

Review Article

Aquatic Insect from Iran for Possible Use of Biological Control of Main Vector-Borne Disease of Malaria and Water Indicator of Contamination

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Abstract

Iran has a wide variety of zoogeographical regions and different seasons. Here are some important mosquito-borne diseases. Mosquitoes normally live in waters. Its aquatic insect fauna is highly unexplored. To being resolved this faunal gap, a variety of literature records from previous century in different parts of Iran was reviewed. In some southern and southeastern foci in Iran, Malaria is still a main endemic disease which is unstable with two seasonal spring and autumn peaks even though Iran is lurching Malaria elimination. This review article showed the wide variety of aquatic insects throughout the country. Researchers can discuss water pollutant and its quality by using aquatic insect fauna as well as biological control for vectors. Types of aquatic insects and macroinvertebrates sampling can be useful for water quality monitoring as indicators. Looking at aquatic insects' life in water could be one of the most cost-effective and the easiest method to assess the water contaminations by different pollutants and will provide a guideline for scientific communities and environmental agencies for decision making.

Keywords: aquatic insects, Arthropod-borne diseases, Iran, water quality

Introduction

There are some important arthropod-borne diseases in Iran including Malaria, Cutaneous leishmaniasis, Visceral leishmaniasis, Crimean-Congo hemorrhagic fever, tick relapsing fever, Furthermore scorpions are one of the risk factors for life in some parts, while other arthropod-related diseases such as myiasis exist more or less across the country. Some probable Arthropod-borne disease in the future may be: Q-fever, Papatasi fever, Tularemia, Rift valley fever, Dengue fever, Yellow fever, West Nile viruses, Lactodictism (spider bite), Plague, scabies, Nuisance insects of horseflies and Culicidae mosquitoes, Cockroach-borne diseases, damages by fire ants, blister beetles and bee stings.

In Iran with about 15000 annual cases of the disease in recent years, malaria is known

as one of the most important parasitic infectious diseases. Locally transmitted cases have dropped to 500 recorded cases in 2013. Three most prevalence provinces in Iran are Sistan-Baluchestan, Hormozgan and Kerman which located in south and southeastern part of the country. The rifest route of transmission is immigration from Afghanistan and Pakistan to this area (Ministry of Health, annual report). You can find a considerable decline of malaria burden in Iran during last 20 years. The disease cases have been reduced from about 100000 cases in 1991 to 246 autochthonous cases in 2014. Most of the transmitted cases are reported from the south-eastern part of the country that is related to population traffic across Pakistan border beyond the difficulties in malaria control. Recent malaria number

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reported is 42 cases all over the country including 23 local malaria patients, 12 imported cases and seven relapsed ones before August 2016. Majority of researchers have worked on various aspects of malaria such as insecticide resistance monitoring (1-10) new records, sibling species and molecular studies (11-18). Some researchers have worked on vector control using novel methods (19-24), faunistic study (25-26), Larval control using various plants (3, 27-38), using bed nets and long lasting impregnated nets (39-46), Study on morphology (47-49), Malaria epidemiology (50-54) Malaria vector ecology (18, 39, 52, 55-60), Biodiversity (53, 61), Community participation (62), Vector control (63), Repellent evaluation (31, 64), susceptibility against insecticide (65-67), Anthropophilic index of malaria vectors (68-69) Training (70) is nominated as malaria training center by WHO researchers also can find several reports on different aspects of malaria vectors done in recent years (21, 71-87).

Although Iran has a vast geographical area with a wide range of diversity in climate and animal including insects, its aquatic insect's fauna remains largely unexplored for years. With a total area about 1.65 million Km², around 7% covered with water- Iran is one of the large countries ranked eighteenth in the world (88-89). The aquatic insect has a critical role in biomonitoring of water safety or water contamination. It is inevitable to use such kind of insect to evaluate water quality as a biological indicator and can help us as water resource management. Aquatic insects a vital role in energy flow in fresh water and they are important in food web between aquatic animals.

Historical overview of Aquatic Insects from Iran

Past century

Iran aquatic insects have been studied since 1965 by a hand full of researchers. Vassil

Gueorguiev recorded *Methles rectus* from Iran, but he did not publish the exact location (88). Afterwards, in 1976 some researcher from another field such as environment researchers who surveyed on mayfly and stonefly to determine the acute metal toxicity of some heavy metals such as lead, copper, zinc, and silver. They were found more tolerant than most fish to heavy metals. This study indicated that aquatic insect can help us as effective biological monitors of heavy metals pollution (91). Subsequently a survey was conducted on water beetles of Southwestern Iran and reported Haliplidae (two genera, two species), Dytiscidae (16 genera, 24 species), and Gyrinidae (two genera, two species). Hydrophilidae (10 genera, 34 mostly unidentified species) (92). A researcher from a university of Shiraz focused on life history, morphology and behaviour of the immature stages of a coleopteran, Hydrophilidae in laboratory condition (93). After about 20 years of water beetle collecting from a wide range of area, habitat and provinces in Iran founded a small number of *M. rectus* sharp in a few places in Guilan Province in a collection made in 1976, 1993 and 1995 in Southern part of Caspian Sea, northern Iran (94).

Current century

During 2000–2002 a study on aquatic beetle of Tabriz region, East Azarbaijan, North-western Iran was conducted and four species out of five species of the family Hydraenidae reported a new record (95). During 2001–2005 some specimen collected by Vafaei et al. (96) in Markazi Province central Iran and they established the presence of 24 species of aquatic beetles (Coleoptera: Polyphaga) belonging to 13 genera and five families. In other publication, they claim that they found 33 species of diving beetles belonging to 18 genera during same time and same places (97). In 2005 another team worked on a descriptive study of aquatic insects' fauna in Kashan, central Iran. During nine rounds of sampling from four maturation artificial ponds they reported as fol-

lowed: Diptera order (52%), including Chironomidae and Culicidae families, Hemiptera (24%) Corixidae, Notonectidae, Copepodae and Copepodidae families, Ciclopodidae (12%), Hydroacarina (9.5%), Coleoptera (0.77%), Arachnida (0.67%), Hymenoptera (0.58%), Odonata (0.48%) (98). In another publication, 31 different Plecoptera reported from different families and two families of Ephemeroptera (99).

During 2006 and 2007 39 species have been found belonging to 16 families in Zanjanrud, Zanjan Province. Three specimens belong to Lygaeidae, Scutelleridae and Reduviidae were identified at the genus level. Among them, there are some predators' species such as *Anthocoris nemorum*, *Nabis pseudoferus*, *Notonecta viridis*, *Velia affinis*, *Gerris maculatus*, *Hydrometra stagnorum*. The most frequent Species belonged to Pentatomidae. All species were first records from the Zanjan Province (100).

Some families of Coleoptera such as Dytiscidae, Gyrinidae, Helophoridae and Hydrophilidae with a new record and notes on the rare species *Coleostoma transcaspicum* Reitter, 1906 from North part of Tehran Province was reported (101). Work on Odonata as effective predators in the rice field and other sites in Mazandaran Province North of Iran (2003–2006). They found 30 species from 19 genera and eight families of Odonata (Anisoptera and Zygoptera suborder. In Anisoptera suborder, Aeshnidae, five species, one species of Corduliidae, two species of Gomphidae, 13 species of Libellulidae. In Zygoptera suborder, one species of Calopterygidae, six species of Coenagrionidae, one species of Euphaeidae, one species of Platycnemididae (102). A survey in Zayande Rud River in Esfahan Province, central Iran during one year and in eight stations who found that the water quality can have an effective impact on diversity and richness of benthic macroinvertebrate (103) recorded total of 47 species belonging to 17 Families of Heteroptera in Ghara Dagh forest, East Azarbayjan, Northwestern Iran: Among them,

the species *Nabis pseudoferus*, *Notonecta viridis*, *Anthocoris nemorum*, *Velia affinis*, *Hydrometra stagnorum* and *Gerris maculatus* were predators. The most abundant species belonging to Pentatomidae. They reported 32 species as new records for the studied area. Newly introduced species, *Stinctopleurus crassicornis* and *Stinctopleurus punctatonevrosus*, registered for Iran insect fauna (104).

In another study that carried out in East Azarbaijan Province on Heteroptera, they found 28 species from 12 families and *Polymerus brevirostris* Knight, 1925 was a new record (105). In Ardabil East Azarbaijan Province Northwestern Iran. Two species of aquatic beetles belonging to two genera that did not study before from two sampling site during 2000–2008. They faced *Peltodytes* Regimbart, 1878 and *Halipplus* Latreille, 1802 (106). A species *Halipplus heydeni* Wehncke, 1875 was a new record of Iran. In another teamwork in Neka County, the Mazandaran Province, Northern Iran five species of four genera were found in tree holes during 2009. They reported *Anopheles plumbeus*, *Culisetaannulata*, *Culex pipiens*, and *Ochlerotatus geniculatus* by larval collection, *Ochlerotatus pulcritarsis* by adult collection and *Oc.geniculatus*, 55.87%, *Ochlerotatus echinus* 1.33%, *Oc. pulcritarsis* 8.8%, *Cx. pipiens* 33.8%, and *An. plumbeus* 0.2% of bait net collection. They found some *Cs. Annulata* larvae in low abundance in cavities of trees for the first time (61). During 2008–2009 İncekara et al. (107) collected 42 species of aquatic beetle (Coleoptera: Hydrophiloidea) belonging to 13 genera and three families (Helophoridae, Hydrochidae and Hydrophilidae) in Tehran, Mazandaran, Guilan, Qazvin, and Sanandaj in Kordestan Provinces in Iran. They reported 11 new species from Iran in this survey. During 2009–2011 on the work on the aquatic insect of Karun River, Ahvaz, Khuzestan Province, Southwestern Iran revealed Damselflies and Dragonflies nymphs of Odonata order, five genera from four families and all of them were the new records from this area.

Recent years

These days we are able to find some more articles about Iran aquatic insects that worked in a wide range of natural areas (Fig. 1). It seems more researchers know the importance of aquatic insects as biological control and water indicator and they are interested in investigating on them. In 2011 Salavatian et al. who worked on feeding behavior of Brown trout, *Salmo trutta fario*, published a paper that shows us this fish fed on 32 animal groups including some insects such as Chironomidae (88.6%), Simuliidae (60%), Baetidae (51.4%) and Tipulidae (50%) that they were most frequent food in its gut. They showed that the proportion of consumed food by Brown trout was Diptera 91.5% (Chironomidae pupa and larvae 85.8%), Coleoptera 6.4% and others 2.1% (109). Other team surveyed aquatic insects' fauna of Karun River, Ahvaz City, Khuzestan Province, Southwest of Iran. They reported 57 species belonging to seven orders and 22 families, Collembola (1 species), Ephemeroptera (4 species), Odonata (6 species), Hemiptera (9 species), Coleoptera (34 species), Diptera (2 species) and Trichoptera (1 species). The most abundant species in this study was the beetle *Hydroglyphus signatellus* Klug, 1834 (Coleoptera: Dytiscidae) (110). An Ecological Risk Assessment (ERA) for Shadegan wetland, Khuzestan Province, Southwest of Iran to assess the risk to zooplankton, phytoplankton, invertebrate, insect larvae, and fish affected by Five pesticides, DDT, Aldrin, Dieldrin, Lindane and Ametryn. Insect larvae (*Chironomus* sp) like other creature are highly at risk of harmful pesticide were conducted (111). Study on Tajan river macroinvertebrate communities' distribution in Mazandaran Province, Northern Iran and south part of Caspian Sea. They realized that the dissolved oxygen, turbidity, water temperature, pH and TSS were the most critical physicochemical factors to affect the distribution of them (112).

Work on the potential aquatic habitats for

Anopheles larvae from Indian Remote Sensing Satellite (IRS) image and digital elevation model of the area using GIS by monthly sampling from Surface water bodies during 2009–10 for anopheline larvae carried out. The lowest and highest frequencies were in February and April, respectively. *Anopheles culicifacies* was Dominant species (53). In a study conducted in Gahar Lake, Lorestan Province in three different seasons they found most and least variety and abundance in spring and autumn respectively. Maximum density belonged to Simuliidae and Chironomidae (113).

Ghahari collected, identified and published about 19 species from nine genera (Micronecta, Corixa, Sigara, Aquarius, Gerris, Hydrometra, Anisops, Chartoscirta, Saldula) of aquatic and semiaquatic Heteroptera from the families Corixidae, Gerridae, Hydrometridae, Notonectidae, Saldidae from southern areas of Caspian Sea, Northern Iran (114). From 16 different sites in Iran, 23 nominal species are now identified, including some new records for *Simulium crassicaulum* (Rubtsov) and *Simulium alajense* Rubtsov, and the southernmost world record for *Simulium transcaspicum* Enderlein in Iran. Multiple cytoforms of the *Simulium aureum* group, *Simulium bezzii* complex, and *Simulium ornatum* group were found (115).

Shaverdo et al. reported 21 species of diving beetles Dytiscidae from Ahvaz, Khuzestan Province, southwest Iran. *Cybister lateralim arginalisponticus*, 1882, *Hydroporus inscitus* 1882, and *Laccophilus sordidus* 1882 are reported from Iran for the first time (116). Shayeghi et al. reported a variety of aquatic orders, two families of Hemiptera (Gerridae and Notonectidae) Odonata (Coenagrionidae), Coleoptera (Carabidae), and pro stigmata from the family of Hydrachindae in Zayanderood, Esfahan Province, Central Iran during 2011 (117). In another study in the same area and the same year, they collected 741 specimens of aquatic insects including seven families

and 12 genera of two orders. The order of Diptera (92.31%) including Culicidae, Syrphidae and Chironomidae and Coleoptera (7.69%) including Gyrinidae, Dytiscidae, Halplidae, Hydrophilidae families (76).

Maleki-Ravasan et al. (118) conducted a bi-seasonal study in Lavasan River, North-eastern Tehran, the most abundant species between 14 families and 62 Trichoptera species belonged to the Hydropsychidae. They reported the presence of Annulipalpi *Hydropsyche sciligra* H Malicky, 1977 in that district. Habitat water quality of this species reported resemble human drinking water and presence of *Physa acuta* (snail) and *Capoeta buhsei* (fish) in the sampling area indicated inferior quality. Darilmaz et al. listed 27 species and subspecies of 17 genera of the families Dytiscidae, Halplidae, Noteridae and Gyrinidae (Coleoptera: Adephaga) from Alborz, Gilan, Mazandaran, Qazvin, and Tehran Provinces northern Iran (119). A total of 9 families in Shapoor River in Bushehr region during 2012 (120).

Researchers evaluated aquatic insects' fauna in Golestan Province, North of Iran in different sites during 2011–2012. They published different stages of Diptera 64.54% (Culicidae, Chironomidae, Tabanidae, Simuliidae, Sciomyzidae families), Heteroptera 11.03%, Ephemeroptera 9.53% (Heptagenidae, Baetidae), Trichoptera 7.07% (Limnephilidae), Odonata 4.82% (Aeshnidae, Gomphidae, Libellulidae) and Coleoptera 2.99% (Dytiscidae, Gyrinidae) in this study. They reported some water surface insects such as Gerridae, Corixidae, Hydrometridae, Nepidae families (121). A study in Karaj River, North of Iran. 211 samples of three orders; Plecoptera, Trichoptera and Ephemeroptera and seven genera (*Perla*, *Isoperla*, *Hydropsyche*, *Cheumatopsyche*, *Baetis*, *Heptagenia* and *Maccafferiium*) from five families (Perlidae, Perlodidae, Hydropsychidae, Batidae, Heptagenidae) were found. Order of Plecoptera was the most predominant order then Trichoptera (122). Investigated biodiversity of culicid mosquitoes from Keka re-

vealed 5270 specimens belonging to four genera and 14 species in Northern Iran. They reported one dominant species, two dominant species, two subdominant species, two rare species and eight sub rare species by using Heydemann classification (123). Southwest of Iran, Bashagard district is one of the most important areas because of Malaria transmission collected research conducted revealed totally 5150 larvae from 36 different larval habitats. They recorded six species: *An. culicifacies* (29.36%), *An. moghulensis* (25.20%), *An. dthali* (18.02%), *An. superpictus* (17.24%), *An. turkhudi* (5.17%) and *An. stephensi* (5.01%). They investigated water quality and they stated abundant Anophelin larvae existed in permanent and full sunlight habitat with no vegetation and algae. Larval density had the correlation with water temperature. Some factors also had the specific impact on larval abundance and distribution such as conductivity, total alkalinity, chloride and sulphate. Knowing of this data and correlation between them can be considered for sufficient planning and implementing Malaria elimination program (124). In Bashagard area epidemiological and entomological aspects to determine malaria situation, species composition of anopheline mosquitoes and susceptibility status of main vectors to insecticides/ larvicides during 2002–2010 were conducted. They have reported *An. culicifacies*, *An. dthali*, *An. stephensi*, *An. superpictus*, *An. fluviatilis*, *An. moghulensis*, *An. turkhudi* and *An. apoci* with two peak in April and October. They have found resistance against DDT in *An. stephensi* and tolerance against Deltamethrin and Bendiocarb. Their larvae found susceptible against all larvicides except for *An. stephensi* with tolerance against Fenthion (125). In summer 2014 Shayeghi et al. carried out a study in Sabalan mountainous river, in different sites around Meshginshahr, Ardabil Province, Northwestern Iran. They reported six orders (Coleoptera, Ephemeroptera, Hemiptera, Diptera, Plecoptera and Trichoptera) including 12 families (Helmidae, Leptophlebiidae,

Ecdyonuridae, Corixidae, Culicidae, Simuliidae, Perlidae, Leptoceridae, Hydropsychidae, Chironomidae, Caenidae and Baetidae) among 262 specimens. They wrote that most abun-

dant families were Culicidae (61.55%) and a few number of Plecoptera: Perlodidae (0.5%) (126).



Fig. 3. Map of Iran showing some main rivers and natural events

Conclusion

This review article will provide a clue for management of vector control as well as indicators for water classification.

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References

1. Salari Lak S, Vatandoost H, Entezarmahdi M, Ashraf H, Abai M, Nazari M (2002)

Monitoring of insecticide resistance in *Anopheles sacharovi* (Favre, 1903) in borderline of Iran, Armenia, Naxcivan and Turkey, 2001. *Iran J Public Health*. 31(3–4): 96–99.

2. Enayati AA, Vatandoost H, Ladonni H, Townson H, Hemingway J (2003) Molecular evidence for a kdr-like pyrethroid resistance mechanism in the malaria vector mosquito *Anopheles stephensi*. *Med Vet Entomol*. 17(2): 138–144.

3. Vatandoost H, Vaziri VM (2004a) Larvicidal activity of a neem tree extract (Neemarin) against mosquito larvae in the Islamic Republic of Iran. *East Mediterr Health J*. 10(4–5): 573–581.

4. Vatandoost H, Mashayekhi M, Abaie MR, Aflatoonian MR, Hanafi-Bojd AA, Sharifi I (2005) Monitoring of insecticide resistance in *Anopheles sacharovi* (Favre, 1903) in the Islamic Republic of Iran. *Iran J Public Health*. 31(3–4): 96–99.

- ticides resistance in main malaria vectors in a malarious area of Kahnooj District, Kerman Province, southeastern Iran. *J Vector Borne Dis.* 42(3): 100–108.
5. Hanafi-Bojd AA, Vatandoost H, Jafari R (2006) Susceptibility status of *Anopheles dthali* and *Anopheles fluviatilis* to commonly used larvicides in an endemic focus of malaria, southern Iran. *J Vector Borne Dis.* 43(1): 34–38.
 6. Davari B, Vatandoost H, Ladonni H, Shaeghi M, Oshaghi M, Basseri H (2006) Comparative Efficacy of Different Imagicides Against Different Strains of *Anopheles stephensi* in the Malarious Areas of Iran, 2004–2005. *Pak J Biol Sci.* 9(5): 885–892.
 7. Davari B, Vatandoost H, Oshaghi M, Ladonni H, Enayati A, Shaeghi M (2007) Selection of *Anopheles stephensi* with DDT and dieldrin and cross-resistance spectrum to pyrethroids and fipronil. *Pestic Biochem Physiol.* 89(2): 97–103.
 8. Abai MR, Mehravaran A, Vatandoost H, Oshaghi MA, Javadian E, Mashayekhi M (2008) Comparative performance of imagicides on *Anopheles stephensi*, main malaria vector in a malarious area, southern Iran. *J Vector Borne Dis.* 45(4): 307–312.
 9. Vatandoost H, Hanafi-Bojd AA (2012) Indication of pyrethroid resistance in the main malaria vector, *Anopheles stephensi* from Iran. *Asian Pac J Trop Med.* 5(9): 722–726.
 10. Soltani A, Vatandoost H, Oshaghi MA, Enayati AA, Raeisi A, Eshraghian MR (2013) Baseline Susceptibility of Different Geographical Strains of *Anopheles stephensi* (Diptera: Culicidae) to Temephos in Malarious Areas of Iran. *J Arthropod Borne Dis.* 7(1): 56–65.
 11. Dezfouli SR, Oshaghi MA, Vatandoost H, Assmar M (2003) rDNA-ITS2 based species-diagnostic polymerase chain reaction assay for identification of sibling species of *Anopheles fluviatilis* in Iran. *Southeast Asian J Trop Med Public Health.* 34 Suppl 2: 56–60.
 12. Naddaf SR, Oshaghi MA, Vatandoost H, Assmar M (2003) Molecular characterization of *Anopheles fluviatilis* species complex in the Islamic Republic of Iran. *East Mediterr Health J.* 9(3): 257–265.
 13. Naddaf SR, Oshaghi MA, Vatandoost H (2012) Confirmation of Two Sibling Species among *Anopheles fluviatilis* Mosquitoes in South and Southeastern Iran by Analysis of Cytochrome Oxidase I Gene. *J Arthropod borne Dis.* 6(2): 144–150.
 14. Oshaghi MA, Sedaghat MM, Vatandoost H (2003 b) Molecular characterization of the *Anopheles maculipennis* complex in the Islamic Republic of Iran. *East Mediterr Health J.* 9(4): 659–666.
 15. Oshaghi MA, Shemshad K, Yaghobi-Ershadi MR, Pedram M, Vatandoost H, Abaie MR (2007) Genetic structure of the malaria vector *Anopheles superpictus* in Iran using mitochondrial cytochrome oxidase (COI and COII) and morphologic markers: a new species complex. *Acta Trop.* 101(3): 241–248.
 16. Sedaghat MM, Linton YM, Oshaghi MA, Vatandoost H, Harbach RE (2003) The *Anopheles maculipennis* complex (Diptera: Culicidae) in Iran: molecular characterization and recognition of a new species. *Bull Entomol Res.* 93(6): 527–535.
 17. Azari-Hamidian S, Abai MR, Ladonni H, Vatandoost H, Akbarzadeh K (2006) *Anopheles peditaeniatus* (Leicester) new to the Iranian mosquito fauna with notes on *Anopheles hyrcanus* group in Iran. *J Am Mosq Control Assoc.* 22(1): 144–146.
 18. Mehravaran A, Oshaghi MA, Vatandoost H, Abai MR, Ebrahimzadeh A, Roodi

- AM (2011) First report on *Anopheles fluviatilis* U in southeastern Iran. *Acta Trop.* 117(2): 76–81.
19. Soltani A, Vatandoost H, Jabbari H, Mesdaghinia A, Mahvi A, Younesian M (2008) Use of expanded polystyrene (EPS) and shredded waste polystyrene (SWAP) beads for control of mosquitoes. *J Arthropod Borne Dis.* 2(2): 12–20.
 20. Soltani A, Vatandoost H, Jabbari H, Mesdaghinia AR, Mahvi AH, Younesian M (2012) Field efficacy of expanded polystyrene and shredded waste polystyrene beads for mosquito control in artificial pools and field trials, Islamic Republic of Iran. *East Mediterr Health J.* 18(10): 1042–1048.
 21. Omrani SM, Vatandoost H, Oshaghi MA, Shokri F, Guerin PM, Yaghoobi Ershadi MR (2010a) Fabrication of an olfactometer for mosquito behavioral studies. *J Vector Borne Dis.* 47(1): 17–25.
 22. Omrani SM, Vatandoost H, Oshaghi M, Shokri F, Yaghoobi-Ershadi M, Rassi Y (2010b) Differential Responses of *Anopheles stephensi* (Diptera: Culicidae) to Skin Emanations of a Man, a Cow, and a Guinea Pig in the Olfactometer. *Iran J Arthropod Borne Dis.* 4(1): 1–16.
 23. Omrani SM, Vatandoost H, Oshaghi MA, Rahimi A (2012) Up wind responses of *Anopheles stephensi* to carbon dioxide and L-lactic acid: an olfactometer study. *East Mediterr Health J.* 18(11): 1134–1142.
 24. Chavshin AR, Oshaghi MA, Vatandoost H, Pourmand MR, Raeisi A, Enayati AA (2012) Identification of bacterial microflora in the midgut of the larvae and adult of wild-caught *Anopheles stephensi*: a step toward finding suitable paratransgenesis candidates. *Acta Trop.* 121(2): 129–134.
 25. Moosa-Kazemi S, Vatandoost H, Nikookar H, Fathian M (2009) Culicinae (Diptera: culicidae) mosquitoes in Chabahar County, Sistan and Baluchistan Province, Southeastern Iran. *Iran J Arthropod Borne Dis.* 3(1): 29–35.
 26. Oshaghi MA, Vatandoost H, Gorouhi A, Abai MR, Madjidpour A, Arshi S (2011) Anopheline species composition in borderline of Iran-Azerbaijan. *Acta Trop.* 119(1): 44–49.
 27. Hadjiakhoondi A, Aghel N, Zamanizadeh-Nadgar N, Vatandoost H (2000) Chemical and biological study of *Mentha spicata* essential oil from Iran. *DARU J Pharmaceutical Sci.* 8(1–2): 19–21.
 28. Hadjiakhoondi A, Vatandoost H, Jamshidi A, Amiri EB (2003) Chemical Constituents of Efficacy of *Cymbopogon Olivieri* (Boiss) Bar Essential Oil Against Malaria Vector, *Anopheles stephensi*. *DARU J Pharmaceutical Sci.* 11(3): 125–128.
 29. Hadjiakhoondi A, Vatandoost H, Khanavi M, Abai MR, Karami M (2005) Biochemical investigation of different extracts and larvicidal activity of *Tagetes minuta* L. on *Anopheles stephensi* larvae. *Iran J Pharmaceutical Sci.* 1(2): 81–84.
 30. Hadjiakhoondi A, Vatandoost H, Khanavi M, Sadeghipour Roodsari HR, Vosoughi M, Kazemi M (2006) Fatty acid composition and toxicity of *Melia azedarach* L. fruits against malaria vector *Anopheles stephensi*. *Iran J Pharmaceutical Sci.* 2(2): 97–102.
 31. Oshaghi M, Ghalandari R, Vatandoost H, Shayeghi M, Kamali-Nejad M, Tourabi-Khaledi H (2003a) Repellent effect of extracts and essential oils of *Citrus limon* (Rutaceae) and *Melissa officinalis* (Labiatae) against main malaria vector, *Anopheles stephensi* (Diptera: Culicidae). *Iran J Pub Health.* 32(4): 47–52.

32. Sadat Ebrahimi S, Hadjiakhoondi A, Reza-zadeh S, Fereidunian N, Vatandoost H, Abaee M (2005) The components of *Tagetes minuta* L. and its biological activities against malaria vector, *Anopheles stephensi* in Iran. *J Medicinal Plants*. 4(16): 43–47.
33. Shahi M, Hanafi-Bojd AA, Iranshahi M, Vatandoost H (2010) Larvicidal efficacy of latex and extract of *Calotropis procera* (Gentianales: Asclepiadaceae) against *Culex quinquefasciatus* and *Anopheles stephensi* (Diptera: Culicidae). *J Vector Borne Dis*. 47(3): 185–188.
34. Khanavi M, Toulabi PB, Abai MR, Sadati N, Hadjiakhoondi F, Hadjiakhoondi A (2011) Larvicidal activity of marine algae, *Sargassum swartzii* and *Chondria dasyphylla*, against malaria vector *Anopheles stephensi*. *J Vector Borne Dis*. 48(4): 241–244.
35. Khanavi M, Vatandoost H, Khosravi Dehaghi N, Sanei Dehkordi A, Sedaghat MM, Hadjiakhoondi A (2013) Larvicidal activities of some Iranian native plants against the main malaria vector, *Anopheles stephensi*. *Acta Med Iran*. 51(3): 141–147.
36. Sedaghat M, Dehkordi AS, Abai M, Khanavi M, Mohtarami F, Abadi YS (2011) Larvicidal activity of essential oils of Apiaceae plants against malaria vector, *Anopheles stephensi*. *Iran J Arthropod Borne Dis*. 5(2): 51–59.
37. Sedaghat MM, Dehkordi AS, Khanavi M, Abai MR, Mohtarami F, Vatandoost H (2011) Chemical composition and larvicidal activity of essential oil of *Cupressus arizonica* E.L. Greene against malaria vector *Anopheles stephensi* Liston (Diptera: Culicidae). *Pharmacognosy Res*. 3(2): 135–139.
38. Vatandoost H, Sanei Dehkordi A, Sadeghi SM, Davari B, Karimian F, Abai MR (2012) Identification of chemical constituents and larvicidal activity of *Kelussia odoratissima* essential oil against two mosquito vectors *Anopheles stephensi* and *Culex pipiens* (Diptera: Culicidae). *Exp Parasitol*. 132(4): 470–474.
39. Vatandoost H, Oshaghi MA, Abaie MR, Shahi M, Yaaghoobi F, Baghahi M (2006a) Bionomics of *Anopheles stephensi* Liston in the malarious area of Hormozgan Province, southern Iran, 2002. *Acta Trop*. 97(2): 196–203.
40. Vatandoost H, Ramin E, Rassi Y, Abai M (2009) Stability and wash resistance of local made mosquito bednets and detergents treated with pyrethroids against susceptible strain of malaria vector *Anopheles stephensi*. *Iran J Arthropod Borne Dis*. 3(1): 19–28.
41. Vatandoost H, Mamivandpoor H, Abai MR, Shayeghi M, Rafi F, Raeisi A (2013) Wash resistance and bioefficacy of alpha-cypermethrin long lasting impregnated nets (LLIN-Interceptor (R)) against *Anopheles stephensi* using Tunnel Test. *J Arthropod Borne Dis*. 7(1): 31–45.
42. Moosa-Kazemi SH, Vatandoost H, Raeisi A, Akbarzadeh K (2007) Deltamethrin impregnated bed nets in a malaria control program in Chabahar, Southeast Baluchistan, Iran. *J Arthropod Borne Dis*. 1(1): 43–51.
43. Rafinejad J, Vatandoost H, Nikpoor F, Abai MR, Shaeghi M, Duchon S (2008) Effect of washing on the bioefficacy of insecticide-treated nets (ITNs) and long-lasting insecticidal nets (LLINs) against main malaria vector *Anopheles stephensi* by three bioassay methods. *J Vector Borne Dis*. 45(2): 143–150.
44. Soleimani-Ahmadi M, Vatandoost H, Shaeghi M, Raeisi A, Abedi F, Eshraghian MR (2012) Effects of educational intervention on long-lasting insecticidal nets use in a malarious area, southeast Iran. *Acta Med Iran*. 50(4): 279–287.

45. Soleimani-Ahmadi M, Vatandoost H, Shaeghi M, Raeisi A, Abedi F, Eshraghian MR (2012) Field evaluation of permethrin long-lasting insecticide-treated nets (Olyset R) for malaria control in an endemic area, south-east of Iran. *Acta Trop.* 123(3): 146–153.
46. Soleimani-Ahmadi M, Vatandoost H, Zare M (2014) Characterization of larval habitat for anopheline mosquitoes in a malarious area under elimination program in the Southeast of Iran. *Asian Pac J Trop Biomed.* 4(1): S73–S80.
47. Doosti S, Azari-Hamidian S, Vatandoost H, Hosseini MOM (2006) Taxonomic differentiation of *Anopheles sacharovi* and *An. maculipennis* Sl (Diptera: Culicidae) larvae by seta 2 (antepalpmate hair). *Acta Med Iran.* 44(1): 21–27.
48. Doosti S, Vatandoost H, Oshaghi M, Hosseini M, Sedaghat M (2007) Applying morphometric variation of seta 2 (Antepalpmate Hair) among the larvae of the members of the Maculipennis Subgroup (Diptera: Culicidae) in Iran. *J Arthropod Borne Dis.* 1(1): 28–37.
49. Emami SN, Vatandoost H, Oshaghi MA, Mohtarami F, Javadian E, Raeisi A (2007) Morphological method for sexing anopheline larvae. *J Vector Borne Dis.* 44(4): 245–249.
50. Vatandoost H, Ashraf H, Lak SH, Mahdi RE, Abai MR, Nazari M (2003) Factors involved in the re-emergence of malaria in borderline of Iran, Armenia, Azerbaijan and Turkey. *The Southeast Asian J Trop Med Public Health.* 34 (Suppl 2): 6–14.
51. Hanafi-Bojd AA, Vatandoost H, Philip E, Stepanova E, Abdi A, Safari R (2010) Malaria situation analysis and stratification in Bandar Abbas county, southern Iran, 2004–2008. *Iran J Arthropod-Borne Dis.* 4(1): 31–41.
52. Hanafi-Bojd AA, Azari-Hamidian S, Vatandoost H, Charrahy Z (2011) Spatio-temporal distribution of malaria vectors (Diptera: Culicidae) across different climatic zones of Iran. *Asian Pac J Trop Med.* 4(6): 498–504.
53. Hanafi-Bojd AA, Vatandoost H, Oshaghi MA, Charrahy Z, Haghdoost AA, Sedaghat MM (2012) Larval habitats and biodiversity of anopheline mosquitoes (Diptera: Culicidae) in a malarious area of southern Iran. *J Vector Borne Dis.* 49(2): 91–100.
54. Hemami MR, Sari AA, Raeisi A, Vatandoost H, Majdzadeh R (2013) Malaria elimination in Iran, importance and challenges. *Int J Prev Med.* 4(1): 88–94.
55. Vatandoost H, Dehakia M, Djavadian E, Abai MR, Duchson S (2006) Comparative study on the efficacy of lambda-cyhalothrin and bifenthrin on torn nets against the malaria vector, *Anopheles stephensi* as assessed by tunnel test method. *J Vector Borne Dis.* 43(3): 133–135.
56. Vatandoost H, Shahi M, Hanafi-Bojd AA, Abai M, Oshaghi M, Rafei F (2007) Ecology of *Anopheles dthali* Patton in Bandar Abbas District, Hormozgan Province, southern Iran. *Iran J Arthropod Borne Dis.* 1(1): 21–27.
57. Vatandoost H, Emami SN, Oshaghi MA, Abai MR, Raeisi A, Piazzak N (2011) Ecology of malaria vector *Anopheles culicifacies* in a malarious area of Sistan va Baluchestan Province, south-east Islamic Republic of Iran. *East Mediterr Health J.* 17(5): 439–445.
58. Soleimani-Ahmadi M, Vatandoost H, Shaeghi M, Raeisi A, Abedi F, Eshraghian MR (2012) Vector ecology and susceptibility in a malaria-endemic focus in southern Islamic Republic of Iran. *East Mediterr Health J.* 18(10): 1034–1041.
59. Soleimani-Ahmadi M, Vatandoost H, Hanafi-

- Bojd AA, Zare M, Safari R, Mojahe-di A (2013) Environmental characteristics of anopheline mosquito larval habitats in a malaria endemic area in Iran. *Asian Pac J Trop Med*. 6(7): 510–515.
60. Vatandoost H, Shahi H, Abai MR, Hanafi-Bojd AA, Oshaghi MA, Zamani G (2004) Larval habitats of main malaria vectors in Hormozgan Province and their susceptibility to different larvicides. *Southeast Asian J Trop Med Public Health*. 35(2): 22–25.
 61. Nikookar S, Moosa-Kazemi SH, Oshaghi MA, Yaghoobi-Ershadi MR, Vatandoost H, Kianinasab A (2010) Species composition and diversity of mosquitoes in Neka County, Mazandaran Province, Northern Iran. *Iran J Arthropod Borne Dis*. 4(2): 26–34.
 62. Hanafi-Bojd AA, Vatandoost H, Oshaghi MA, Eshraghian MR, Haghdoost AA, Abedi F (2011) Knowledge, attitudes and practices regarding malaria control in an endemic area of southern Iran. *Southeast Asian J Trop Med Public Health*. 42(3): 491–501.
 63. Vatandoost H, Abai MR, Abbasi M, Shaeghi M, Abtahi M, Rafie F (2009) Designing of a laboratory model for evaluation of the residual effects of deltamethrin (K-othrine WP 5%) on different surfaces against malaria vector, *Anopheles stephensi* (Diptera: Culicidae). *J Vector Borne Dis*. 46(4): 261–267.
 64. Vatandoost H, Hanafi-Bojd AA (2008) Laboratory evaluation of 3 repellents against *Anopheles stephensi* in the Islamic Republic of Iran. *East Mediterr Health J*. 14(2): 260–267.
 65. Chavshin AR, Dabiri F, Vatandoost H, Bavani MM (2015a) Susceptibility of *Anopheles maculipennis* to different classes of insecticides in West Azarbaijan Province, Northwestern Iran. *Asian Pac J Trop Biomed*. 5(5): 403–406.
 66. Vatandoost H, Zahirnia AH (2010) Responsiveness of *Anopheles maculipennis* to different imagicides during resurgent malaria. *Asian Pac J Trop Med*. 3(5): 360–363.
 67. Abai MR, Hanafi-Bojd AA, Vatandoost H (2016) Laboratory evaluation of temephos against *Anopheles stephensi* and *Culex pipiens* Larvae in Iran. *J Arthropod Borne Dis*. 10(4): 510–518.
 68. Oshaghi MA, Chavshin AR, Vatandoost H (2006) Analysis of mosquito blood meals using RFLP markers. *Exp Parasitol*. 114(4): 259–264.
 69. Oshaghi MA, Chavshin AR, Vatandoost H, Yaaghoobi F, Mohtarami F, Noorjah N (2006) Effects of post-ingestion and physical conditions on PCR amplification of host blood meal DNA in mosquitoes. *Exp parasitol*. 112(4): 232–236.
 70. Vatandoost H, Mesdaghinia AR, Zamani G, Madjdzadeh R, Holakouie K, Sadrizadeh B (2004) Development of the regional malaria training center in Bandar Abbas, Islamic Republic of Iran. *East Mediterr Health J*. 10(1–2): 215–224.
 71. Chavshin AR, Oshaghi MA, Vatandoost H, Yakhchali B, Zarenejad F, Terenius O (2015) Malpighian tubules are important determinants of *Pseudomonas* transstadial transmission and longtime persistence in *Anopheles stephensi*. *Parasites Vectors*. 8: 36–42.
 72. Anjomruz M, Oshaghi MA, Pourfatollah AA, Sedaghat MM, Raeisi A, Vatandoost H (2014) Preferential feeding success of laboratory reared *Anopheles stephensi* mosquitoes according to ABO blood group status. *Acta Trop*. 140: 118–123.
 73. Anjomruz M, Oshaghi MA, Sedaghat MM, Pourfatollah AA, Raeisi A, Vatandoost H (2014) ABO blood groups of residents and the ABO host choice of ma-

- laria vectors in southern Iran. *Exp Parasitol.* 136: 63–67.
74. Khoshdel-Nezamiha F, Vatandoost H, Azari-Hamidian S, Bavani MM, Dabiri F, Entezar-Mahdi R (2014) Fauna and larval habitats of mosquitoes (Diptera: Culicidae) of West Azerbaijan Province, Northwestern Iran. *J Arthropod Borne Dis.* 8(2): 163–173.
 75. Khoshdel-Nezamiha F, Vatandoost H, Oshaghi MA, Azari-Hamidian S, Mianroodi RA, Dabiri F (2016) Molecular characterization of mosquitoes (Diptera: Culicidae) in Northwestern Iran by using rDNA-ITS2. *Jpn J Infect Dis.* 69(4): 319–322.
 76. Shayeghi M, Vatandoost H, Gorouhi A, Sanei-Dehkordi AR, Salim-Abadi Y, Karami M, Jalil-Navaz MR, Akhavan AA, Shiekh Z, Vatandoost S, Arandian MH (2014) Biodiversity of aquatic insects of Zayandeh Roud river and its branches, Isfahan Province, Iran. *J Arthropod Borne Dis.* 8(2): 197–203.
 77. Ghezlbash Z, Vatandoost H, Abai MR, Raeisi A, Rassi Y, Hanafi-Bojd AA (2014) Laboratory and field evaluation of two formulations of *Bacillus thuringiensis* M-H-14 against mosquito larvae in the Islamic Republic of Iran, 2012. *East Mediterr Health J.* 20(4): 229–235.
 78. Karimian F, Oshaghi MA, Sedaghat MM, Waterhouse RM, Vatandoost H, Hanafi-Bojd AA (2014) Phylogenetic analysis of the oriental Palearctic Afrotropical members of *Anopheles* (Culicidae: Diptera) based on nuclear rDNA and mitochondrial DNA characteristics. *Jpn J Infect Dis.* 67(5): 361–367.
 79. Soleimani-Ahmadi M, Vatandoost H, Zare M, Turki H, Alizadeh A (2015) Topographical distribution of anopheline mosquitoes in an area under elimination programme in the south of Iran. *Malar J.* 14: 262–268.
 80. Fathian M, Vatandoost H, Moosa-Kazemi SH, Raeisi A, Yaghoobi-Ershadi MR, Oshaghi MA (2015) Susceptibility of Culicidae Mosquitoes to Some Insecticides Recommended by WHO in a Malaria Endemic Area of Southeastern Iran. *J Arthropod Borne Dis.* 9(1): 22–34.
 81. Ataie A, Moosa-Kazemi SH, Vatandoost H, Yaghoobi-Ershadi MR, Bakhshi H, Anjomruz M (2015) Assessing the susceptibility status of mosquitoes (Diptera: Culicidae) in a *Dirofilariasis* Focus, Northwestern Iran. *J Arthropod Borne Dis.* 9(1): 7–21.
 82. Soltani A, Vatandoost H, Oshaghi MA, Ravasan NM, Enayati AA, Asgarian F (2015) Resistance Mechanisms of *Anopheles stephensi* (Diptera: Culicidae) to Temephos. *J Arthropod Borne Dis.* 9(1): 71–83.
 83. Golfakhrabadi F, Khanavi M, Ostad SN, Saeidnia S, Vatandoost H, Abai MR (2015) Biological activities and composition of *Ferulago carduchorum* essential oil. *J Arthropod Borne Dis.* 9(1): 104–115.
 84. Tavassoli M, Shayeghi M, Vatandoost H, Abai MR, Khoobdel M, Bakhshi H, Rafie F (2015) Repellency effect of Picaridin and DDT against *Anopheles stephensi* on human volunteers. *J Entomol Zool Studies.* 3(2): 343–347.
 85. Pirmohammadi M, Shayeghi M, Vatandoost H, Abaei MR, Mohammadi A, Bagheri A (2016) Chemical composition and repellent activity of *Achillea vermiculata* and *Satureja hortensis* against *Anopheles stephensi*. *J Arthropod Borne Dis.* 10(2): 201–210.
 86. Gorouhi MA, Vatandoost H, Oshaghi MA, Raeisi A, Enayati AA, Mirhendi H (2016) Current susceptibility status of *Anopheles stephensi* (Diptera: Culicidae) to different imagicides in a malarious area, southeastern Iran. *J Arthropod Borne Dis.* 10(4): 493–500.

87. Sanei-Dehkordi A, Vatandoost H, Abaei MR, Davari B, Sedaghat MM (2016) Chemical composition and larvicidal activity of *Bunium persicum* essential oil against two important mosquitoes vectors. *J Essential Oil Bearing Plants*. 19(2): 349–357.
88. World Wildlife Federation (2013) Ecoregions: Earth's most special places. Available at: http://wwf.panda.org/about_our_earth/ecoregions/ (Accessed 1 March 2013)
89. World Wildlife Federation (2013) Wildfinder. Available at: <http://worldwildlife.org/science/wildfinder/> (Accessed 23 April 2013)
90. Gueorguiev V (1965) Sur la fauna des coleopteres Hydrocantharesd'Iran (Resume). *Acad. Bulg. Sci.* 19: 116–117.
91. Nehring RB (1976) Aquatic insects as biological monitors of heavy metal pollution. *Bull Environ Contam Toxicol.* 15: 147–154.
92. Gentilil E, Ostovan H, Ghahari H, Komarek A (2018) Annotated checklist of Iranian Hydrophilidae (Coleoptera: Polyphaga: Hydrophiloidea). *Aquatic Insect.* 1: 12–18.
93. Hosseinie SO (1995) Life history, behavior and morphology of the immature stages of *Enochrus quadripunctatus* herbest in the laboratory (Coleoptera: Hydrophilidae) II. Morphology *J Sci.* 6(4): 195–206.
94. Hosseinia S, Hosseinpour H (1996) *Methles rectus* sharp confirm for Iran. *Lattissmus.* 7: 18–28.
95. Atamehr A, Kamali K, Ostovan H (2004) Report on aquatic beetles of the family Hydraenidae (Coleoptera) in Tabriz region. *J Agricultural Sci.* 10(3): 13–29.
96. Vafaei R, Ostovan H, Incekara Ü, Pešic V (2007) Faunistic study of the aquatic beetles (Coleoptera: Polyphaga) of Markazi Province (Central Iran) with new records. *Arch Biol Sci. Belgrade.* 59(3): 239–242.
97. Vafei R, Ostovan H, Incekara Ü, Pesic V (2008) A faunistic study on the diving beetles (Coleoptera: Dytiscidae) of Markazi Province (Central Iran) with the new records. *Mun Ent Zool.* 3(1): 165–170.
98. Dehghani R, Miranzadeh MB, Yosef Zadeh M, Zamani S (2007) Fauna aquatic insects in swage maturation ponds of Kashan University of medical sciences. *Pak J Biol Sci.* 10(6): 928–931.
99. Mohammadian HH (2008) Aquatic insects of Iran, First volume, Ephemeroptera. shabpare publication, Iran, p. 184.
100. Askari O, FarshbafPourabad R, Khaganinia S (2009) Faunistic study of Heteroptera of Zanjanroud region in Zanjan Province of Iran. *Mun Entomol Zool.* 4(2): 560–563.
101. Vafaei R, Darilmaz MJ, Nazari E, Incekara U, Piazak N (2009) Contributions to the knowledge of Iranian aquatic Coleoptera fauna (Dytiscidae, Gyrinidae, Helophoridae and Hydrophilidae) with new records and notes on the rare species *Coleostoma transcasicum* Reitter-1906. *Acta Entomol Serbica.* 14(1): 101–107.
102. Ghahari H, Tabari M, Sakenin H, Ostovan H, Imani S (2009) Odonata (Insecta) from Northern Iran, with comments on their presence in rice fields. *Mun Entomol Zool.* 4(1): 148–154.
103. Nemati Varnosfaderany M, Ebrahimi E, Mirghaffary N, Safyanian A (2010) Biological assessment of the Zayandeh Rud River, Iran, using benthic macroinvertebrates. *Limnologica.* 40: 226–232.
104. Khaghaninia S, Askari O, Farshbaf Pour Abad R, Shahim K (2010) Some additional notes about Heteroptera fauna of Qaradag forests-Iran. *Mun Entomol Zool.* 5(2): 513–518.
105. Sadeghi R, Farshbaf Pourabad R, Kazemi MH, Hassanzadeh M (2009) Introduc-

- tion of some Heteroptera of Qurigol (Iran). *Mun Entomol Zool.* 4(2): 498–500.
106. Atamehr A, Alaei M (2010) Two aquatic beetles reported (Haliplidae: Coleoptera) from Azerbaijan, Iran. *World Applied Sci J.* 11(8): 918–923.
 107. İncekara Ü, Darilmaz M, Vafaei R, Polat A (2013) Contributions to the knowledge of Iranian aquatic polyphaga (Coleoptera) fauna. *Turk J Entomol.* 37(1): 49–56.
 108. Esfandiari M, Sadeghi S, Khadempour A (2014) First record of Odonata nymphs from Karun River, south-west Iran. *Iran J Animal Biosys.* 10(2): 205–208.
 109. Salavatian M, Gholiev Z, Aliev A, Abassi K (2011) Feeding behaviour of brown trout, *Salmo truttafarior*, during spawning season in four rivers of Lar National Park, Iran Caspian. *J Environ Sci.* 9(2): 223–233.
 110. Khadempoor A, Esfandiari M, Jamshidniya A (2011) Aquatic insects of Karun River at Ahvaz City, SW Iran. Annual Zoological Congress of “GrigoreAntipa” Museum, Nov 2011, National Museum of Natural History, Bucharest, Romania. P. 200.
 111. Karimi F, Moattar F, Farshchi P, Savari A, Parham H (2012) ERA: Suitable method for estimation of ecological effects of pesticide contamination on aquatic species. *J Persian Gulf (Marine Science).* 3(8): 67–73.
 112. Sharifinia M, Imanpour Namin J, Bozorgi Makrani A (2012) Benthic Macroinvertebrate distribution in Tajan River using canonical correspondence analysis. *Caspian J Env Sci.* 10(2): 181–194.
 113. Gorjian Arabi MH, Shapoori M, Hosseinzadeh MA, Erfanifar E, Abedi K, Erfanifar E (2013) Effectiveness of macro invertebrate based biotic indexes in assessing lake water quality in Gahar, Iran. *World J Zool.* 8(3): 285–291.
 114. Ghahari H (2013) A study on aquatic and semiaquatic bugs (Hemiptera: Heteroptera) from northern Iran. *Biologiezentrum Linz/Austria.* 45(2): 1991–1996.
 115. Khazeni A, Adler PH, Telmadareiyi Z, Oshaghi MA, Vatandoost H, Abtahi SM, Lotfi A (2013) The Black Flies (Diptera: Simuliidae) of Iran. *Zootaxa.* 3694(1): 67–74.
 116. Shaverdo HV, Esfandiari M, Khadempour A, Nasserzadeh H, Ghodrati A (2013) Diving beetles of Ahvaz City, Khuzestan Province, Iran (Coleoptera: Dytiscidae). *Koleopt Rdsch.* 83: 17–22.
 117. Shayeghi M, Doosti S, Bazrafkan S, Hosseini-Vasoukolaei N, Vatandoost H, Akhavan AA, Vatandoost S, Arandian MH (2013) Prevalence of aquatic entomofauna, the predators of mosquitoes, in the Zayandeh River of Central Iran. *Asian Pac J Trop Dis.* 4(1): S240–S245.
 118. Maleki-Ravasan N, Bahrami A, Shayeghi M, Oshaghi MA, Malek M, Mansoorian AB, Vatandoost H (2013) Notes on the Iran Caddisflies and role of *Annulipalpi*an *hydropsychid* Caddisflies as a bio-monitoring agent. *J Arthropod Borne Dis.* 7(1): 71–82.
 119. Darilmaz MC, Incekara Ü, Vafaei R (2013) Contributions to the knowledge of Iranian aquatic Adephaga (Coleoptera). *Spixiana.* 36(1): 149–152.
 120. Pourbehi H, Zare Khormizi M, Biranvand A (2013) Estimation of field biotic index and water quality of Shapoor River in autumn season using aquatic insect's fauna. *Int J Agric Crop Sci.* 6(11): 766–768.
 121. Eyidozehl K, Narouyi Y, Mehraban A, Vazirimehr MR, Rigi K (2014) Evaluation of aquatic insect fauna such as Heteroptera, Ephemeroptera, Diptera, Trichoptera, Coleoptera, Odonata and

- so on in east of Golestan Province. *J Bio Env Sci.* 5(1): 508–513.
122. Shayeghi M, Nejati J, Shirani-Bidabadi L, Koosha M, Badakhshan M, Mohammadi Bavani M, Arzamani K, Choubdar N, Bagheri F, Saghafipour A, Veysi A, Karimian F, Akhavan AA, Vatandoost H (2014) Assessing the fauna of aquatic insects for possible use for malaria vector control in large river, central Iran. *Acta Med Iran.* 53(9): 523–532.
123. Nikookar SH, Moosa-Kazemi SH, Oshaghi MA, Vatandoost H, Yaghoobi-Ershadi MR, Enayati AA, Motevali-Haghi F, Ziapour SP, Fazeli-Dinan M (2015) Biodiversity of culicid mosquitoes in rural Neka township of Mazandaran Province, Northern Iran. *J Vector Borne Dis.* 52(1): 63–72.
124. Soleimani-Ahmadi M, Vatandoost H, Zare M, Alizadeh A, Salehi M (2014) Community knowledge and practices regarding malaria and long-lasting insecticidal nets during malaria elimination programme in an endemic area in Iran. *Malaria J.* 13: 511–521.
125. Hanafi-Bojd AA, Vatandoost H, Oshaghi MA, Haghdoost AA, Shahi M, Sedaghat MM (2012b) Entomological and epidemiological attributes for malaria transmission and implementation of vector control in southern Iran. *Acta Trop.* 121(2): 85–92.
126. Shayeghi M, Moradi Asl E, Saeidi Z, Mozafari E, Poudat A, Salimi M, Vatandoost H (2016) Aquatic insects fauna of Meshkin Shahr, Ardabil Province, Northwestern Iran, 2014. *J Marine Sci Res Dev.* 6: 206–211.