

Original Article

A Checklist of Iranian Cockroaches (Blattodea) with Description of *Polyphaga* sp as a New Species in Iran

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Abstract

Background: Cockroaches are of vital importance medically and hygienically. They are able to contaminate foods and act as vectors of pathogenic agents such as bacteria, protozoa, and parasites to human environment either mechanically or through their digestive system. Cockroaches belong to the phylum Arthropoda, class Insecta, and order Blattodea or Blattaria. To date, over 4,500 cockroach species have been reported from different parts of the world. We overviewed the documents involved Iranian cockroaches to up-to-date checklist of cockroach species distributed in various provinces of Iran.

Methods: An extensive literature review was performed in 2013 on Iranian handbooks, reports and published data available since 1986 to obtain a comprehensive list of Iranian cockroaches. Furthermore, in an entomological survey in Tehran, cockroach specimens were collected and identified based on morphological and the DNA sequences of the mitochondrial cytochrome oxidase subunit II (COII) gene (mt-DNA COII) characteristics.

Results: Morphological characterization revealed presence of an un-described species very similar to *Polyphaga aegyptiaca*, *P. indica* and somehow to *Pycnoscelus surinamensis*, however, supplementary molecular analysis revealed the species was associated with *Polyphaga* of Corydiidae (Polyphagidae). With regards to the report of the un-described species, the cockroach fauna of Iran includes three families, 14 genera, and 26 species.

Conclusion: Some species has not been collected or reported recently and also many geographical regions of the country have not been studied yet, hence a systematic research is required to reveal the real cockroach list of the country. Geographical distributions, nomination changes, and synonyms of cockroach species are presented.

Keywords: Cockroach, Blattodea, *Polyphaga* sp, mtDNA-COII, Molecular systematics

Introduction

Cockroaches are one of the oldest and the most successful insect lives have been present on the earth from Pennsylvanian Epoch (the Upper Carboniferous period). The fossil records indicate that cockroaches have undergone rapid changes correlated with developmental cycles to obtain the ideal body form and survived as resistant taxa (Moore et al. 1952). To date, over 4,500 cockroach species have been reported from different parts of the world of which about 30 species are associated with human habitats (Valles et

al. 1999). Cockroaches live all over the world but most of the species are found in tropical and equatorial regions (Schal and Hamilton 1990). Cockroaches hygienically are one of the important pests widely distributed throughout the world. Frightening and pesky appearance of cockroaches is another significant factor to call them pest. The sanitary and medical significance of cockroaches is owing to their presence in homes, groceries, food warehouses, restaurants, hotels, hospitals on the one hand and in sewer systems and rubbish

bins on the other hand. They can act as vectors of pathogenic agents such as bacteria, protozoa (single-celled eukaryotes), and parasite eggs and can transmit diseases to humans either mechanically or through their digestive system. Thus they are considered a very important vector of diseases including cholera and typhoid fever to humans. Moreover, cockroach infestations, including saliva, feces and cast skins, are a source of allergens and can irritate allergies and asthma in people, especially children (Farhoudi et al. 2003, Ahmed et al. 2010, Sookrung and Chaicumpa 2010, Shahraki 2011). Almost 40%–60% of patients with asthma in urban and inner-city areas possess IgE antibodies to cockroach allergens (Sohn and Kim 2012). Cockroaches belong to the order Blattodea or Blattaria (sometimes considered a suborder, Blattaria, of order Dictyoptera), and are regarded as the most primitive winged insects. *Blatta* is of Latin origin and means shunning light (Hanafi-Bojd and Sadaghiani 2009).

Many adult cockroaches have fully developed wings, whereas other cockroaches have short wings or lack wings altogether. Young, immature cockroaches resemble adults but are smaller and wingless. Cockroaches are identified by the following taxonomic features: color, number and the shape of spines on the femora, tarsus and wings, reproductive organs, and head frontal. Moreover, at the posterior end of the male abdomen, there are cercus, stylus and hypandrium which are important factors in species identification.

Historically, according to the classification of Mckittrick (1964) and Roth (1970), cockroaches have been regarded as a separate order divided into two superfamilies of Blattoidea and Blaberoidea which totally include five families of Polyphagidae, Blaberidae, Blattellidae, Blattidae, and Cryptocercidae. However, in more recent classification, number of superfamilies tops out at three including Corydioidea (Synonym: Polyphagoidea), Blattoidea (Synonym: Termitoidea), and Bla-

beroidea. And number of family tops out at nine including Blaberidae, Ectobiidae (synonym: Blattellidae), Blattidae, Lamproblattidae, Tryonicidae, Cryptocercidae, Termitidae, Corydiidae (Synonym: Polyphagidae), Nocticolidae (Inward et al. 2007, Lo et al. 2007). However, Lo et al. (2007) criticized the classification of termites as a family of Blattaria and suggested to retain the order of Isoptera (Termites with seven families including Mastotermitidae, Termopsidae, Hodotermitidae, Kalotermitidae, Serritermitidae, Rhinotermitidae, and Termitidae) as an unranked name within Blattaria (i.e Blattaria: Isoptera), until cockroach phylogeny is better resolved and an appropriate ranking can be applied. Currently, Beccaloni and Eggleton (2013) classified the termites as an epifamily (ie Termitoidea including 9 families of Mastotermitidae, Archotermopsidae, Hodotermitidae, Stolotermitidae, Kalotermitidae, Stylotermitidae, Rhinotermitidae, Serritermitidae, and Termitidae) and created two other epifamilies to contain the cockroach species also placed in the superfamily Blattoidea with the termites. Unfortunately, in terms of faunistic studies on the Iranian cockroaches, there are no enough records available. The only evidence is a paper written by Mirzayans (1986) in which four families, eleven genera and 24 species of cockroaches were reported in Iran. However, considering the report of *Parcoblatta* sp by Fathpour et al. (2003) and on the base of recent classification, Iranian cockroaches could be classified in three superfamilies, three families, 14 genera, and 25 species.

Different species of family Blattidae can be found all over the world. Most of the species that are recognized as house pests belong to this family. Among family Blattidae, five species have been reported from different parts of Iran. Species of family Corydiidae (Polyphagidae) live in arid regions particularly in desert and semi desert areas. In Iran twelve species of this family have already been recognized. In terms of the number of species,

family Ectobiidae (Blattellidae) is the largest order of cockroaches in the world and eight species of this family have been reported from the country. The German roach, *Blattella germanica*, the major pest of residential dwellings, belongs to family Blattellidae as well.

In an entomological survey, we have found two male cockroach specimens originated from north of Tehran which showed morphological characters of Corydiidae (Polyphagidae) and by some means to *Pycnoscelus surinamensis*. However, further taxonomic investigation revealed some morphological characters distinct the two specimens from *Polyphaga aegyptiaca*, *P. indica*, and *Py. surinamensis*. This encouraged us to use molecular technique to determine their identity. Currently, different mitochondrial and nuclear DNA markers have been used for species identification and phylogenetic analysis of different groups of cockroaches (Maekawa and Matsumoto 2000 and 2003, Maekawa et al. 2001 and 2007, Lo et al. 2006 and 2000, Park et al. 2004, Sulaiman et al. 2012). Among the loci, mitochondrial cytochrome oxidase subunit II (mtDNA-COII) gene has been commonly used for cockroaches (e.g Maekawa et al. 2007) and other insects (Liu and Beckenbach 1992, Chen et al. 2002, Oshaghi et al. 2006 and 2007, Preativatanyou et al. 2010, Chen et al. 2012).

In this study we tested the mtDNA-COII sequences of the two specimens. Meanwhile, this paper overviewed the documents involved Iranian cockroaches to up-to-date checklist of cockroach species distributed in various provinces of the country.

Materials and Methods

To obtain a complete list of Iranian cockroaches, a broad literature evaluation including Persian and English documents has been carried out on Iranian handbooks, reports and published data which were published since 1986 onwards.

Besides, in an entomological survey in north Tehran, cockroach specimens were collected actively using boxes from indoor of buildings in summer 2011. The collected specimens were transferred to the Insect Molecular Laboratory of School of Public Health, Tehran University of Medical Sciences (SPH-TUMS) and then were morphologically studied using the available pictorial and morphological keys of Pratt and Stojanovich (1966), Mirzayans (1986), Cochran (1999), and Hanafi-Bojd and Sadaghiani (2009). Further molecular characters were provided to test sequence homology and phylogenetic relationship with the available entries in GenBank.

DNA extraction, mtDNA-COII PCR, sequencing, and Phylogeny

The male specimens were subjected to DNA extraction using two legs from each individual. Total genomic DNA was extracted using QIAamp® Mini Kit (Qiagen, Germany) according to the manufacturer's protocol. The COII gene of the cockroach mitochondrial genome was amplified using polymerase chain reaction (PCR) and then subjected to DNA sequencing. PCR was carried out in 25 µL reactions, with the final concentrations of 1 out 100 µL template DNA, 1 unit (0.2 µL) of *Taq* polymerase, 1× PCR reaction buffer, 2mM MgCl₂, 200µM of each dNTPs (Fermentas, Sinaclon) and 10 µM (1.2 µL) of each forward and reverse primer (Sinaclon, Iran). The primers used in this study were A-tLeu 5'- ATGGCAGATT AGTGCAATGG-3' and reverse primer of B-tLys 5'-GTTTAAGAGACCAGTACTT G-3' as previously described (Liu and Beckenbach 1992). PCR thermal program included an initial denaturation step of 94 °C of 5 minutes, followed by 5 cycles of 94 °C for 1 minute, 45 °C for 40 seconds, 72 °C for 1 minute, and then followed by 35 cycles of 94 °C for 40 seconds, 50 °C for 40 seconds, 72 °C for 1 minute, and a final elongation step for 72 °C for 5 minutes. PCR products were visu-

alized on 1% agarose gel containing ethidium bromide and using an UV transilluminator. The amplified mtDNA-COII amplicons were bidirection sequenced via the same amplification primers by Bioneer Company (S. Korea) and SeqLab (Germany). The DNA sequence reads were edited manually using the Chromas software to eliminate discrepancies between forward and reverse sequences.

The consensus sequences were analyzed using the BLAST search available in Nucleotide collection of NCBI. To determine association of the undescribed specimens with species of Polyphagidae, most of the mtDNA-COII entries of Corydiidae (Polyphagidae) including *P. aegyptiaca*, *Ergaula capucina*, *Therea* sp, and *Eremoblatta subdiaphana*, and a subset of entries represented species of other families of the order Blattodea were retrieved from Genbank and used for data analysis. Representatives of other families were *Blattella germanica*, *Symploce pallens*, and *Blattella lituricollis* of Ectobiidae (Blattellidae), *Shelfordella lateralis*, *Blatta orientalis*, *Periplaneta fuliginosa*, and *P. americana* of Blattidae, *Py. surinamensis* of Blaberidae, and *Locusta migratoria* from Orthoptera as outgroup. The sequences were aligned using the multiple alignment program CLUSTALW2 online program and manually adjusted. The two specimen sequences were identified to genus level by sequence comparison with the GenBank entries and by the phylogenetic analysis using the neighbor-joining method embedded in the CLUSTALW2. Phylogenetic analysis was performed on a combination of the data obtained from this study plus representatives of the cockroach species mentioned above.

Results

Entomological survey

The undescribed species (*Polyphaga* sp) were found, out of houses close to mountain area of Assad-Abad zone, Velenjak area in

northern part of Tehran. Morphological investigation showed that they look like two other known Iranian species of *Polyphaga indica* and *P. aegyptiaca* (Egyptian) and by some means to *Py. surinamensis* but in some characters they stand as a distinct species. In addition to variation in the size and color with the mentioned species, they had a distinct pronotum with straight edge posteriorly and laterally (Fig. 1C, 1D). Pronotum was angularly in *Py. surinamensis* and rounded laterally in *P. aegyptiaca*. They also had a separation line between inferior part of forehead and main part of face which is specific character of *P. aegyptiaca* but lacked distinctive ocelli (simple eyes) which is specific character of *Py. surinamensis*. It is noticeable that *P. aegyptiaca* and *P. indica* belong to Corydiidae (Polyphagidae) whereas *Py. surinamensis* belongs to Blaberidae. The most important morphological traits of this species which shared with the mentioned species include lack of strong spines along the internal margin of the middle and hind femora; pronotum dark brown, except a narrow yellowish band along anterior and lateral margins (Fig. 1). Morphological characters of the specimens somehow represented a new record for the country.

Our study using molecular mtDNA COII marker revealed that the specimens belong to *Polyphaga* of Corydiidae (Polyphagidae) however their COII sequences were only 85% homologue to *P. aegyptiaca* and far more different from other species of Corydiidae (Polyphagidae) indicating presumably a distinct and new species in Iran. The mtDNA-COII sequences of the two specimens were submitted to GenBank with accession numbers of KJ769153-KJ769154. The sequences include 683 bp un-ambiguous data and there were no polymorphic sites between the samples. Interestingly, alignment of the sequence data showed a fixed six DNA base pairs deletion equals to two amino acids (AA) deletion in species of

Corydiidae (Polyphagidae) including the specimens found in this study in comparison with other cockroaches (Fig. 2) indicating the undescribed specimens definitely belongs to Corydiidae (Polyphagidae) and presumably to *Polyphaga* genus. Further phylogenetic analysis confirmed the close association of the undescribed specimens to the *Polyphaga* genus. Phylogenetic analysis was performed using 16 sequences of the mtDNA-COII of various cockroach species and of *Locusta migratoria* (Orthoptera) as outgroup. The cladogram inferred using the neighbor-joining method strongly supported association of the specimens (we call them as *Polyphaga* sp) with other Corydiidae (Polyphagidae) species (Fig. 3). The tree resolved very well the four families of the cockroaches each one formed a major group. Two families of Blaberidae and Ectobiidae (Blattellidae) were shown to be sister groups.

Checklist of Iranian Cockroaches

With regards to the report of the undescribed species (*Polyphaga* sp), the cockroach fauna of Iran includes three families, 14 genera, and 26 species (Table 1).

Superfamily Blattoidea

Family Blattidae

Periplaneta americana (Linnaeus 1758)

Synonymy: *Blatta aurelianensis* Fourcroy 1785, *Periplaneta americana colorata* Rehn 1902, *Blatta domicola* Risso 1826, *Blatta ferrugineofusca* Gronovius 1764, *Blatta heros* Eschscholtz 1822, *Blatta kakkerlac* De Geer 1773, *Blatta americana* Linnaeus 1758, *Blatta orientalis* Sulzer 1776, *Blatta siccifolia* Stoll 1813, *Periplaneta stolidus* Walker 1868.

Iranian records: Almost all parts of Iran (Mirzayans 1986), Southwest Iran (Shahraki 2010), Hamedan-Hamedan (Salehzadeh 1995, Mahjoob et al. 2010, Nejati et al. 2011), Isfahan (Fathpour et al. 2003), Isfahan-Kashan (Doroodgar et al. 2006), Khuzestan-Khorramshahr (Kassiri and Kazemi 2012), Kohkiluyeh

va Boyer-Ahmad-Yasuj (Shahraki et al. 2011), Kurdistan-Sanandaj (Vahabi et al. 2007), Mazandaran-Sari (Motavali Haghi et al. 1997), Tehran (Karimi Zarchi and Vatani 2009), Zanjan-Zanjan (Mohammadi 1996), Qom-Qom (Fahiminia et al. 2010).

Periplaneta australasiae (Fabricius 1775)

Synonymy: *Blatta aurantiaca* Stoll 1813, *Blatta australasiae* Fabricius 1775, *Blatta domingensis* Palisot de Beauvois 1805, *Periplaneta emittens* Walker 1871, *Periplaneta inclusa* Walker 1868, *Periplaneta repanda* Walker 1868, *Periplaneta subcincta* Walker 1868, *Polyzosteria subornata* Walker 1871, *Periplaneta zonata* Haan 1842.

Iranian records: Most southern states and warm (Persian Gulf coast) (Mirzayans 1986), Hamedan-Hamedan (Mahjoob et al. 2010, Nejati et al. 2011), Khorassan-e-Jonubi-Birjand, Yazd (Hanafi-Bojd and Sadaghiani 2009).

Blatta orientalis (Linnaeus 1758)

Synonymy: *Blatta badia* Saussure 1863, *Blatta castanea* Blanchard 1851, *Blatta culinaris* De Geer 1773, *Blatta europaea* Bartsch 1846, *Blatta ferruginea* Thunberg 1810, *Stylopyga orientalis gracilis* Adelung 1903, *Blatta hemialata* Gistel 1856, *Pulex imperator* Westwood 1858, *Blatta lucifuga* Poda 1761, *Kakerlac pallipes* Philippi 1863, *Kakerlac platystetho* Philippi 1863, *Blatta secunda* Schaeffer 1769, *Stylopyga orientalis spontanea* Semenov-Tian-Shansky 1909, *Blatta tertia* Schaeffer 1769.

Iranian records: Almost all parts of Iran (Mirzayans 1986), Southwest Iran (Shahraki et al. 2010), Hamedan-Hamedan (Salehzadeh 1995, Mahjoob et al. 2010, Nejati et al. 2011), Tehran (Karimi Zarchi and Vatani 2009), Zanjan-Zanjan (Mohammadi 1996).

Shelfordella lateralis (Walker 1868)

Synonymy: *Blatta lateralis* Walker 1868, *Shelfordella ahngeri* Adelung 1910,

Paraloboptera sillemi Hanitsch 1935, *Periplaneta tartara* Saussure 1874, *Periplaneta lateralis* Walker 1868, *Shelfordella tartara zarudnyi* Adelung 1910.

Iranian records: Sistan va Balouchestan (Sarbaz, Saravan, Jalgh, Pishin, Zabol), Ardebil-Mogan, Kermanshah-Kangavar, Isfahan-Kashan, Tehran (Tehran, Varamin), Fars (Firuzabad, Kakan), Golestan (Gonbad-e-Kavus), Kerman-Kerman, Khuzestan (Masjed-Soleiman, Ahvaz), Hormozgan (Bandar-Lengeh, Issin), (Mirzayans 1986), Southwest Iran (Shahraki et al. 2010), Isfahan (Fathpour et al. 2003), Hamedan-Hamedan (Salehzadeh 1995), Kohkiluyeh va Boyer-Ahmad-Yasuj (Shahraki 2011), Yazd (Hanafi-Bojd and Sadaghiani 2009), Gilan Province, Assalem district (Authors of this article).

***Shelfordella monochroma* (Walker 1871)**

Synonymy: *Blatta monochroma* Walker 1871, *Shelfordella gussakovskii* Bei-Bienko 1950, *Shelfordella tertia* Bei-Bienko 1938, *Periplaneta monochroma* Walker 1871.

Iranian record: Hormozgan-Bandar-Abbas (Mirzayans 1986).

Superfamily Corydioidea (Polyphagoidea) Family Corydiidae (Polyphagidae)

***Polyphaga aegyptiaca* (Linnaeus 1758)**

Synonymy: *Blatta lata* Gistel 1856, *Blatta omega* Costa 1839, *Heterogamia punctata* Fischer 1846, *Blatta sphaerica* Gistel 1856, *Blatta spinifer* Kirby 1910, *Heterogamia spinipes* Fischer 1846, *Steleopyga trichoprocta* Fischer 1833, *Blatta aegyptiaca* Linnaeus 1758.

Iranian records: Khuzestan (Ahvaz, Dezful), Fars (Shiraz, Firuzabad, Dehram), Lorestan (Aligudarz-Ghalikuh 2360 m. alt.), Tehran (Damavand 2070 m. alt.), Mazandaran (Babol, Gaemshahr), Golestan-Kalaleh, Kermanshah (Gilan-e-Gharb, Chuar, Sumar, Ghasre-Shirin), Elam-Mehran, (Mirzayans 1986), Isfahan (Fathpour et al. 2003), Khuzestan-Ahvaz (Vazirianzadeh et al. 2009).

***Polyphaga indica* (Walker 1868)**

Synonymy: There is no synonym.

Iranian records: Khuzestan-Ahvaz, Fars (Mount Dena 2210 m. alt. Western slope, Kazerun: Gavkoshak, Dashte-Arjan 1900 m. alt.), Azarbayjan-e-Sharghi (Tabria, Moghan), Khorassan-e-Razavi- Safi Abad, Sistan va Balouchestan, Tehran (Varamin, Tehran, Rudehen, Damavand), Isfahan-Golpayegan, Semnan-Garmsar, Salt desert, Kerman-Rudbar, Mazandaran (Mirzayans 1986).

***Polyphaga saussurei* (Dohrn 1888)**

Synonymy: *Heterogamia saussurei* Dohrn 1888, *Polyphaga camelorum* Kirby 1903, *Heterogamia pellucida* Redtenbacher 1889.

Iranian records: Khorassan-e-Razavi (Dareh-Gaz), Hormozgan-Minab, Fars (Midast, Firuzabad, Farrashband, Kazerun, Sarmashhad), Sistan va Balouchestan (Zabol, Pishin, Bampur, Iranshahr, Khash, Sarbaz-Dez) (Mirzayans 1986), Yazd (Hanafi-Bojd and Sadaghiani 2009).

Note: In the study of Salehzadeh (1995), one unknown species of this genus has been reported from Hamedan.

***Polyphaga* sp (sp Nov?)**

In this study for the first time two specimens of a new but undescribed species (*Polyphaga* sp) (sp Nov?) were found in a summer time (Agust 2011), in a house (third floor) where was built in close affinity with Touchal Mountain, Asad-abad zone, Shemiranat, northern Tehran. The voucher specimen (Fig. 1) is deposited in Entomology Museum of the School of Public Health, Tehran University of Medical Sciences.

***Arenivaga livida* (Brunner von Wattenwyl 1865)**

Synonymy: There is no synonym.

Iranian records: Azarbayjan-e-Sharghi (Jolfa, Aras) (Bey-Bienko 1950), Azarbayjan-e-Sharghi (Tabriz-Khalat pushan) (Mirzayans 1986).

***Hemelytrobatta subhyalina* (Chopard 1921)**

Synonymy: *Arenivaga subhyalina* Chopard 1921, *Polyphaga subhyalina* Chopard 1921, Iranian records: Gazvin (Chopard 1929, Bey-Bienko 1950), North of Iran (Bey-Bienko 1950), Fars (Shiraz, Dashte-Arjan 1900 m. alt.) (Mirzayans 1986).

***Hemelytrobatta roseni* (Brancsik 1898)**

Synonymy: *Arenivaga roseni* Brancsik 1898, *Homoeogamia roseni* Brancsik, 1898.

Iranian records: Sistan va Balouchestan-Bampur, Isfahan-Murchehort, Khuzestan (Chopard 1929, Bey-Bienko 1950), Isfahan (Kashan, Kabutarabad, Barzok), Semnan-Garmsar, Sistan va Balouchestan (Zabol, Khash), Tehran-Varamin (Mirzayans 1986), Isfahan (Fathpour et al. 2003).

***Hemelytrobatta longipes* (Chopard 1929)**

Synonymy: *Heterogamodes longipes* Chopard 1929, *Arenivaga longipes* Chopard 1929.

Iranian records: North of Iran (Chopard 1929, Bey-Bienko 1950), Fars (Firuzabad, Shiraz, Dehram), Semnan-Garmsar, Tehran-Varamin (Mirzayans 1986).

***Hemelytrobatta marismortui* (Janson 1891)**

Synonymy: *Arenivaga marismortui* Janson 1891, *Heterogamia maris-mortui* Janson 1891.

Iranian records: Fars (Kazerun-Chah Chenar), probably in provinces Lorestan, Azarbayjan-e-Gharbhi, Kermanshah, Khuzestan (Mirzayans 1986).

***Hemelytrobatta latifrons* (Chopard 1929)**

Synonymy: *Heterogamodes latifrons* Chopard 1929, *Arenivaga latifrons* Chopard 1929.

Iranian records: Boushehr (Chopard 1929), Chaharmahal va Bakhtiari (Bakhtiari Mountains) (Bey-Bienko 1950), Khuzestan (Ahvas-Molla Sani) (Mirzayans 1986).

***Heterogamisca persica* (Chopard 1921)**

Synonymy: *Polyphaga persica* Chopard 1921.

Iranian records: Markazi-Arak, Sistan va Balouchestan (Khash-Mount Taftan), Khorassan-e-Jonubi-Nehbandan (Chopard 1929), Kerman-Esfandagheh, Isfahan (Kabutarabad), Sistan va Balouchestan (Chahbahar, Tiss, Iranshahr), Gazvin, Yazd, Khuzestan (Ahvaz), Fars-Yazd khast (Mirzayans 1986).

***Leiopteroblatta monodi* (Chopard 1969)**

Synonymy: Does not exist.

Iranian record: Lut-Desert (Mirzayans 1986).

***Tivia inconspicua* (Bei-Bienko 1950)**

Synonymy: There is no synonym.

Iranian records: Sistan va Balouchestan (Bahukelat, Ghasr-Ghand, Dashtiari, Tang Sarheh) (Bey-Bienko 1950), Hormozgan (Isin: Mount Geno 750 m. alt.) (Mirzayans 1986).

Superfamily Blaberoidea**Family Ectobiidae*****Blattella germanica* (Linnaeus 1767)**

Synonymy: *Blatta asiatica* Pallas 1773, *Blatta bivittata* Serville 1838, *Eublattella cuneivittata* Hanitsch, 1925, *Phyllodromia cuneivittata* Hanitsch 1925, *Blatta daurica* Laxmann 1769, *Phyllodromia magna* Tepper 1895, *Phyllodromia niitakana* Shiraki 1931, *Blatta obliquata* Daldorf 1794, *Ischnoptera parallela* Tepper 1893, *Blatta germanica* Linnaeus 1767, *Ischnoptera parallela* Princis 1969, *Blattella germanica shuguroffi* Karny 1908, *Blatta transfuga* Brünnich 1763.

Iranian records: Almost all parts of Iran (Mirzayans 1986), Southwest Iran (Shahraki et al. 2010), Fars (Fallahzadeh et al. 2008), Hamedan-Hamedan (Salehzadeh 1995, Mahjoob et al. 2010, Nejati et al. 2011), Hormozgan-Bandar-Abbas (Shahi et al. 2008), Isfahan (Fathpour et al. 2003), Isfahan-Kashan

(Doroodgar et al. 2006), Kerman-Kerman (Kamyabi et al. 2006), Kermanshah (Limoe et al. 2011), Kordestan-Sanandaj (Vahabi et al. 2007), Kohkiluyeh va Boyer-Ahmad-Yasuj (Shahraki et al. 2011), Mazandaran-Sari (Motavali Haghi et al. 1997, Abedi and Dayer 2006, Enayati and Haghai 2007), Khorassan-e-Razavi-Mashhad (Naderinasab and Moravvej 2012), Tehran (Ladonni 1997, Mousavi et al. 2004, Baniardalani et al. 2006, limoe et al. 2006, Nasirian 2007, Karimi Zarchi and vatani 2009, Fakoorziba et al. 2010), Zanzan-Zanzan (Mohammadi 1996, Ghavami et al. 2005), Qom-Qom (Fahiminia et al. 2010).

***Blattella biligata* (Walker 1868)**

Synonymy: *Blatta cercalis* Walker 1868, *Ischnoptera evansi* Chopard 1921, *Blatta fasciceps* Walker 1871, *Ischnoptera fulvastra* Chopard 1924, *Blatta mellea* Krauss 1902, *Ischnoptera modestiformis* Karny 1915, *Symploce mossambica* Princis 1965, *Symploce persica* Bei-Bienko 1935, *Ischnoptera biligata* Walker 1868, *Phyllodromia unicolor* Brunner von Wattenwyl 1893, *Blatta cercalis* Walker 1868.

Iranian records: Sistan va Balouchestan (Bey-Bienko 1950), Hormozgan (Bandar-Abbas, Shamil, Minab, Tonbe bozorg), Sistan va Balouchestan (Sarbaz, Saravan, Iranshahr, Chabahar, Tiss, Baftan) (Mirzayans 1986).

Note: In the studies of Salehzadehs (1995), two unknown species of *Symploce* have been reported from Hamedan.

***Supella (Supella) longipalpa* (Fabricius 1798)**

Synonymy: *Blatta cubensis* Saussure 1862, *Blatta extenuata* Walker 1868, *Blatta incisa* Walker 1868, *Blatta phalerata* Saussure 1863, *Ischnoptera quadriplaga* Walker 1868, *Blatta subfasciata* Walker 1871, *Blatta (Phyllodromia) supellectilium* Serville 1838, *Blatta transversalis*

Walker 1871, *Ischnoptera vacillans* Walker 1868, *Blatta longipalpa* Fabricius 1798.

Iranian records: Tehran (Bey-Bienko 1950), Isfahan (Fathpour et al. 2003), Southwest Iran (Shahraki et al. 2010), Hamedan-Hamedan (Salehzadeh 1995).

***Symploce zarudniana* (Bei-Bienko 1963)**

Synonymy: There is no synonym.

Iranian records: Sistan va Balouchestan (Bey-Bienko 1950), Hormozgan (Bandar-Abbas, Shamil), Sistan va Balouchestan (Pishin, Iranshahr, Baftan), Fars (Mirzayans 1986).

***Balta ramifera* (Walker 1871)**

Synonym: *Blatta ramifera* Walker 1871.

Iranian record: Sistan va Balouchestan-Bampur (Bey-Bienko 1950), Sistan va Balouchestan- Baftan (Mirzayans 1986).

***Phyllodromica (Phyllodromica) polita* (Krauss 1888)**

Synonym: *Aphlebia polita* Krauss 1888.

Iranian record: Gilan (Assalem, Parehsar 750m. alt) (Mirzayans 1986).

***Phyllodromica (Lobolampra) persa* (Bei-Bienko 1935)**

Synonymy: Does not exist.

Iranian record: Golestan (Gorgan-Shahkuh) (Bey-Bienko 1950).

***Parcoblatta* sp Hebard 1917**

Synonym: *Ischnoptera* Fox 1917, *Platamodes* Scudder 1862.

Iranian records: Isfahan (Fathpour et al. 2003). This species was reported in a study that was focused on cockroaches as reservoirs and vectors of drug resistant *Salmonella* spp Since this species was new for Iran, further investigation will confirm its presence in the country.

<i>E. capucina</i>	ATTTGATTCATATATAAATTCCTCAAAATGAATTAATACTGAAGATTTT
<i>Therea sp</i>	ATTTGACTCTTATATAATCCACAAAATGAAATAATATTAAGAGATTTT
<i>B. lituricollis</i>	ATTTGATTCCTACATAATCCACAAAATGAATTAATAAGTAATGACTTT
<i>B. germanica</i>	ATTTGACTCCTACATAATCCACAAAATGAATTAATAAGTGATGATTTT
<i>S. pallens</i>	TTTTGATTCATATATAATCCACAAAATGAGATAAGAAGTAGAGATTTT
<i>P. surinamensis</i>	ATTTGATTCATATATAATCCACAAAATGATATAACAAGTTCTGATTTT
<i>B. orientalis</i>	ATTTGATTCATATATAATTCCTCAAGATGAAATAGATCATAGTATGTTT
<i>P. americana</i>	ATTTGATTCATATATAATCCCAGGATGAAATAAATCCCAATATATTC
<i>P. fuliginosa</i>	ATTTGATTCATATATAATTCCTCAAGATGAAATAAATTC TAATATATTT
<i>S. lateralis</i>	ATTTGATTCATATATAATTCCTCAAGATGAAATAAATTC TAATATATTT
<i>E. subdiaphana</i>	ATTTGATTCACATATAATTCACAAAATGATAATAAAAATGATGATTTT
<i>P. aegyptiaca J</i>	ATTAGACTCCTATTTAATTACA-----GACATAATATCAAATAAATTT
<i>P. aegyptiaca L</i>	ATTAGACTCCTATTTAATTACA-----GACATAATATCAAATAAATTT
<i>Polyphaga sp</i>	ATTCGATTCCTATTTAATAACA-----GAAGAAATATCAAGTAAATTT

Fig. 2. Partial Comparison of the mtDNA-COII gene of different cockroach specie. The dashes (-) in the red square in the last three lines show the six DNA base pairs deletion in species of *Polyphaga* genus including the undescribed specimens (*Polyphaga* sp) and other two *Polypahaga aegyptica* from Japan (J) and London (L). The species from top to down respectively are: *Ergaula capucina*, *Blattella lituricollis*, *Blattella germanica*, *Symploce pallens*, *Pycnoscelus surinamensis*, *Blatta orientalis*, *Periplaneta americana*, *Periplaneta fuliginosa*, *Shelfordella lateralis*, *Eremoblatta subdiaphana*, and *Polypahaga aegyptica*.

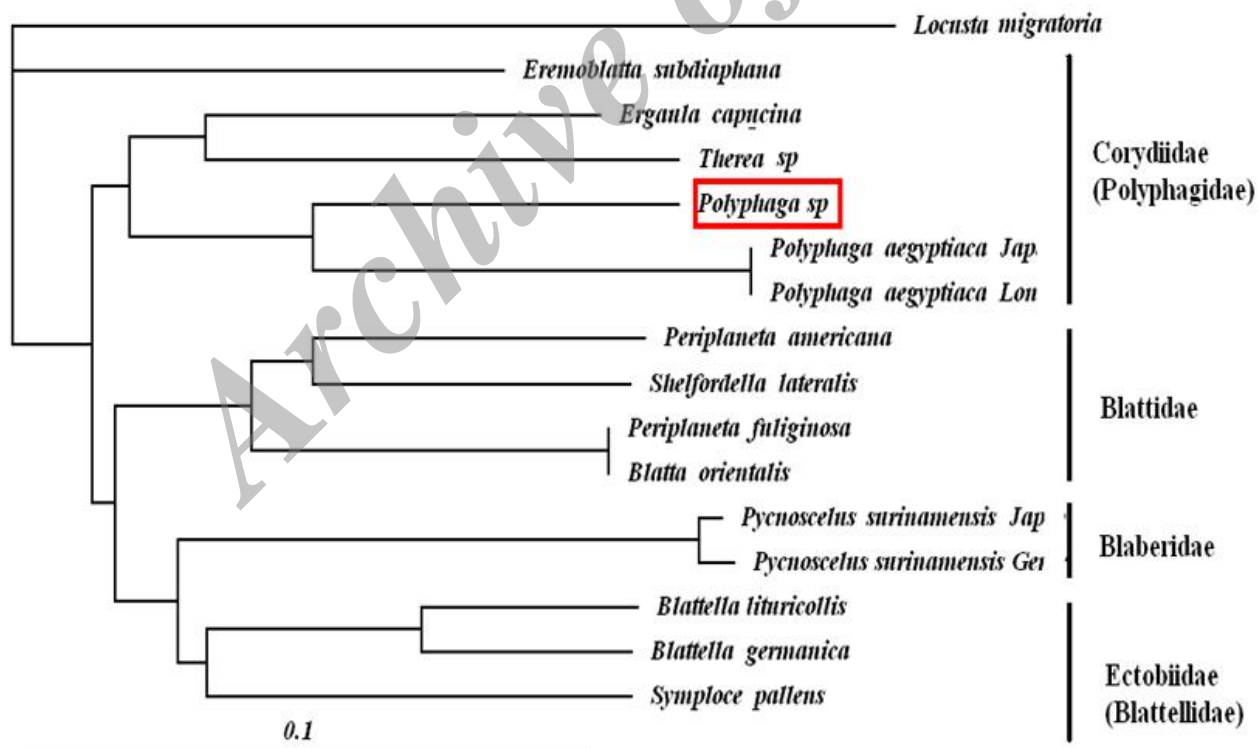


Fig. 3. The neighbor-joining tree for mtDNA-COII sequences of some representative species of four known cockroach families. Except for *Polyphaga* sp, sequence data of other species were retrieved from Genbank. The line underneath shows the genetic distance scale

Table 1. Classification of the 26 Iranian cockroach species. NS: Not stated

Superfamily	Family	Genus	Species	General name
Blattoidea	Blattidae	<i>Periplaneta</i>	<i>P. americana</i>	American
		<i>Periplaneta</i>	<i>P. australasiae</i>	Australian
		<i>Blatta</i>	<i>B. orientalis</i>	Oriental
		<i>Shelfordella</i>	<i>S. lateralis</i>	Turkistan
		<i>Shelfordella</i>	<i>S. monochroma</i>	NS
Corydioidea	Corydiidae (Polyphagidae)	<i>Tivia</i>	<i>T. inconspicua</i>	NS
		<i>Polyphaga</i>	<i>P. aegyptiaca</i>	Egyptian
		<i>Polyphaga</i>	<i>P. indica</i>	NS
		<i>Polyphaga</i>	<i>P. saussurei</i>	NS
		<i>Polyphaga</i>	<i>Polyphaga sp</i>	unknown
		<i>Hemelytrobatta</i>	<i>H. livida</i>	NS
		<i>Hemelytrobatta</i>	<i>H. subhyalina</i>	NS
		<i>Hemelytrobatta</i>	<i>H. longipes</i>	NS
		<i>Hemelytrobatta</i>	<i>H. roseni</i>	NS
		<i>Hemelytrobatta</i>	<i>H. marismortui</i>	NS
		<i>Hemelytrobatta</i>	<i>H. latifrons</i>	NS
		<i>Heterogamisca</i>	<i>H. persica</i>	NS
		<i>Leiopteroblatta</i>	<i>L. monodi</i>	NS
Blaberoidea	Ectobiidae (Blattellidae)	<i>Supella</i>	<i>S. longipalpa</i>	Brown-banded
		<i>Symploce</i>	<i>S. zarudniana</i>	NS
		<i>Blattella</i>	<i>B. biligata</i>	NS
		<i>Blattella</i>	<i>B. germanica</i>	German
		<i>Balta</i>	<i>B. ramifera</i>	NS
		<i>Phyllodromica</i>	<i>P. polita</i>	NS
		<i>Phyllodromica</i>	<i>P. persa</i>	NS
		<i>Parcoblatta</i>	<i>P. sp</i>	Wood

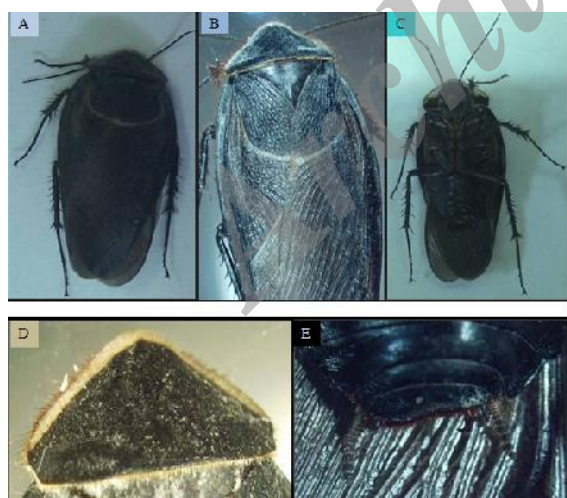


Fig. 1. Photos of an adult male specimen of *Polyphaga* sp found in Assad-Abad, northern Tehran, Iran, 2011. General top (A and B) and ventral (C) views, pronotum with a narrow yellowish band along anterior and lateral margins and straight posteriorly (D), and end of abdomen with a pair of anal styles (E). (Photos: original)

Discussion

Result of this study revealed presence of an undescribed species of *Polyphaga* in Iran. In this research we tried to use the cockroach morphological characteristics for identification of the unknown specimens but presence of some similar characteristics among three species of *P. indica*, *P. aegyptiaca*, and *Py. surinamensis* made identification problematic. This situation highlights usefulness of molecular data in resolving systematic of closely related species. The molecular analysis including phylogenetic analysis using mtDNA COII sequences showed that the specimens belong to Corydiidae (Polyphagidae) and suggested that they are most closely related to *Polyphaga* genus. MtDNA COII is the most frequently gene used for molecular system-

atic of cockroaches (Liu and Beckenbach 1992, Park et al 2004, Lo et al 2000 and 2006, Bergamaschi et al. 2007, Maekawa et al. 2007), however, due to lack of available data on different *Polyphaga* species in GenBank database, identification of the specimens at the species level postpones until other *Polyphaga* species molecular data becomes available. Also more specimens especially female specimens of the species should be collected and subjected to further morphological, biological and ecological investigations.

With regards to the report of the undescribed species, the cockroach fauna of Iran includes three families, 14 genera, and 26 species. However, it should be mentioned that since some species has not been collected or reported recently and many geographical regions of the country have not been studied yet, hence a systematic research is required to reveal the real cockroach list of the country.

Conclusion

The usefulness of molecular markers for species identification. Recently regions of mtDNA have been used as DNA barcodes to identify and classify living organisms. Application of DNA barcode could put light on many un-identified or questionable taxa. Due to lack systematic study on cockroach fauna of Iran, available data is not representing real fauna of the Iranian cockroaches. It is highly recommended to conduct a comprehensive systematic research using a combination of morphological, ecological, and molecular techniques in various geographical regions to reveal the composition of Iranian cockroach species.

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