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REVIEW ARTICLE

The fauna and perspective of rodentia ectoparasites in Iran relying on their roles within public health and veterinary characteristics

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Abstract Historically, rodents-ectoparasites are responsible for many diseases in human and domestic animal communities because they are well-adapted to the environment and nutritional resources. In addition, ectoparasites can affect the reproductive rates, ecological fitness and the dispersal pattern of their hosts. Data was compiled through all publications relating to ectoparasites fauna from Iranian rodents. Host specificity, rodent-parasites interaction, geographical distribution, ecological trends as well as the medical or veterinary importance of ectoparasites are considered in this review. Also, results compared with other equal global findings. According to the obtained information, the genus *Hyalomma* considered being the major vector of Crimean-Congo hemorrhagic fever. Sistan-Balouchistan, Isfahan, Fars and Khuzestan are endemic provinces of this disease in Iran. Ixodes ticks (especially *Hyalomma* spp.) commonly existed throughout the months but had high activity in spring and late autumn seasons. Muridae as the most diversified rodent family was more reiterated exploited host by all parasites in this knowledge. *Tatera indica* confirmed as a positive host for *Francisella tularensis* by serological test but the definitive reservoir is still unclear in Iran. *Meriones persicus* as a nocturnal jird has been permanently presented in semi-desert areas except Dasht-e Kavir desert. This rodent was the frequent host for Pulicid fleas followed by *Mus musculus* and *Cricetulus migratorius* (Cricetidae). *Rattus norvegicus* was specialized host for *Polyplax spinulosa* (spiny rat louse). *Pulex irritans* from Pulicidae was spread in particularly west of Iran which known as an endemic focus of plague. Mites were high diversity than other taxa. The domestic vertebrates (sheep, goat and cattle) were primitive hosts and rodents were discovered as auxiliary hosts for ticks in Iran apparently. The available data suggested that lice had a type of model of host specificity due to their morphological traits. Meanwhile, Alborz and Zagros mountains ranges provided the specialized habitats for animals which have been surrounded by northern and western regions. Perhaps these mountainous areas can prevent gene flow between local mammalian populations. Notably, the genealogy of parasite genome can orient toward the evolutionary process into speciation point. In general, more researches are needed to decipher the whole sights of host-parasite association and the role of ectoparasites within zoonosis diseases.

Keywords Diversity · Ectoparasites · Host · Iran · Rodents

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Introduction

Rodentia species are the important pest for many agricultural products as well as oil seeds within pre and post-harvest stages. Also, they are widely distributed and adapted to different ecosystems and climates due to their reproductive abilities (Parshad 1999). Commensal rodents can damage the stored foods, digging burrow under buildings and gnawing materials because of physical and behavioral features (Brooks and Jackson 1973; Brown et al. 2008). Indeed, they are important as reservoir, carrier or incidental hosts in veterinary and medical scopes also contribute to transmission of zoonosis diseases including: Bubonic Plague, Tularemia, Bartonellosis, Leptospirosis,

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Tick-borne relapsing fever, Murine typhus, Trichinelliasis, Toxoplasmiasis, Echinostomiasis, Schistosomiasis, Leishmaniasis and Hantavirus Pulmonary Syndrome (Meerburg et al. 2009). Rodents can transmit pathogens to human directly or indirectly. For example, Omsk hemorrhagic fever virus (OHFV) transmits through direct contact of humans with infected animals or ectoparasite bite (tick) (Li et al. 2004). Numerous of the rodent-borne diseases have occurred in Southeastern Asia where rodents' population were increased in accordance with rice cultivation. (WHO 1988). In addition, gastrointestinal termatodes such as *Plagiorchis muris and Neodiplostomum seoulense* as endoparasites have been isolated from human and rodents communities which have a significant role in human health (Albon et al. 2002; Wells et al. 2007; Lee et al. 2013). Host specificity is one of the most important parameters which describes the ecological and evolutionary patterns of both host and parasite (Rosario Robles et al. 2016). Herein fleas (*Xenopsylla conformis*) at a given stage can affect the behavioral defence of their rodents (Hawlena et al. 2007). The genus *Ornithodoros* has been presented in the colony of Palearctic rodents (e.g. *Meriones* spp., *Microtus* spp. and *Tatera* spp.) (Naddaf et al. 2012). This tick divides the two species; *Ornithodoros tholozani* and *O. erraticus*. *Borrelia persica* (Spirochaetal agent of Tick-borne relapsing fever) is associated with *O. tholozani*. In contrast, *Borrelia microti* parasitizes *O. erraticus* in southern Persia (Aghighi et al. 2007; Naddaf et al. 2015). These soft ticks were mostly found from rodents burrows located in northwestern and central Iran specially Ardabil district (Masoumi-Asl et al. 2009). Unfortunately, the plague caused a pandemics disaster in the twentieth century and millions of people died throughout the world by this disease. The oriental rat flea (*Xenopsylla cheopis*) was identified as the main vector for bubonic plague (Adjemian et al. 2007; Gage and Kosoy 2005). Afterwards, the plague caused a horrible decline in Iranian population during the nineteenth century. More than two-thirds of residents from Kermanshah province died due to an outbreak of disease during the 1800–1906 period (Seyf 1989). Besides, *Yersinia pestis* (the microbial organism of plague) circulates between the wild mammal's population such as *Meriones* spp. rodents in Kurdistan province as the main former endemic foci of plague disease, west of Iran (Hashemi-Shahraki et al. 2016). It should be noted that Leishmaniasis is prevalent with high incidence rates in different parts of Iran (Khosravani et al. 2016). Gerbillinae Subfamily has been proven as the reservoir host for Zoonotic cutaneous leishmaniasis (ZCL) (Rassi et al. 2006). Strikingly, Dr. Etemad was the eminent Iranian scientist that published the principal's information of the Rodentia order in 1977. Sciuridae, Hystricidae, Dipodidae, Muscardinidae, Muridae and Cricetidae were discovered as the families of rodents from Iran (Sedaghat and Salahi-Moghaddam 2010a, b). The objective of present study is a complete reappraisal of the ectoparasites associated with rodents that have been recorded from Iran. This paper is the first novel in Iran that addresses all aspects of rodents-ectoparasites based on their importance to public health and veterinary scopes. Definitive species of host, local distribution, host-parasites interaction, host specification, biodiversity, the pattern of seasonal activity and ecological trends were accommodated in this review. Also, these results compared with other global studies comprehensively.

Materials and methods

Study site

Iran (32°00′N; 53°00′E) is a country in western Asia with an area of 1,648,195 km^2 (80,000,000 population). Azerbaijan, Armenia, Turkmenistan, Pakistan, Afghanistan, Turkey and Iraq have a common border with Iran (a common name: Persia). Zagros and Alborz mountains ranges are high altitude areas. Southern shores of Caspian is covered by forest and trees. The Dasht-e Kavir and the Dasht-e Lut are the Iran's largest deserts also two-third of this country have arid or semiarid climates. The average annual rainfall are 246 mm approximately thereby, precipitation has a significant role in the life of plants and animals in Iran.

Research tool

This descriptive study was given on earlier investigations and references that have been conducted on different rodents and their ectoparasites fauna in Iran. Parasites classified in four groups are as follows: fleas, mites, ticks and lice. All taxonomic information about ectoparasites was ranked based on recent definitions. Sometimes the scientific classification and nomenclature of parasites have overlapping meanings but considerably related (Small 1989). In this approach, local distribution of both rodent species and their ectoparasites were tabulated. Many parameters of host-parasite re-evaluated and reviewed. In addition, some characteristics of ectoparasites compared with previous researches across rodent species as follows: geographic ranges of host-parasite "host switching in parasites, the community dynamics of parasite related to its host, ecological changes, host behaviour, parasite species richness" host defence, competition in parasite, host-parasite interaction, transmission of pathogen agents to human and the medical/veterinary importance of rodents ectoparasites. All data gathered and arranged from well-known scientific databases and search engines such as

ScienceDirect, Scopus, ProQuest, Sage, Wiley Online Library, Nature, Springer, Jstor, Bio One, PubMed, Google scholar, ResearchGate, Magiran and Sid.

Results

In this review 58 arthropod specimens within four taxa (flea, mite, tick and lice) were found on rodents species from 22 regions as follows:

Order: Siphonaptera Latreille, 1825
Pulicidae
Xenopsylla buxtoni Jordan, 1949, *Xenopsylla gerbilli* Wngner, 1903, *Xenopsylla nubica* Rothschild, 1903, *Xenopsylla astia* Rothschild, 1911, *Xenopsylla cheopis* Rothschild, 1903, *Xenopsylla conformis* Rothschild, 1904, *Xenopsylla nuttalli* Loff, 1930, *Ctenocephalides felis* Bouche, 1835, *Pulex irritans* Linn, 1758

Ceratophyllidae
Nosopsyllus fasciatus Bosc, 1800, *Nosopsyllus iranus* Wagner et Argyropulo, 1934, *Nosopsyllus medus* Jordan, 1938

Leptopsyllidae
Leptopsylla taschenbergi taschenbergi Wagner, 1898, *Leptopsylla aethiopica* Rothschild, 1908

Hystrichopsyllidae
Stenoponia tripectinata Tiraboschi, 1902, *Ctenophthalmus rettigi* Rothschild, 1908

Subclass: Acari Leach, 1817
Order: Mesostigmata
Hirstionyssidae
Hirstionyssus Fonseca, 1948

Laelapidae
Laelaps nuttalli Hirst,1915, Hurlbut 1949, *Laelaps acuminata, Laelaps algericus* Hirst, 1925, *Echinolaelaps echidninus* Berlese, 1887, Hurlbut 1949, *Androlaelaps hermaphrodita* Berlese, 1887, *Haemolaelaps glasgowi* Ewing

Dermanyssidae
Dermanyssus gallina Geer, 1778, *Dermanyssus sanguineus* Hirst, 1914, *Dermanyssus americanus* Ewing, 1922, *Liponyssoides Sanguineus* Hirst

Macronyssidae
Ornithonyssus bacoti Hirst, 1931, Pippin & Shimada, 1966, *Ornithonyssus sylviarum* Canestrini and Fanzago, 1877

Pachylaelapidae
Pachylaelaps spp. Berlese, 1888

Order: Trombidiformes
Suborder: Prostigmata
Cheyletidae Leach, 1815
Cheyletus malaccensis

Myobiidae
Myobia musculi Schrank, 1781, *Radfordia affinis* Poppe, 1896

Trombiculidae Ewing, 1929
Microtrombicula spp.

Order: Sarcoptiformes
Acaridae
Acarus siro Linnaeus, 1758, *Tyrophagus putrescentiae* Schrank 1781, *Caloglyphus* Berlese, 1924

Order: Astigmata
Myocoptidae Gunther, 1942
Myocoptes musculinus Koch, 1844, *Trichoecius romboutsi* Van Eyndhoven, 1946

Glycyphagidae
Lepidoglyphus destructor Schrank, 1781

Order: Opilioacarida Johnston, 1968 (= Notostigmata With, 1903–1904)
Opiliacaridae With, 1902

Order: Ixodida
Ixodidae Koch, 1844
Haemaphysalis Koch, 1844, *Rhipicephalus sp, Hyalomma* spp., *Boophilus* spp., *Haemaphysalis punctata* Canestrini & Fanzago, 1878, *Ixodes trianguliceps* Birula, 1895, *Ixodes ricinus* Linnaeus, 1758
Subclass: Pterygota Lang, 1888
Superorder: Exopterygota
Order: Phthiraptera Haeckel, 1896
Hoplopleuridae
Neohaematopinu spp. Mjöberg, 1910, Ferris, 1942, *Hoplopleura oenomydis* Ferris 1921, *Hoplopleura captiosa* Johnson, 1960
Polyplacidae
Polyplax spinulosa Burmeister, 1839, *Polyplax stephensi* Christophers and Newstead, 1906, *Polyplax asiatica* Ferris, 1923, *Polyplax paradoxa* Johnson, 1960, *Polyplax gerbilli* Ferris, 1923, *Polyplax serrata* Burmeister, 1839, *Eulinognathus* spp.

Discussion

Fleas

All fleas insects have consisted of 16 species belong to 4 families, Pulicidae, Ceratophyllidae, Leptopsyllidae and Hystrichopsyllidae in Iran as Pulicidae contains over 57% of all species alone (Table 1). Fleas are obligatory hematophagous (male & female) with 2550 species/subspecies from 18 families that struggle in the Holarctic, Nearctic, Palearctic, Afrotropical and Oriental regions. They have

Table 1 Ectoparasites fauna of Iranian rodents in the various districts

Ectoparasite	Host	Region	Researcher
Fleas			
Xenopsylla spp.	*Rattus norvegicus, Nesokia indica*	Ahvaz, Hovizeh, Mashhad	Rahdar et al. (2015) and Moravvej et al. (2015)
Xenopsylla buxtoni	*Meriones persicus, Microtus socialis, Calomyscus bailwardi, Cricetulus migratorius, Rattus rattus, R. norvegicus, Tatera indica*	Khorram abad, Meshkinshahr, Bandar Abbas	Shayan and Rafinejad (2006), Zarei et al. (2015) and Hanafi-Bojd et al. (2007)
Xenopsylla gerbilli	*M. persicus*	Meshkinshahr	Mohebali et al. (1997)
Xenopsylla nubica	*M. persicus, Mus musculus, C. migratorius,* Muridae and Cricetidae families	Meshkinshahr, Iran Shahr, Nikshahr	Zarei et al. (2015) and Nateghpour et al. (2013)
Xenopsylla astia	*M. persicus, M. musculus, C.migratorius*	Meshkinshahr, Iran Shahr, Nikshahr	Zarei et al. (2015) and Nateghpour et al. (2013)
Xenopsylla cheopis	*M. persicus, M. musculus, C.migratorius, N. indica*	Meshkinshahr, Mashhad	Zarei et al. (2015) and Moravvej et al. (2015)
Xenopsylla conformis	Muridae and Cricetidae families	Iranshahr, Nikshahr	Nateghpour et al. (2013)
Xenopsylla nuttali	*Rhombomys opimus*	North of Khorasan province, Kalaleh, Damghan, Shahrood, Badrood, Habibabad, Meshkinshahr	Tajedin et al. (2009) and Mohebali et al. (1997)
Pulex irritans	Muridae and Cricetidae families	Sarpole-Zahab	Telmadarraiy et al. (2007)
Ctenocephalides felis	*M. musculus, M. persicus, C. migratorius*	Meshkinshahr	Zarei et al. (2015)
Nosopsyllus spp.	*N. indica, M. persicus*	Mashhad	Moravvej et al. (2015)
Nosopsyllus fasciatus	*M. persicus, M. musculus, C. migratorius, M. socialis, Spermophilus fulvus, N. indica, R. norvegicus*	Meshkinshahr, Khorram abad, Mashhad, Tehran, Turkmen Sahra	Zarei et al. (2015), Shayan and Rafinejad (2006), Moravvej et al. (2016), Moravvej et al. (2015), Pakdad et al. (2012), Mohebali et al. (1997) and Gholipoury et al. (2016)
Nosopsyllus medus	Muridae and Cricetidae families	Sarpole-Zahab	Telmadarraiy et al. (2007)
Nosopsyllus iranus	*M. musculus, M. persicus, C. migratorius*	Meshkinshahr	Zarei et al. (2015)
Leptopsylla aethiopica	*M. musculus*	Semnan	Darvishi et al. (2014)
Leptopsylla taschenbergi taschenbergi	*Apodemus sylvaticus*	Razan plain	Yousefi et al. (2015)
Ctenophthalmus rettigi	*M. musculus, R. norvegicus, M. persicus, C. migratorius*	Mashhad, Meshkinshahr	Moravvej et al. (2016), Moravvej et al. (2015) and Zarei et al. (2015)
Stenoponia tripectinata	*M. persicus*	Meshkinshahr	Mohebali et al. (1997)
Mites			
Laelaps spp.	*M. musculus*	Mashhad	Moravvej et al. (2015)
Laelaps nuttalli	Muridae and Cricetidae families, *R. norvegicus, T. indica, M. musculus*	Sarpole-Zahab, Bandar Abbas, Turkmen Sahra	Telmadarraiy et al. (2007), Hanafi-Bojd et al. (2007) and Gholipoury et al. (2016)
Laelaps ciccuminata	Muridae (Gerbillinae)	Iranshahr, Nikshahr	Nateghpour et al. (2013)
Laelaps algericus	*M. musculus*	Mashhad	Moravvej et al. (2016)
Haemolaelaps spp.	*M. musculus, M. persicus*	Mashhad	Moravvej et al. (2016) and Moravvej et al. (2015)

Table 1 continued

Ectoparasite	Host	Region	Researcher
Haemolaelaps glasgowi	*M. persicus, M. musculus, M. socialis, C. migratorius, Ellobius fuscocapillus, R. rattus, R. norvegicus, T. indica*	Khorram abad, Bandar Abbas	Shayan and Rafinejad (2006) and Hanafi-Bojd et al. (2007)
Echinolaelaps echidninus	*R. norvegicus, T. indica, R. rattus*	Bandar Abbas, Sari	Hanafi-Bojd et al. (2007) and Motevalli-Haghi et al. (2000)
Androlaelaps hermaphrodita	Muridae (Gerbillinae)	Iranshahr, Nikshahr	Nateghpour et al. (2013)
Ornithonyssus spp.	*M. musculus, M. persicus, C. migratorius, T. indica, R. norvegicus*	Meshkinshahr, Ahvaz, Hovizeh	Zarei et al. (2015) and Rahdar et al. (2015)
Ornithonyssus sylviarum	*M. persicus, C.bailwardi, C. migratorius*	Khorram abad	Shayan and Rafinejad (2006)
Ornithonyssus bacoti	Muridae and Cricetidae families, *M. musculus, T. indica, R. opimus, R. norvegicus, M. persicus*	Sarpole-Zahab, Northwest of Iran, Bandar Abbas, North of Khorasan, Kalaleh, Damghan, Shahrood, Badrood, Habibabad, Meshkinshahr, Tehran	Telmadarraiy et al. (2007), Allymehr et al. (2012), Hanafi-Bojd et al. (2007), Tajedin et al. (2009), Pakdad et al. (2012) and Mohebali et al. (1997)
Dermanyssus gallinae	*M. musculus*	Northwest of Iran	Allymehr et al. (2012)
Dermanyssus americanus	*R. norvegicus, T. indica*	Bandar Abbas	Hanafi-Bojd et al. (2007)
Dermanyssus sanguineus	*Muridae and* Cricetidae families, *R.norvegicus*	Sarpole-Zahab, Bandar Abbas	Telmadarraiy et al. (2007) and Hanafi-Bojd et al. (2007)
Liponyssoides sanguineus	*R. norvegicus*	Ahvaz, Hovizeh	Rahdar et al. (2015)
Acarus siro	*M. musculus, R. rattus, R.norvegicus*	Tehran	Shiravi et al. (2013)
Caloglyphus	*M. musculus, R. rattus, R. norvegicus*	Tehran	Shiravi et al. (2013)
Tyrophagus putrescentiae	*M. musculus, R. rattus, R. norvegicus*	Tehran	Shiravi et al. (2013)
Hirstionyssus spp.	*Meriones libycus*	Mashhad	Moravvej et al. (2015)
Trichoecius romboutsi	*M. persicus*	Meshkinshahr	Mohebali et al. (1997)
Myocoptes musculinus	*M. musculus*	Northwest of Iran	Allymehr et al. (2012)
Cheyletus malaccensis	*M. musculus, R. rattus, R. norvegicus*	Tehran	Shiravi et al. (2013)
Myobia musculi	*M. musculus, R. rattus, R. norvegicus*	Tehran	Shiravi et al. (2013)
Radfordia affinis	*M. musculus, R. rattus, R. norvegicus*	Tehran	Shiravi et al. (2013)
Lepidoglyphus destructor	*M. musculus, R. rattus, R. norvegicus*	Tehran	Shiravi et al. (2013)
Pachylaelaps spp.	Muridae (Gerbillinae)	Iranshahr, Nikshahr	Nateghpour et al. (2013)
Microtrombicula spp.	*M. musculus,*	Mashhad	Moravvej et al. (2016)
Opiliacaridae	*R. rattus, R. norvegicus*	Sari	Motevalli-Haghi et al. (2000)
Ticks			
Haemaphysalis spp.	*M. persicus, M. musculus, M. socialis, C. bailwardi, R. rattus, T. indica, Apodemus witherbeyi*	Khorram abad, Ahvaz, Hovizeh, Meshkinshahr Mashhad	Shayan and Rafinejad (2006), Rahdar et al. (2015), Mohebali et al. (1997), Moravvej et al. (2016) and Moravvej et al. (2015)

Table 1 continued

Ectoparasite	Host	Region	Researcher
Haemaphysalis punctata	*M. musculus, M. persicus, N. indica*	Mashhad	Moravvej et al. (2016) and Moravvej et al. (2015)
Rhipicephalus spp.	Muridae and Cricetidae families, Muridae (Gerbillinae), *R.rattus, R. norvegicus, T. indica*	Sarpole-Zahab, Iranshahr, Nikshahr, Bandar Abbas, Sari, Turkmen Sahra	Telmadarraiy et al. (2007), Nateghpour et al. (2013), Hanafi-Bojd et al. (2007), Motevalli-Haghi et al. (2000) and Gholipoury et al. (2016)
Hyalomma spp.	Muridae and Cricetidae families, Muridae (Gerbillinae)	Sarpole-Zahab, Iranshahr, Nikshahr	Telmadarraiy et al. (2007) and Nateghpour et al. (2013)
Boophilus spp.	Muridae (Gerbillinae)	Iranshahr, Nikshahr,	Nateghpour et al. (2013)
Ixodes trianguliceps	*M. persicus*	Mashhad	Moravvej et al. (2015)
Ixodes spp.	*A. witherbeyi*	Mashhad	Moravvej et al. (2015)
Ixodes ricinus	*R. norvegicus*	Tehran	Pakdad et al. (2012)
Lice			
Polyplax spp.	Persian Squirrel (*Sciurus anomalus*), *M. persicus, M. musculus, C. migratorius*	Urmia, Meshkinshahr	Shirazi et al. (2013) and Zarei et al. (2015)
Polyplax spinulosa	Muridae and Cricetidae families, Muridae (Gerbillinae), *R. norvegicus*	Sarpole-Zahab, Tehran, Ahvaz, Hovizeh	Telmadarraiy et al. (2007), Nateghpour et al. (2013), Pakdad et al. (2012) and Rahdar et al. (2015)
Polyplax stephensi	*T.indica*	Ahvaz, Hovizeh	Rahdar et al. (2015)
Polyplax asiatica	*M. persicus, S. fulvus, T. indica*	Mashhad	Moravvej et al. (2015)
Polyplax serrata	*M. musculus*	North west of Iran	Allymehr et al. (2012)
Polyplax paradoxa	*M. persicus*	Mashhad	Moravvej et al. (2015)
Polyplax gerbilli	*R. norvegicus, T. indica*	Bandar Abbas	Hanafi-Bojd et al. (2007)
Eulinognathus spp.	*Allactaga* spp.	Ahvaz, Hovizeh	Rahdar et al. (2015)
Neohaematopinus spp.	*M. persicus, M. socialis*	Khorram abad	Shayan and Rafinejad (2006)
Hoplopleura spp.	*R. norvegicus, R. rattus*	Sari, Tehran	Pakdad et al. (2012) and Motevalli-Haghi et al. (2000)
Hoplopleura captiosa	*N. indica, M. musculus, R. norvegicus*	Mashhad, Bandar Abbas	Moravvej et al. (2015) and Hanafi-Bojd et al. (2007)
Hoplopleura oenomydis	*R. norvegicus*	Tehran	Pakdad et al. (2012)

adapted to ecological features of hosts due to phylogenetic events into their shape and behaviour (Medvedev 1996; Bitam et al. 2010). Also, they implicate as vector or reservoir of Bartonella which circulates between fleas/rodents communities via horizontal and vertical routes. For instance, *Bartonella rochalimae* and *Bartonella tribocorum* DNA has been identified in *Xenopsylla cheopis* fleas (Billeter et al. 2011). As described above Pulicidae was the largest family that more comprised genus *Xenopsylla. Xenopsylla nubica* have widely hosts such as *Meriones persicus* (Persian jird), *Mus musculus, Cricetulus migratorius* and Cricetidae families (uncertain species). *Xenopsylla conformis* have occurred on Cricetidae and Muridae (undetermined species). In a previous study compared with this research *Xenopsylla conformis mycerini* and *X. nubica theodori* were removed from *Gerbillus nanus*, *Acomys dimidiatus*, *Meriones lybicus* (the Libyan jird) and *Meriones rex* but they were more exist on *M. rex* (Harrison et al. 2015). As such *Xenopsylla cheopis* (the Oriental rat flea) was dominant on Muridae (Persian jird, *M. musculus, Nesokia indica*) and a species from Cricetidae (*C.migratorius*) in Iran. Also, this flea was named as a parasite for *Rattus rattus* in Sri Lanka, Asia (Sumangali et al. 2012) and the Canary Islands in Spain, Europe (Feliu et al. 2012) as well as for *Rattus flavipectus* in Yunnan Province, China (Xian-guo et al. 2000). In other words, it is a broad species of genus *Xenopsylla* throughout the world. Sometimes, even more, this parasite considered to be the important vector of plague bacteria (*Yersinia pestis*) in the zoonotic areas (Eisen et al. 2007) As regards co-infection with *Rickettsia typhi* and *Rickettsia felis* have been shown in the Oriental rat flea from *M. musculus* in previous investigation

(Eremeeva et al. 2008). *Meriones persicus, M. musculus and C.migratorius* are hosts to *Xenopsylla asti*a. This specimen was a vector within sylvatic and human forms of plague in India (Renapurkar 1988) besides, *Bandicota* bengalensis was the ideal host for *X. astia* in this country (Shyamal et al. 2011). *Xenopsylla astia, X. buxtoni, X. stenoponia, X. conformis* and *Pulex irritans* was recorded as vectors of plague on genera *Gerbillidae* from Muridae in the endemic spots (Kurdestan, Ardebil) in Iran (Nekouie et al. 2003). In view of *Xenopsylla gerbilli,* Mohebali and his coworkers have reported the replacement of *X. gerbilli* on *M. persicus* in Meshkinshahr, northwestern Iran (Mohebali et al. 1997) while this flea has infested great gerbil in plague focus, Central Asia (Samia et al. 2011). Another species of Pulicidae, *P. irritans* (the human flea) resided on Muridae and Cricetidae families of rodents in the west of Iran that was once the important foci of plague. This species as domestic ectoparasite was prevailing flea in the risk districts of plague in Madagascar (Ratovonjato et al. 2014) and Tanzania, Africa (Laudisoit et al. 2007). *Ctenocephalides felis* (Pulicidae) is known as cat flea was found on three species of small mammals e.g. *M. musculus, M. persicus* and *C. migratorius.* It was established where CSD (cat scratch disease) cases documented increasingly (Breitschwerdt and Kordick 2000). Additionally, it was confirmed as a vector of *Rickettsia felis* (the etiologic agent of rickettsial fleaborne spotted fever) (Jiang et al. 2006), plague and murine typhus (Rust 1997). It is noteworthy that infected female flea can transmit *Rickettsia typhi* (the causative agent of Murine typhus) by transovarial transmission (Ford et al. 2004). In this research, the Ceratophyllidae family contained 3 species as *Nosopsyllus fasciatus* (the northern rat flea) was extremely common parasitic arthropod on *M. persicus, M. musculus, C. migratorius, Microtus socialis, Spermophilus fulvus* (squirrel)*, N. indica* (the Indian Bandicoot) and *R. norvegicus*. In Compared with this survey it has been collected from Norway rat in rural areas from dumps during the warm months (0.24 fleas per rat) also mostly from buildings in the cold season with 1.3 (Burbutis and Hansens 1955) and 2.7 fleas per rat in U.S (Eskey 1938). Furthermore, *Nosopsyllus fasciatus* transmits *Trypanosoma lewisi* among rat populations. A filarial nematode (*Dipetalonema reconditum*) can transmit *by C. canis* and *C. felis* (Ford et al. 2004). *Ctenocephalides felis canis*, *X. cheopis and P. irritans* have been infected as the accidental hosts by the cysticercoids of *Hymenolepis diminuta* (the rat tapeworm), *Hymenolepis nana* and *Dipylidium caninum* (Oldham 1931; Ford et al. 2004) also transmit to susceptible hosts (especially children) upon ingestion of these intermediated hosts occasionally (Craig and Ito 2007). *Leptopsylla aethiopica* and *L. taschenbergi* from Leptopsyllidae have newly been recorded from Iran (Darvishi et al. 2014; Yousefi et al. 2015) (Table 1). *Stenoponia tripectinata* (Hystrichopsyllidae) didn't only find from Iran. This flea has been removed from *Meriones crassus*, *Jaculus jaculus* and *Gerbillus cheesman* within two genders (female & male) in Northern Saudi Arabia (Lewis 1964) whereas it was taken on *M. persicus* predominantly in Iran. *Mus musculus, R. norvegicus, M. persicus* and *C. migratorius* were the determined hosts for *Ctenophthalmus rettigi* from this family. *Ctenophthalmus* species was also described from *Apodemus agrariu*s (genus of Muridae) in the Far East (Smit 1955).

Mites

In the case of mites, 25 genus/species from 12 families are known in this study. They are high biodiversity than other groups. Laelapidae, Macronyssidae and Dermanyssidae (mesostigmatid mite) more have been recorded in Iran. According to my knowledge *Laelaps nuttalli* (domestic rat mite) has been found on many of rodents from Cricetidae (unknown species) and *T. indica* (Table 1). It was also common on *R. norvegicus* (Yang et al. 2009), *R. rattus mansorius* and *Rattus exulans* in other places (Wilson 1967). *Laelaps echidninus* has appeared on Norway/black rats in Chile, South America (Lareschi and Gonzalez-Acuna 2010) thereby, it can be concluded that Laelaps mites initially associate with *Rattus* spp. as Indian gerbil was secondary hosts for this group. In this family, *Haemolaelaps* spp. (adult and nymphal stages) was taken from birds, nest and rodents but more tended to rodent hosts. *Haemolaelaps glasgowi* has been demonstrated on captured hosts belong to different families (Muridae and Cricetidae) as follows: *M. persicus, M. musculus, M. socialis, C. migratorius, Ellobius fuscocapillus, R. rattus, R. norvegicus* and *T. indica*. As this ectoparasite was occurred on *Microtus arvalis* and *Citellus citellus* (ground squirrel) in Turkey (Cicek et al. 2008) as well as on the Meadow Vole in Wisconsin, north-central United State (Amin 1976). *Echinolaelaps echidninus* (gamasid mite) was a scarce species that happened on genera rat naturally in the spring season (Davis 1951) also on *T. indica* in this literature. This mite is a vector of *Hepatozoon muris*, which involves white rats (Jakeman 1961). Genus *Dermanyssus* from Dermanyssidae consists of 23 species (Roy and Chauve 2007). It was determined as a vector of viral zoonoses diseases such as Saint-Louis encephalitis virus and fowl-pox. Moreover, bacterial agents (*Salmonella gallinarum, Erysopelothrix rhusiopathiae*) isolated from *Dermanyssus gallinae* on Flows hosts. Western equine encephalitis virus (WEE) has also been isolated in wild birds roosts from this acarian although no transovarial transmission or viral replication has been observed. In general, the role of these mites into pathogenicity process is a controversial issue yet (Valiente Moro et al. 2005). *Dermanyssus gallinae* (the red mite of poultry) was collected solely from *M. musculus* in my study. It would infest birds/nests (Huhta 2016; Arjomandi et al. 2013) especially hen in other regions if the condition was suitable for this mite (Rosen et al. 2002). *Dermanyssus sanguineus* can parasitize birds like other dermanyssid mites (Roy and Chauve 2010). Muridae and Cricetidae families, in particular, *R.norvegicus* have been noted as the hosts for this mite based on current data. This hematophagous mite also has been occurred on house sparrows (Brown and Wilson 1975). *Liponyssoides sanguineus* (the mouse mite) from Dermanyssidae has been assigned as the main vector of *Rickettsia akari*. This agent can transmit via bite and causes Rickettsialpox disease in human. It has been recorded from Ukraine, Korea, North Carolina, South Africa (Lahey 2003) and Netherlands (Renvoise et al. 2012). In Persia, this mite first was reported on *R. norvegicus* in Ahvaz city (Rahdar et al. 2015) although the possible cases have not been diagnosed yet. Within the Macronyssidae, *Ornithonyssus bacoti* (the tropical rat mite) was parasitic on *M. musculus, T. indica* (Indian gerbil), *Rhombomys opimus, R. norvegicus* and *M. persicus* (Muridae). This species prefers Rats to other groups as the principal hosts (Reeves et al. 2007; Bhuyan and Nath 2016). *Bartonella* spp. and *Rickettsia* spp. were detected in *O. bacoti* by molecular technic although the figure of transmission of these pathogens to human or animal is still unclear (Reeves et al. 2007). On the other hand, it infests small mammals' fur also it has medical important due to causing dermatitis in human (Beck and Folster-Holst 2009; Baumstark et al. 2007; Rahdar and Vazirianzadeh 2009). Furthermore, this mite feeds on the man when other hosts are not accessible (Fischer and Walton 2014). Considerably, *Litomosoides carinii* (the filarial nematode) of rodents can parasitize *O. bacoti* as an intermediated host (Fagir and El-Rayah 2009). *Ornithonyssus sylviarum* (The northern fowl mite) was revealed on *M. persicus, Calomyscus bailwardi* and *C. migratorius* in the findings. It specimen served as an avian parasite on the diversity of orders of birds (e.g. Falconiformes, Passeriformes and Piciformes) (Knee and Proctor 2007; Mullens et al. 2001; Owen et al. 2009). Interestingly, *Dermanyssus gallinae* (obligatory ectoparasite), *O. bacoti* and *O. sylviarum* had analogous relationship morphologically (Beck and Folster-Holst 2009). In this overview, *Acarus siro* (the flour mite), *Lepidoglyphus destructor*, *Cheyletus malaccensis*, *Tyrophagus putrescentiae, Caloglyphus berlesei*, *Myobia musculi* and *Radfordia affinis* were only common on commensal rats particularly *Mus musculus* in wheat stores. The first four species have more abundant in rodents' burrows. Many records have shown allergic reactions through contact with storage mites (the flour mite, *T. putrescentiae* and *L. destructor*) in patients that were sensitized to *Dermatophagoides pteronyssinus* (the house-dust mite) (Green and Woolcock 1978; Llerena et al. 1991; Heide et al. 1998; Johansson et al. 2001). *Tyrophagus putrescentiae* (the mold mite) was known as the causal ectoparasite of allergic manifestations among farmers (Sanchez-Ramos and Castanera 2001). *Cheyletus malaccensis* (Cheyletidae) as known predator was used into biological control in order to reduce its prey density either *A. siro* (Solomon 1962; Pekar and Hubert 2008) or *T. putrescentiae* (the cheese mite) in gain/seeds products of plants (Kuwahara et al. 1975; Palyvos et al. 2006). House mice were favorable host for *Myobia musculi* and *Radfordia* (Myobiid mites) in South Carolina. (Reeves and Cobb 2005) As they have been typically presented on the murine rodents in Europe (Bochkov and Labrzycka 2003). Two species of Myocoptid mites have been reported from Iran. *Myocoptes musculinus* and *Trichoecius romboutsi* were taken from house mouse and *M. persicus* respectively. Dr. Flynn removed these species from mice (Fain and Hyland 1970). *Microtrombicula* spp. was merely common on *M. musculus*. Another chigger mite, *Leptotrombidium scutellare* (a vector of tsutsugamushi disease) has been presented on individual rodents (Wei et al. 2010) chiefly *Eothenomys miletus* (vole) male in China (Peng et al. 2015). Additionally, these groups transmit the rickettsial agents to man only in the larval sitting (Pratt 1963). Several investigations implicate that both chiggers and Laelapinae mites can transmit Hantaan virus to rodents in laboratory and field examinations. This viral pathogen causes HFRSV (hemorrhagic fever with renal syndrome) in human through inhalation of aerosols of small mammals feces although their vector competence is still unfamiliar (Yu and Tesh 2014). Among Opilioacaridae, 3 genera have been described in the new world: *Neocarus*, *Opilioacarus* and *Caribeacarus* (Vazquez and Klompen 2009). In conducted researches, these species were observed in the regions with warm climates (Vazquez and Klompen 2015). This family was determined on commensal rats in the present publication. *Pachylaelaps* spp. (Pachylaelapidae) was removed from Murid rodents. This genus has been collected from soil and decomposing organic matter in Iran (Ahadiyat et al. 2014). Pachylaelapid mites are free-living soil mites consist of 16 genera with 230 species in throughout the world. They were found in organic substances, soil, decaying wood and plant material as well as nests of mammals and birds (Masan and Halliday 2014; Ozbeka 2015; Masan et al. 2016).

Ticks

Ticks as the competent vectors transmit the infectious disease to human, domestic and wild animals including

Rocky spotted fever, Lyme disease, Babesiosis, Theileriosis, Dermatophilosis and Issyk-Kul fever virus (Fuente et al. 2008; Lindquist et al. 2016). Ixodidae transmits rickettsiae to the next generation by the transovarial mechanism. In addition, they acquire bacteria via transstadial direction from a stage to another stage during feeding practice or localization of rickettsia in the salivary glands. This approach deals with pathogen circulation between vector and host to host (Parola et al. 2005). Hard ticks array within two lineages (the Prostriata and Metastriata) belong to Ixodidae family. The Metastriata group consists of 4 subfamilies: Amblyomminae, Haemaphysalinae, Rhipicephalinae and Hyalomminae. Similarly, Rhipicephalinae includes 9 genera e.g. *Rhipicephalus*, *Dermacentor*, *Margaropus*, and *Boophilus.* (Beati and Keirans 2001). Ticks have been assigned many studies in Iran, including the Ixodidae and Argasidae families. In the case of Ixodidae, *R. norvegicus* was a unique host for *Ixodes ricinus* in Iran so far. This species is the most widespread tick in central Europe (Sekeyova et al. 2000). Besides, it was reported to be positive for *Rickettsia raoultii, R. monacensis* and *R. Helvetica* by real-time PCR (Obiegala et al. 2016). In Poland, *Ixodes* (*I.*) *ricinus* was more reiterative ticks pertaining to bacterial infections like human granulocytic anaplasmosis (HGA) and Lyme borreliosis (LB) (Grzeszczuka et al. 2006). Subsequently, Granulocytic ehrlichial (GE) DAN was detected by the molecular method in both *Ixodes ricinus* and wild small mammals (*Apodemus sylvaticus*, *A. flavicollis*, *Sorex araneus*) mainly *Clethrionomys glareolus* in Switzerland (Liz et al. 2000). *Babesia microti* (the rodent parasite) and *Babesia divergens* as the causal haemoprotozoan of human babesiosis were demonstrated in *I. ricinus* (nymphal and adult stages) by PCR assay in Europe (Duh et al. 2001; Skotarczak and Cichocka 2001). *B. divergens* as a zoonotic protozoan causes bovine babesiosis in cattle (Zintl et al. 2003). Other species of Ixodidae, *I. trianguliceps* was typically associated with Persian jird in the present study. Also, this tick was a vector of human anaplasmosis. In other respects, it manages the transmission of *Anaplasma phagocytophilum* and *B. microti* to rodents communities under natural conditions (Bown et al. 2008). The genera *Boophilus* currently has been categorized within the subgenus of Rhipicephalus which subdivides into five species as follows: *R.* (*Boophilus*) *annulatus*, *R.* (*B*) *decoloratus*, *R.* (*B*) *geigyi*, *R.* (*B*) *kohlsi* and *R.* (*B*) *microplus* (Lempereur et al. 2010). These have been proven as vectors of Babesiosis in livestock and wild animals (Oliveira-Sequeiraa et al. 2005). *Gerbillinae* has hosted Boophilus ticks in the recent data. *Rhipicephalus Sanguineus* (the brown dog tick) has been indicated to be a vector/reservoir of *Rickettsia conorii* and *Ehrlichia canis* (Dantas-Torres 2008). This specimen has been confirmed as a vector of *Theileria* spp., Babesia spp. and *Anaplasma marginale* parasites in Iranian sheep (Ranjbar-Bahadori 2003; Khayat-Nouri and Hashemzadeh-Farhang 2011; Farzinnia et al. 2012;) also it has been accepted to be a significant vector of *Ehrlichia canis* (responsible for canine monocytic ehrlichiosis) (Bremer et al. 2005) as well as spotted fever group rickettsia in Nearctic zones (Burgdorfer et al. 1975). Haemaphysalis (166 species) is distributed throughout the world and it acts as the vector of tick-borne diseases such as Kyasanur Forest disease, tick-borne encephalitis virus (Far Eastern subtype) and Rickettsioses (Ahantarig et al. 2011). This genus has less propensity to bite humans (Duh et al. 2006) but it has been indicated to be the vector of *Babesia major and B. bigemina* (protozoan parasites) in animals (Yin et al. 1996). Indeed, it found in vast species e.g. *Haemaphysalis parva, H. sulcata, H. choldokovskyi, H. concinna*, *H. numidiana, H. inermis* as well as *H. punctate* that they have infested domestic animals (cattle, sheep, goats and camels) in mountainous regions adjacent to the Caspian Sea, Iran (Rahbari et al. 2007; Hosseini-Chegeni et al. 2014; Hosseini-Vasoukolaei et al. 2010). Haemaphysalis ticks collected from *M. musculus, M. persicus* and *N. indica*. *Haemaphysalis erinacei* was often found on the hosts as follows: hedgehog, bat, rodents (*Meriones* spp.) and fox cub (Hosseini-Chegeni et al. 2014**).** Compared with the recent survey, house mouse and *R. norvegicus* have hosted *H. punctate in* Ukraine (Akimov and Nebogatkin 2012). The genera *Hyalomma* has been considered to be the major vector of Crimean-Congo hemorrhagic fever (CCHF) virus and *Nairovi*rus transmits through close contact with contaminated blood and tissues of vertebrates (Maltezou et al. 2010). Also this ixodid tick has been gathered from domestic ruminants within variant species including: *Hyalomma dromedarii*, *H. marginatum, H. anatolicum, H. detritum, H. asiaticum, H. rufipes* and *H. excavatum* in the whole of Iran (Yakhchali and Haji hasanzadehzarza 2004; Fakoorziba et al. 2006; Nasiri et al. 2010; Salim-abadi et al. 2010; Hosseini-Chegeni et al. 2013; Mirzaei and Khedri 2014). Strikingly, *Rhipicephalus sanguineus*, *H. marginatum*, *H. anatolicum*, *H. asiaticum* and *H. dromedarii* species have been considered as the reservoirs/vectors for CCHF virus in Iran (Telmadarraiy et al. 2015). It is noteworthy that the CCHFV genome newly was isolated from *Rhipicephalus appendiculatus* by RT-PCR in Iran but more researches are needed to discriminate vectorial capacity of this species (Fakoorziba et al. 2015). CCHF is an endemic disease whereas Sistan-Balouchistan, Isfahan, Fars and Khuzestan are the more involved focus in Iran (Alavi-Nainia et al. 2006; Chinikar et al. 2010). Notably, *Tatera indica* has shown to be positive for tularemia by serological test (Pourhossein et al. 2015) coupled with the point that definitive reservoir is not explicit in Iran (Zargar et al. 2015). Ixodid ticks have been proposed as the vector of *Francisella* (*F.*) *tularensis* for man namely *Dermacentor* (*D.*) *andersoni, D. variabilis,* and *Amblyomma americanum. Dermacentor marginatus, D. reticulatus,* and *Ixodes* (*I.*) *ricinus* ticks were suspected vectors for this bacteria. (Gehringer et al. 2012). On the other hand, *Francisella tularensis* serves as the most biological agent in the weapons of mass destruction (WMD) (Sjostedt 2007). In this literature Argasid soft tick wasn't observed on rodent bodies directly but *Ornithodoros* and *Argas* genera have been collected from human place, domestic animal corrals and poultry farms (Nabian et al. 2007; Enayati et al. 2012; Mohammadi et al. 2013; Aghighi et al. 2007; Telmadarraiy et al. 2004; Moradi et al. 2009; Banafshi et al. 2004). Soft ticks have been clarified as certain vectors for TBRF (Tick-borne relapsing fever) infection. This disease has been described to be an endemic disease in rural regions of many provinces such as Hamadan, Zanjan, Kurdestan and Qazvin in particular Ardabil in northwestern Iran (Masoumi-Asl et al. 2009; Moemenbellah-Fard et al. 2009; Rafinejad et al. 2012).

Lice

Lice (Phthiraptera) divide into 4986 genus/species within 4 sub-orders: Anoplura, Amblycera, Ischnocera and Rhynchophthirina. They can infest mammals, birds and many classes of animals (Kenis and Roques 2010). Trench fever, Epidemic typhus and louse-borne relapsing fever (LBRF) are associated with lice (Raoult et al. 1999). In terms of the genus Polyplax, it had a wide host spectrum in Iran (Table 1). For instance, *Rattus norvegicus* was specialized host for *Polyplax spinulosa* (spiny rat louse) in Iran similar to other studies (Koyee et al. 2011; Sanchez-Montes et al. 2013). This louse is cosmopolitan parasitic arthropod collected from *Ratt* spp. in all continents as follows: *R. exulans*, *R. nitidus*, *R. norvegicus*, *R. argentiventer*, *R. tanezumi* and *R. rattus* (Durden and Page 1991; Durden and Musser 1994; Durden et al. 1997). It can transmit Haemobartonella muris from rat to rat (Crystal 1958). *Polyplax paradoxa* occurred on *M. persicus*, *P. gerbilli* on Norway rat and *T. indica*, *P. serrata* on *M. musculus*, *P. stephensi* on *T.indica*, *P.* asiatica on Persian jird, Indian jird and *Spermophilus fulvus* as well as *Polyplax* spp. on *Scuirus anomalus*. Substantially, *Polyplax serrata* can transmit *Eperythrozoon coccoides* (EC) to mice (Reeves and Cobb 2005). Remarkably, *Polyplax paradoxa* was found on *Meriones crassus* (Durden and Musser 1994). *Gerbillus pyramidum* harbored *P. gerbilli* in Egypt (Happold 1968). *Polyplax indica* appeared on *Golunda ellioti* (the Indian bush rat) (Mishra and Kulkarni 1974). *Eulinognathus* spp. on polyplacidae is ectoparasite of the desert rodent, *Allactaga* spp. in Iran up to now. *Eulinognathus americanus* associated with *Ctenomys talarum* (tuco–tuco) in South America (Martino et al. 2015). *Neohaematopinus* spp. (Hoplopleuridae) was observed on *M. persicus* and *M. socialis* in this information. At least 31 species/subspecies of this genus have been recognized in Holarctic and Asian regions (Shinozaki et al. 2004). More publications have quoted that *Neohaematopinus* species was closely associated with squirrel, *N. appressus* (flying squirrels) (Johnson 1972a), and *N. sciuri* from the grey squirrel (O'Connor et al. 2005) as well as N. *callosciuri* from Pallas squirrel (*Callosciurus erythraeus*) (Shinozaki et al. 2004). Among the *Hoplopleura* species, *H. captiosa and H. oenomydis* (the tropical rat louse) were presented on *N. indica, M. musculus, R. norvegicus* and *R. rattus* at this point. It is apparent that the genus *Hoplopleura* has been distributed widely in geographical territories. *Hoplopleura hirsute* was isolated from cotton rats, *Sigmodon* spp. in the U.S (Kucera et al. 2007) also another species of *Hoplopleura*, *H. acanthopus* from *lasiopodomys* (Kristofik 1999)*, Microtus longicaudus* (the long-tailed vole) and *Microtus montanus* (vole) (Hansen 1964). Other records have been described within various landscapes. *Hoplopleura cornata* was found on *R. cornatus* in Australia (Kim 1972), *H. pahari* on *Mus pahari* (Johnson 1972b), *H. captiosa* on *Mus cervicolor,* Thailand (Kim 1966) *H. ramgarh* on *Mus platythrix*, India (Mishra et al. 1972) *H. oenomydis* on (black and Norway rats) (Pratt and Karp 1953) and *H. pacifica* on *R. norvegicus* lastly (Gomez 1989).

Interaction of host-parasite within diversity, density, habitat, climate and host indices

Parasites affect the reproductive, survival dynamic of hosts as well as host dispersal pattern (Heeb et al. 1999) Also, they increase the mortality rate of the juvenile host rodents (Hawlena et al. 2006). As discussed above Muridae was an important group of rodent host that has been diversely adapted to the all geographical regions of Iran. For instance, *R. norvegicus* and black rat have a large-scale distribution along with coastal provinces like Mazandaran, Hormozgan and Bushehr. They are extended to the central parts recently. *Meriones persicus* as a nocturnal jird has been permanently presented in semi-desert areas except Dasht-e Kavir desert. *Tatera indica* digs burrow contiguous with the grasslands and human dwelling that was found in Southeastern Iran. *Meriones lybicus* (Libyan jird) was a preponderant host in every part of Iran particularly Yazd and Fars provinces. Until recently, there is no record of this species from the Northwestern and forest regions. *Rhombomys opimus* or great gerbil was more a sociable rodent that was occurred in sandy and clay deserts. It has been reported from Northeastern (Khorasan and Golestan zones) and central districts of Iran (Sedaghat and Salahi-

Moghaddam 2010a, b; Zarei et al. 2010, Dehghani et al. 2013). Murid mammals have been determined as the natural reservoirs of Zoonotic cutaneous leishmaniasis infection (ZCL). For example, *Rhombomys opimus* is documented as the major reservoir of ZCL in central and northeast; *M. libycus*, *T. indica* and *N. indica* in the center towards southwest Iran (Mirzaei et al. 2011; Ghaffari et al. 2013). As a consequence *Meriones persicus* is the frequent host for Pulicid fleas in Iran (Maleki-Ravasan et al. 2017) followed by *M. musculus* and *C.migratorius* (Cricetidae). *Pulex* irritans from Pulicidae is spread in particularly west of Iran that is known as an endemic foci of plague. *Xenopsylla buxtoni*, *N. fasciatus* and *Haemaphysalis* (tick) had a wide host spectrum. It appears that these are heteroxenous parasites because they can shift their mammalian hosts within the life cycle repeatedly (Whiting et al. 2008). Switching from small mammals to bird hosts was also seen in fleas pertaining to ecological characteristics but up to 94% of fleas species principally parasitize mammals and insectivores (Krasnov 2008). It is postulated that fleas are may be considered as the host-opportunistic parasites into two forms; locally or high alpha-specificity (a particular district where parasites may exploit the available of host species) (Krasnov et al. 2011). Additionally, more perspective works are necessary to decipher the mechanism of host speciation in parasites. The genealogy of parasite genome can orient toward the evolutionary process into speciation point (Nieberding and Olivieri 2006). Surveys showed that the fleas population grow according to hosts propensities under the environmental condition (Rafinejad et al. 2013; Moemenbellah-Fard et al. 2014). Consequently, micro climatic factors (e.g. humidity and temperature) can affect the survival of juvenile fleas in their habitat (Krasnov et al. 2001). Fleas are strongly susceptible to lack of humidity in their sites also they can spend off-host without blood meals around 89 days (Cox et al. 1999). The Pattern of parasitism is perplexed view related to sexual dimorphism, the scheme of seasonality burdens and body mass of host species (Krasnov et al. 2005; Kiffner et al. 2013). This review was shown that Sistan-Baluchistan and Khuzestan provinces had the similar ectoparasites richness may be due to the same climatic and environmental requirements of species (Rahdar et al. 2015; Nateghpour et al. 2013; Krasnov et al. 2010). Therefore, understanding the ecological models of *Hyalomma* ticks can help us to control of CCHF disease (Ansari et al. 2014) in these provinces. Accordingly, domestic vertebrates (sheep, goat, cattle and cow) was considered as the primitive hosts also Rodentia was alternative hosts for ticks in Iran (Telmadarraiy et al. 2004; Rahbari et al. 2007; Nabian et al. 2007; Salari-Lak et al. 2008; Mohammadi et al. 2013). There is an increasing belief that Ixodes ticks (particularly *Hyalomma* spp.) commonly existed throughout the months, but more frequent in spring and late autumn while Argasid ticks exhibited exclusively in autumn to late winter in Northwestern Iran (Rahbari 1995; Salari-Lak et al. 2008; Bahman Shabestari and karimian 2011). Other ectoparasites groups such as *Polyplax spinulosa* (sucking louse) and *L. nuttalli* (mite) infested rodents in autumn and spring respectively (Telmadarraiy et al. 2007). As such, seasonal tick activity had two major peaks, one in early summer and the other one in autumn in accordance with the environmental temperature in addition, ticks were less susceptible to relative humidity fluctuations (Hussein 1980). Each kind of seasonal alternation affects the preferred host species in ticks relating to their biome (Randolph and Rogers 2007). *Boophilus annulatus* and *I. ricinus* (on domestic ruminants) are disturbed only in the regions with the highest percentage of forest cover in Iran (Nabian et al. 2007) also many tick species such as *Ornithodoros* and *Rhipicephalus* are more prevalent in the case of numbering in mountainous suburbs compared with plateau areas (Telmadarraiy et al. 2004). Alborz mountain range has steppe climates, which lies between south of the Caspian Sea and plateau (Darvish et al. 2014). Prevalence of rodents and related ectoparasites was high in some fragments containing organic supplies but they was had less parasites diversity (Hamidi et al. 2015). Access to food resources affect the evolutionary aspects within host–parasite linkage (Tschirren et al. 2007). It is remarkable that the greater degree of homogeneity within ecological components in habitat of sociable rodents reduce macroparasites diversity (Bordes et al. 2007) and increase host density (Froeschke et al. 2013). Notably, Host tendency within biased parasitism has been assigned periodically in many studies (Gorrell and Schulte-Hostedde 2008; Morand et al. 2004; Perez-Orella and Schulte-Hostedde 2005). Immunosuppression, Social reaction and stable temperature during the reproductive time induce parasite load in female than male (Christe et al. 2007). Additionally, most female ectoparasites have active selection to host gender for feeding therefore they adapt to male host greatly (Khokhlova et al. 2011). There are well known hypotheses for interpretation of this phenomenon. First, high level of androgenic hormones (e.g. testosterone) can depress immune system in male hosts and increase the predisposition to parasitism (Mougeot et al. 2006). Male host grooms less than female during the reproductive seasons because of the suppressive impact of testosterone (Mooring and Hart 1995). This hormone lead to more mobility of host within its home range thereby, it obtain high infestation rate of parasite (Hughes and Randolph 2001). Secondary outcome focus on the sexual size dimorphism (SSD) refers to individual males that more likely harbor greater parasites as many of mammalian males have the high body mass than females (Harrison et al. 2010). There is no simple mechanism to this affair actually. Besides, difference in ectoparasitism may result from variant model of parasite behaviour based on occupied burrows between males and females (Waterman et al. 2014). In this review two independent ectoparasites (*O. bacoti* and *H. oenomydis*) coexisted on *R. norvegicus*. Perhaps host defence has the important role in the interactions between rival species and organizes co-occurrence of parasite communities (Bush and Malenke 2008). Mites were more diverse than others may be due to their small size body compared with other taxa (Walter and Proctor 2013). This finding was obviously shown that *P. spinulosa* was strictly host-specific to Rat species. In the following, Haematophagous lice have certain morphological traits within claw structure that adapted to their host body and hair size. For this reason, they are mainly host-specific and rarely attach to each other individuals hair (Cannon 2010; Zuo et al. 2011). Unfortunately, few studies have been carried out concerning to host-ectoparasite aspects in Persia thereby, the ecological, seasonality, diversity and host speciation dimensions are still equivocal approximately. Obviously, it should be employed more genetic and phylogenic studies about the identification of ectoparasites within subfamilies or sub-species levels to incorporate a comprehensive picture of parasite-host association. Authorities importantly scrimmage with two emerging diseases. Tick-borne relapsing fever is the more predominant disease in the highland mountainous regions and CCHF cases have been more reported from southern, central and western Iran. Although, plague cases has not been reported since long time ago but related fleas species have been occurred on captured rodents in Bijar County (the earlier district of plague) frequently. Strikingly, Alborz and Zagros mountains ranges provide the specialized habitat for animals that are enclosed by northern and western regions as well as Kavir and Dasht-e Loot deserts in central plateau toward south of Iran. Besides, the Iranian mountains can prohibit gene flow between local mammalian communities thus lead to generate the populations with different gene pool. Also this event raise the genetic variation into sympatric/allopatric speciation probably. In addition to, human interventions in nature within urbanization or agricultural activities induce many uncontrolled changes in animal life history and vector-borne diseases. For instance, these modifications affect longevity, diversity, microclimate, density and adaptive host in ectoparasites. Also they impress the habitat, abundance, spatial distribution and supply accessibility in hosts by different methods (Friggens and Beier 2010).

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Compliance with ethical standards

Conflict of interest This paper hasn't received financial interests by any organization, corporation or university.

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