests of the Zagros Mountains in western Iran; followed by climate change (e.g. drought) and smuggling are drivers of primary concern. The illegal collection of specimens is also of current concern. Especially the recent fad in Iran over collections of many thousands of scorpions and false statements about selling their venoms to pharmaceutical companies and scientific researchers. The scam claims earnings as much as US$ 10 million for each liter of venom produced, but the truth is that there is no market, nobody is buying the venom for research or pharmaceutical development.

Table 9. Numbers of known species of the Class Arachnida from Iran and neighboring countries.

Orders	Iran	Azerbaijan	Armenia	Turkey	Iraq	Pakistan	Afghanistan	Turkmenistan
"Acari"	>1,733	1,315	?	548	?	1,105	?	?
Araneae	764	717	163	>1,128	60	~400	~130	>335
Solifugae	67	19	8	40	24	29	41	31
Scorpiones	68	4	4	41	19	49	31	10
Pseudoscor-piones	65	63	23	116	3	32	39	32
Opiliones	22	36	16	88	3	5	4	6
Amblypygi	1	0	0	1	0	1	0	0

So far, there has been no studies on the conservation of Iranian arthropods, and according to the IUCN Red List of Threatened Species, there are only about 130 species of arthropods occurring in Iran covered by that list (no arachnids), mostly thanks to the studies carried out on wider ranging Iran to European populations (not the strict endemics to Iran). Considering all of these, there is a higher need for studies clarifying the conservation status of Iranian arthropods, particularly spiders and scorpions because they are studied more and better known. Such studies would serve as a stepping stone toward more practical actions.

The current publication will serve as a guide to the history of arachnid studies of Iran. This contribution contains many properly cited and spelled scientific names and references providing a single resource so that future studies on arachnids in Iran will have a starting point to build upon. The interesting history and lives of some key proponents of their study will hopefully help foster new awareness and stimulate interest in these remarkable creatures. Instructors and teachers should be ever mindful of student's inclinations and lead them into arachnology and encourage them to collect new samples in as many situations as permitted as well as search for other specimens laying hidden in unstudied institutional collections worldwide.

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Conflict of Interests

The authors declare that there is no conflict of interest regarding the publication of this paper.

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بررسی اجمالی عنکبوتیان و عنکبوتی‌شناسی در ایران

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چکیـــده: در این مقاله، مروری بر عنکبوتیان (Arachnida) و مطالعات انجام شده روی آنها در ایران ارایه شده است. با در نظر نگرفتن اشعار، سازه‌های بشری باقی مانده از ۵۰۰۰ سال پیش و مشاهدات پزشکی بدوی از حداقل ۲۰۰۰ سال پیش، اولین مشاهدات تاکسونومیک از عنکبوتیان در ایران در سال ۱۸۰۷ منتشر شده و به عقرب‌ها اشاره دارد. به خاطر اهمیت اقتصادی و پزشکی/دامپزشکی خود، بالاراسته‌های انگل‌شکلان (Parasitiformes) و کنه‌شکلان (Acariformes) در ایران بیشترین میزان توجه را در میان کل عنکبوتیان دریافت کرده‌اند. از این گروه، بیش از ۱۷۳۳ گونه از ایران گزارش شده است، که به چهار راسته تعلق دارند: Ixodida، Mesostigmata، Sarcoptiformes و Trombidiformes. اولین کنه از راسته Ixodida از ایران در سال ۱۸۱۸ توصیف شد. اولین گونه‌های هیره توصیف شده از ایران به راسته Mesostigmata تعلق داشتند. با اینکه مشخص نیست که اولین گونه راسته Sarcoptiformes که از ایران معرفی شده کدام گونه است، اما اولین گونه ایرانی از زیرراسته Oribatida در سال ۱۹۸۴ توصیف شد که به احتمال قوی اولین گونه ایرانی از این راسته نیز می‌باشد. نهایتا، اولین گونه‌های ایرانی توصیف شده از راسته Trombidiformes در سال ۱۹۹۵ معرفی شدند. در مقام دوم، مطالعات صورت گرفته بر عنکبوت‌ها (Araneae) قرار داشته، که اولین گونه ایرانی آنها در سال ۱۸۷۴ معرفی شد؛ تاکنون حضور حدودا ۷۶۴ گونه از این راسته در ایران شناسایی شده است. از راسته عقرب‌ها (Scorpiones) ۶۸ گونه از ایران شناسایی شده است، که با در نظر داشتن میزان تنوع جهانی آنها، این راسته در قیاس با کنه‌سانان و عنکبوت‌ها در ایران به مراتب بهتر مطالعه شده است. اولین گونه از راسته رتیل‌ها (Solifugae) از ایران در سال ۱۸۹۵ توصیف شد؛ در حال حاضر ۶۷ گونه از این راسته از ایران شناخته شده است. راسته‌های شبه-عقرب‌ها (Pseudoscorpiones) و درازپایان (Opiliones) به ترتیب ۶۵ و ۲۲ گونه گزارش شده از ایران را شامل شده، و نهایتاً راسته عنکبوت‌های شلاقی یا تاژک‌پایان (Amblypygi)، که تنها یک گونه ایرانی توصیف شده در سال ۲۰۱۸ را در بر می‌گیرد.

واژگــان کلیدی: کنه‌شناسی، عنکبوت‌شناسی، درازپاشناسی، دیرینه‌عنکبوتی‌شناسی، شبه‌عقرب‌شناسی، عقرب‌شناسی، عقرب، عنکبوت، کنه، هیره

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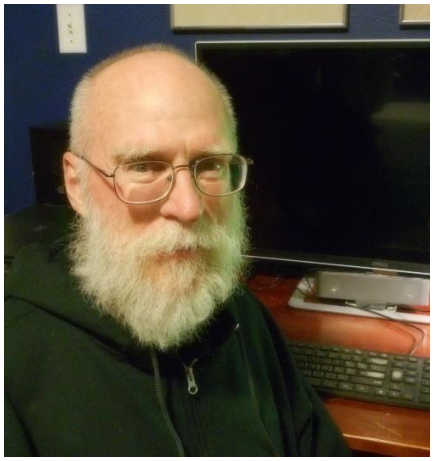

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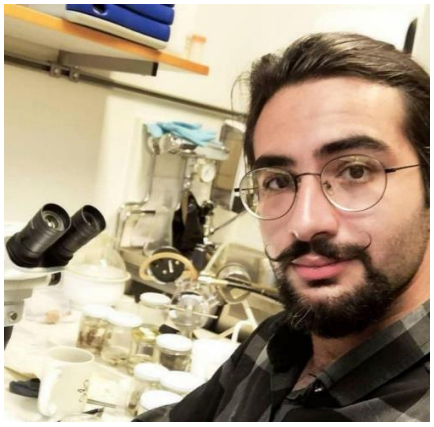

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