Iranian Journal of Animal Biosystematics (IJAB)
Vol.18, No.1, 1-7, 2022
DOI: 10.22067/ijab.2022.72454.1019

IJAB
ISSN: 1735-434X (print); 2423-4222 (online)

RESEARCH ARTICLE Open access

A report on *Platyceps ventromaculatus* (Colubridae) from Fereydan County in Isfahan province-Iran

Rouhullah Dehghani [1], Behrooz Fathi H.[2]*, Nasrullah Rastegar Pouyani,[3] Nahid Chaharbaghi[1]

[1] *Social Determinants of Health (SDH) Research Center and Department of Environment Health and Kashan University of Medical Sciences, Kashan, Iran*
[2] *Department of Basic Sciences, Faculty of Veterinary Medicine, Ferdowsi University of Mashhad, Mashhad, Iran*
[3] *Department of Biology, Faculty of Science, Razi University, Kermanshah, Iran*

(Received: 11 September 2021; Accepted: 06 September 2022)

Abstract
Snakes are among the predatory reptiles in the wild. Due to the importance of knowing the habitats of these reptiles and their distribution, this study has been done. During the study, the specimen snake was found in the garden of a house in the region of Afus, of Fereydan County, in the west of Isfahan province. The city of Afus is 2800 meters above the sea level, on the roof of Iran. Afus is located at 50°5', 646 East longitude, and at 33°1', 464 North Latitude. Afus is a mountainous region with a moderate climate, its winters are cold and snowy while its summers are mild and pleasant. The mountainous nature of Afus and the sudden changes in temperature cause seasonal winds to blow. Temperature changes in this city are such that in winter and especially in January reaches minus 30°C and in summer and on the hottest day of the year will be 31°C. This suitable climate and soil type cause the growth of varieties of herbaceous plants and medicinal herbs in this region. The presence of these plants causes Afus land to be green and fertile in the hot season. After initial identification of this species according to the available sources, its photos and videos were presented to a high expert herpetologist who confirmed the identity of the snake. On the basis of morphological characters, the specimen was *Platyceps ventromaculatus* belong to the Colubridae family and is considered as a non-venomous snake.

Key words: *Platyceps ventromaculatus, Fereydan, Afus, Snake.*

INTRODUCTION

Snakes are incredible creatures, they have extraordinary, mysterious, and scary appearances and inspire fear in a way that no other type of animal can. They bite for hunting the prey or self-defense, some of them are venomous and some are non-venomous. Non-venomous snakes are about 90% of all snake species. There are about 3700 species that have been identified throughout the world in a variety of different habitats (Dehghani, 2017; Trape et al., 2001). Based on their habitats and human interference it is possible that incidences of bites take place. Most deaths from snake bites have been reported from South and Southeast Asia and sub-Saharan Africa (Bawaskar & Bawaskar, 2002).

Iran is located in a region with a tropical and subtropical climate, and a variety of snakes are habitant in this climate than in colder climates. The distribution of snakes throughout Iran has been reported from the southern islands located in the Persian Gulf to the northernmost regions (Rezaie-Atagholipour et al., 2016). Iran has 83 different identified species of snakes of which about 27 species are

Corresponding Author: b-fathi@um.ac.ir

FIGURE 1. Location of Isfahan Province and Afus in this province in the central of Iran.

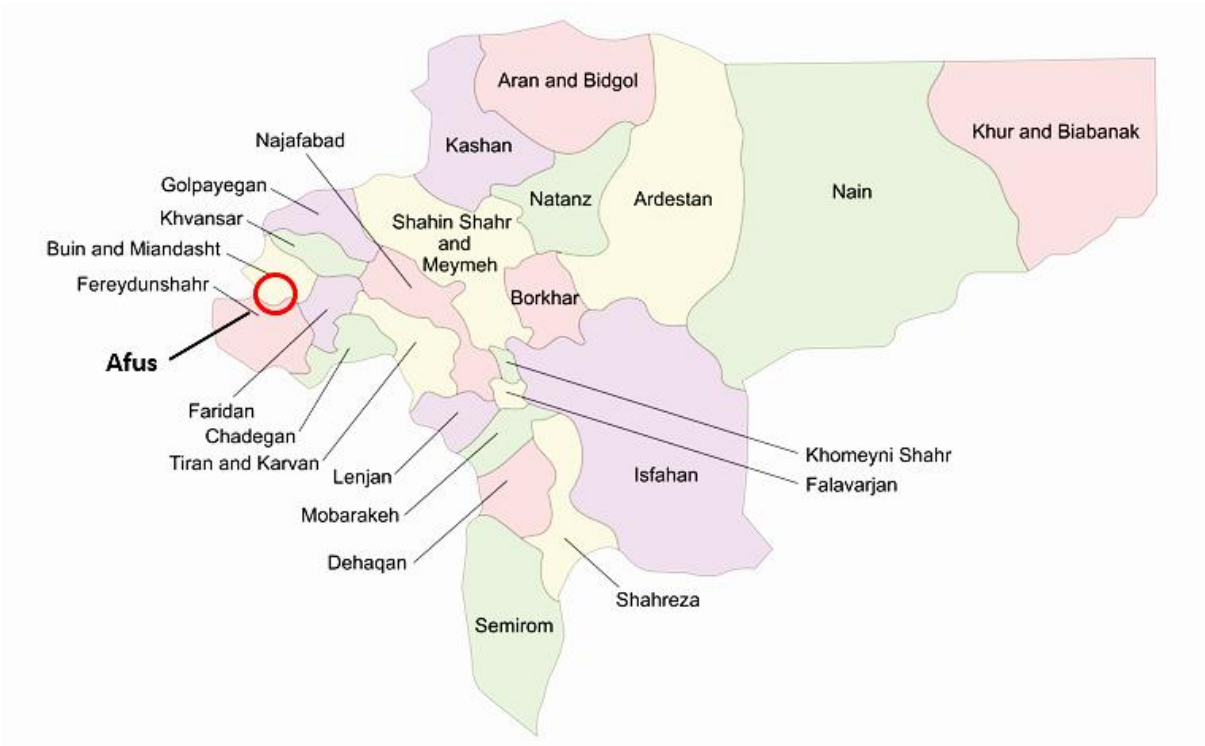

FIGURE 2. Isfahan Province and the location of Afus in the west of this province.

venomous and 11 species are semi-venomous. Non-venomous snakes or Aglypha have no venom gland and possess a series of simple teeth. Most of them have round pupils and their tail is usually round and long. They usually are active and very fast (Gholamifard, 2011; Dehghani et al., 2016a; Rastegar-Pouyani et al., 2008).

All venomous and non-venomous snakes bite for self-defense therefore, in addition to the possible envenomation, victims may experience mild to severe pain and discomfort. The snake oral bacterial flora contains a wide range of aerobic and anaerobic micro-organisms based on snake species and inhabitant geographical regions therefore, local or general bacterial and fungal infections, may also occur. People with immunodeficiency disorders are most likely to develop secondary infections (Dehghani et al., 2016b).

Snakes are the most important and valuable creatures in nature not only for their medical significance but also for their roles in ecosystem balance. They are Effective hunters and play a key role in the natural environment and food webs. As they are sign of a healthy ecosystem, their habitat, their population, and their proximity to humans should be given more attention.

Human possible misconceptions in different societies, ancient beliefs, common myths, fear, and hate about snakes, lead to an increase in their chance to be destroyed and kill. As a result, increase their risk of extinction (Reading et al., 2010; Jowkar et al., 2016). Therefore, investigation and collecting the exact information on their distribution, their habitat, and the risk of being bitten by them, can increase the level of awareness and knowledge of the people and change their perspective. These in turn can help to preserve these valuable animals for maintaining the balance of the ecosystem. On the other hand, accurate knowledge of living animals, their importance, and their role in nature will increase the level of public education and reduce people's unnecessary fear. This also will reduce the damage to their habitats and will preserve ecological values for future generations.

MATERIALS AND METHODS

The region of study

Afus City of Fereydan County is located in the west of Isfahan province and 5 km away from Isfahan, Lorestan, and Buin and Miandasht transit road. It is bordered to the north by Khansar city, to the south by Chaharmahal and Bakhtiari province, to the east by Najafabad city, and to the west by Aligudarz. The nearby cities to Afus are Barf Anbar, Buin and Miandasht, and Fereydunshar which are about eight kilometers distance. Afus is the highest city in Iran at an altitude of 2800 meters above sea level. The mountainous climate of this city is moderate in spring, rarely warm in summer, and very cold in winter. According to the studies from 1981 to 2001, the average annual rainfall is about 3,317.4 mm and the average annual temperature is about 10.4 °C, this average temperature causes pleasant weather on most days of spring and summer (Fig. 1, 2 and 3). The snake sample was first observed in a walnut garden of a house in Afus, and it took a long time for the animal to finally be captured.

Specimen morphometric character

The specimen of a snake was temporarily captured and examined live. Photos and videos were taken from the sample and its morphometric characteristics such as size, shape, color, and other characteristics were recorded (Table 1). It was an immature snake of 47 cm **in** length (Fig. 4). The head dorsal surface was black. The body is uniformly light olive green to grayish olive brown with different lines and patterns. The abdominal surface was clear with small dark spots on the lateral side. Two narrow and uniform olive-gray stripes were observed on its body back (Fig. 5) (Table 1). The dorsal surface had a transverse black zigzag band and was relatively regular. An ocular scale was attached to the forehead scale and below it, a small scale was located. It had two posterior ocular scales. The upper lip had nine scales, the fifth and sixth scales were attached to the eye. The scales on the back surface were smooth and arranged in 19 rows. The scales on the ventral surface were 205 and on the lower surface of the tail was 88. The scales of the anus were divided. All these characters were in accordance with Latifi and Mozaffari reports, (Latifi., 2000; Mozaffari et al., 2016). After primary identification and verification of the species according to reliable sources, the specimen photos and video were sent to a high expert herpetologist who finally

FIGURE 3. The location of Afus in the west of Isfahan province.

FIGURE 4. (Left & Right) Dorsal view of *Platyceps ventromaculatus*.

FIGURE 5. (Left) Lateral and (Right) dorsal view of *Platyceps ventromaculatus* head.

TABLE 1. Some metric (mm) and meristic characters of investigated specimen.

Variable	Measurement
Snout-vent length	470 mm
Tail length	110 mm
Supralabials	9
Dorsals	19 rows
Ventrals	205
Subcaudals	88

confirmed the exact identity of the snake. The Specimen was confirmed as *Platyceps ventromaculatus* snake. The snake then was released in the same habitat.

RESULTS AND DISCUSSION

The Colubridae family is one of the largest and the most diverse families of snakes. Their size varies and males and females often have a similar appearance but the female's tails are longer which gradually become narrower. The scales are symmetrical on the upper surface of the head. The scales on the dorsal surface of the body are smooth or keeled, the eyes are usually large and the pupils are round. The maxilla is fixed and located horizontally (Dehghani et al., 2016a; Rastegar-Pouyani, 2008). The Glossy Bellied Racer or *Platyceps ventromaculatus*, commonly known as Glossy Bellied Racer with synonym name as Coluber *ventromaculatus*, belongs to the Colubridae family. This species is widely distributed in the Southwest of Asia and it has been reported from India, Pakistan, Afghanistan, Turkey, Iraq, the former Soviet Union, Kuwait, Bahrain, and Saudi Arabia. These species feed on lizards, small mammals like mice and birds. As a hunter of insects and arthropods, they play an important role in their habitat. They are laying 3 to 7 relatively large eggs and newborns hatch in summer (Latifi, 2000). They are very calm in terms of behavior and are not dangerous or aggressive (Dehghani et al., 2016a; Safaei-Mahroo et al., 2015). They can easily be touched and picked up. Its habitats have been reported in desert areas, hillsides, and mountainous areas and in Iran, it has been reported in Tehran, Khorasan, Fars, Bushahr, Sistan and Baluchestan, Kerman, Khuzestan, Semnan, Kurdistan, Markazi, Qom, and Golestan provinces (Dehghani et al., 2016a; Latifi, 2000; Yousefkhani et al., 2014; Nasrabadi et al., 2016; Soleimanfallah et al., 2018; Hojati & Deymekar, 2020; Kazemi et al., 1015). Based on this study the snake's habitat is reporting in the mountainous region of Afus in the west of Isfahan province.

CONCLUSION

Although, distribution of *Platyceps ventromaculatus* has been reported from different provinces of Iran. But so far, its exact habitat in Isfahan province was unknown. Therefore, with this report, it is declared that its habitat is in the west of Isfahan province. A region that is characterized as a cold climate and at an altitude of 2800 meters above sea level.

LITERATURE CITED

Bawaskar, H.S., & Bawaskar, P.H., 2002. Profile of snake envenoming in western Maharashtra, India. Transactions of The Royal Society of Tropical Medicine Hygiene 96(1), 79-84.

Dehghani, R., 2017. Solpugidophobia in Iran: Real or Illusion. Journal of Biology and Today's World 6(3), 46-48.

Dehghani, R., Dadpour, B., Keyler, D., Panjehshahi, M., Jazayeri, M., Mehrpour, O., et al., 2016a. A survey on non-venomous snakes in Kashan (Central Iran). Journal of Biology and Today's World 5(4), 65-75.

Dehghani, R., Sharif, A., Assadi, M.A., Kashani, H.H., & Sharif, M.R., 2016b. Fungal flora in the mouth of venomous and non-venomous snakes. Comparative Clinical Pathology 25(6), 1-5.

Firouz, E. 2000. A Guide to the Fauna of Iran. Iran University Press; Tehran. 491 pp. [In Persian].

Gholamifard, A., 2011. Endemism in the reptile fauna of Iran. Iranian Journal of Animal Biosystematics, 7(1), 13-29.

Google map., 2015: available at (http://www.iranvisitor.com/index.php?cID=414&pID=1427)

Hojati, V. & Deymekar, M., 2020. The study of the snakes fauna of Taloo and Shirband hunting prohibited area in Semnan province. Nova Bioloica Reperta 7 (3), 285-294. (In Persian).

Jowkar, H., Ostrowski, S., Tahbaz, M., & Zahler, P., 2016. The conservation of biodiversity in Iran: threats, challenges and hopes. Iranian Studies 49(6), 1065-1077.

Kazemi, S.M., Rastegar-Pouyani, E., Shafiei Darabi S.A., Tehrani, M.E., Hosseinzadeh, M.S., Mashayekhi, M., et al., 2015. Annotated checklist of amphibians and reptiles of Qom Province, central Iran. Iranian Journal of Animal Biosystematics 11(1), 23-31.

Latifi, M., 2000. The snakes of Iran. 3nd ed. Environment Protection Organization publisher, Tehran Press.

Mozaffari, O., Kamali, K., & Fahimi, H., 2016. The atlas of reptiles of Iran. Tehran: Department of the Environment. 251-252(364pp). (In Persian and English).

Nasrabadi, R., Rastegar-Pouyani, E., Yousefkhani, S.S., & Khani, A., 2016. A checklist of herpetofauna from Sabzevar, Northeastern Iran. Iranian Journal of Animal Biosystematics 12(2), 255-259.

Reading, C.J., Luiselli, L.M., Akani, G.C., Bonnet. X., Amori, G., Ballouard, J.M., et al., 2010. Are snake populations in widespread decline? Biology Letters 6(6), 777-780.

Rezaie-Atagholipour, M., Ghezellou, P., Hesni, M.A., Dakhteh, S.M.H., Ahmadian, H., & Vidal, N., 2016. Sea snakes (Elapidae, Hydrophiinae) in their westernmost extent: an updated and illustrated checklist and key to the species in the Persian Gulf and Gulf of Oman. ZooKeys 622, 129-164.

Rastegar-Pouyani, N., Kami, H.G., Rajabzadeh, M., Shafiei, S., & Anderson, S.C., 2008. Annotated Checklist of Amphibians and Reptiles of Iran. Iranian Journal of Animal Biosystematics 4(1), 43-66.

Safaei-Mahroo, B., Ghaffari, H., Fahimi, H., Broomand, S., Yazdanian, M., Najafi-Majd, et al., 2015. The herpetofauna of Iran: checklist of taxonomy, distribution and conservation status. Asian Herpetological Research 6(4), 257-290.

Soleimanfallah, D., Hojati, V., Shajiee, H., Sharafi, S., Babaei Savasari, R., & Khani, S., 2018. The study of reptiles fauna in Sefid Kouh-Aresk no-hunting area in Semnan Province. Journal of Animal Environment 10(2), 97-106.

Trape, J.F., Pison, G., Guyavarch, E., & Mane, Y., 2001. High mortality from snakebite in south-eastern Senegal. Transactions of the royal society of tropical medicine hygiene 95, 420-423.

Yousefkhani, S.S., Yousefi, M., Khani, A., & Pouyani, E.R., 2014. Snake fauna of Shirahmad wildlife refuge and Parvand protected area, Khorasan Razavi province, Iran. Hepetology Notes 7(10, 75-82. https://www.researchgate.net/publication/260182693

Iranian Journal of Animal Biosystematics (IJAB)
Vol.18, No.1, 9-24, 2022
DOI: 10.22067/ijab.2022.71228.1016

IJAB
ISSN: 1735-434X (print); 2423-4222 (online)

RESEARCH ARTICLE Open access

Complementary investigation and taxonomic identification of starfishes, (Echinodermata: Asteroidea) from the Northern Persian Gulf, Iran

Behjat Adeli, Pargol Ghavam Mostafavi, Seyed Mohammad Reza Fatemi
Department of Marine Sciences, Faculty of Natural Resources and Environment, Science and Research Branch, Islamic Azad University, Tehran, Iran

(Received: *29 June 2021*; Accepted: 28 *April 2022*)

Abstract
Sea Stars are one of the most incredible creatures in the coastal and open waters. In this study, 11 species of starfishes have been identified which belonging to six genera and five families in northern islands of Persian Gulf during May 2017 to September 2018. Among the species, *Astropecten hemprichi* (Müller & Troschel, 1842), *Astropecten indicus* (Döderlein, 1888), *Astropecten polyacanthus polyacanthus* (Muller and Troschel, 1842), *Astropecten polyacanthus phragmorous* (Muller and Troschel, 1842), *Luidia hardwicki* (Gray, 1840), *Aquilonastra iranica* (Mortensen, 1940), *Linckia multifora* (Lamarck, 1816), *Culcita novaeguineae* (Muller & Troschel, 1842) and *Pentaceraster mammillatus* (Audouin, 1826) have been reported in the past. The species of *Aquilonastra watersi* (O'Loughlin and Rowe, 2006) and *Linckia laevigata* (Linnaeus, 1758) are new records in the Persian Gulf.

Key words: *Sea stars, morphology, Iran, systematic, Echinodermata*

INTRODUCTION

Asteroidea (starfish or sea stars) is one of the most diverse classes of phylum Echinodermata comprising about 1900 extant species (Mah and Blake, 2012). So far 21 species of starfishes are recorded for the Persian Gulf. The first report of Echinodermata in the Persian Gulf was performed by Mortensen in 1940. In this work 10 species of starfishes were identified from Iranian waters of the Gulf. Then Clark and Row (1971) in their paper with title of monograph of Shallow-water Indo-West Pacific Echinoderms described 13 species of starfishes from Persian Gulf. Price (1983) was reported 14 species from the Saudi coasts in the Persian Gulf in 1981 and 1983. Price and Rezai (1996) recorded the species of *Acanthaster planci* from Larak and Tonb-e-Kouchak Islands. Pourvali (2015) recorded six species of starfishes from Hormuz Island (Table 1).

Since studies on the morphological identification of starfish from Iranian waters of the Persian Gulf are very limited, our knowledge of the identification of this fauna in this region still remains unsatisfactory from a systematic and an ecological point of view. The aim of the present work is to expand our knowledge of the morphological characteristics of the species of Asteroidea from northern Persian Gulf and complements the molecular analysis performed by Adeli *et al*. (2020).

*Corresponding Author: *mostafavi_pa@srbiau.ac.ir*

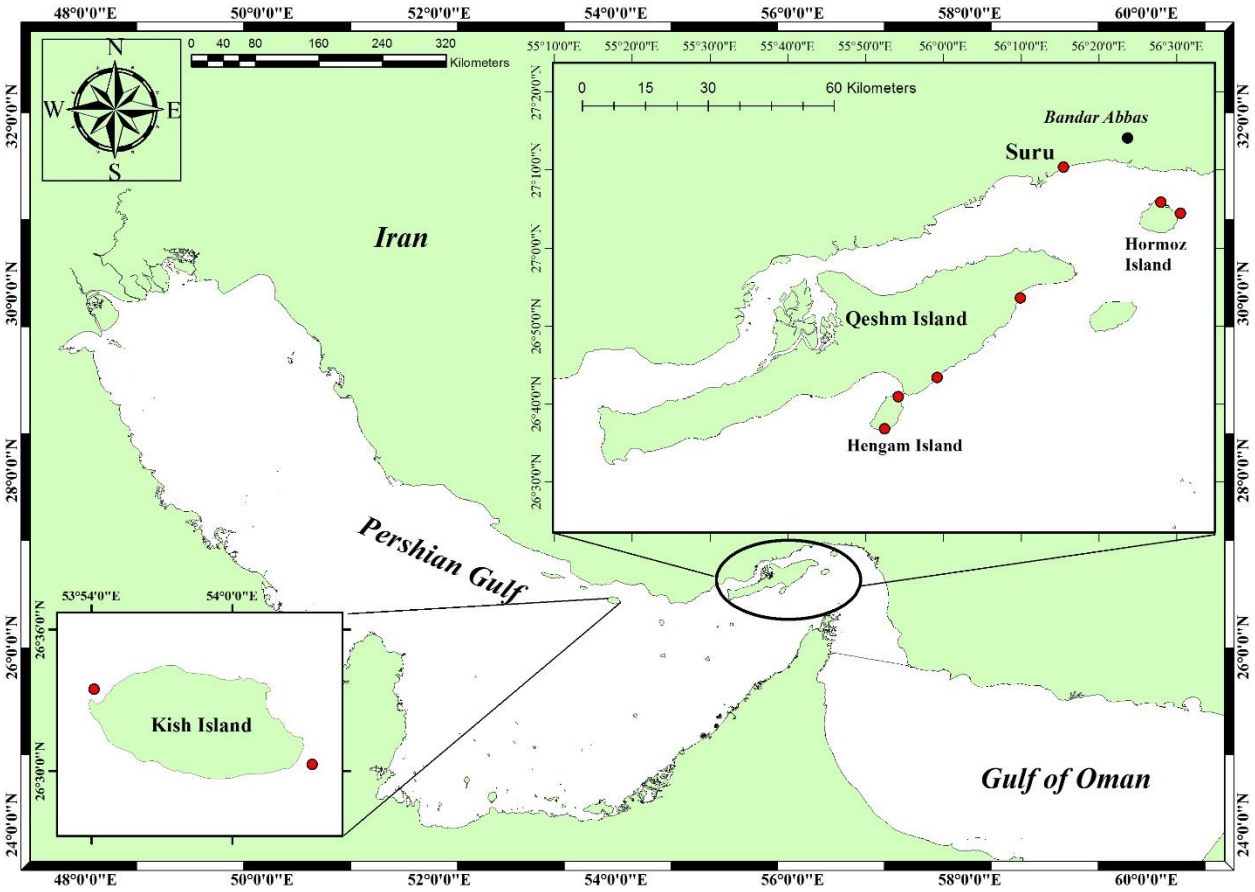

FIGURE 1. The locations of the sampling stations.

MATERIAL AND METHODS

52 specimens of starfishes were collected between May 2017 and September 2018 at nine locations from the northern islands (Qeshm, Kish, Hengam and Hormuz) and Suru beach in the tidal zones by scuba diving (Fig. 1). The samples were transferred to the laboratory and the significant morphological characteristics were photographed using a stereomicroscope (Leica Ez-40). The identification of species was performed following Clark and Row (1971).

RESULTS

Total of 11 species of starfishes was identified belonging to six genera, five families and two orders including *Astropecten hemprichi* (Müller & Troschel, 1842), *Astropecten indicus* (Döderlein, 1888), *Astropecten polyacanthus polyacanthus* (Muller and Troschel, 1842), *Astropecten polyacanthus phragmorous* (Muller and Troschel, 1842), *Luidia hardwicki* (Gray, 1840), *Aquilonastra iranica* (Mortensen, 1940), *Aquilonastra watersi* (O'Loughlin and Rowe, 2006), *Linckia laevigata* (Linnaeus, 1758), *Linckia multifora* (Lamarck, 1816), *Culcita novaeguineae* (Muller & Troschel, 1842) and *Pentaceraster mammillatus* (Audouin, 1826) (Table 2).

Taxonomic account

Class Asteroidea de Blainville, 1830

Order Paxillosida Perrier, 1884

Family Astopectinidae Gray 1840

Genus *Astropecten* Gray 1840

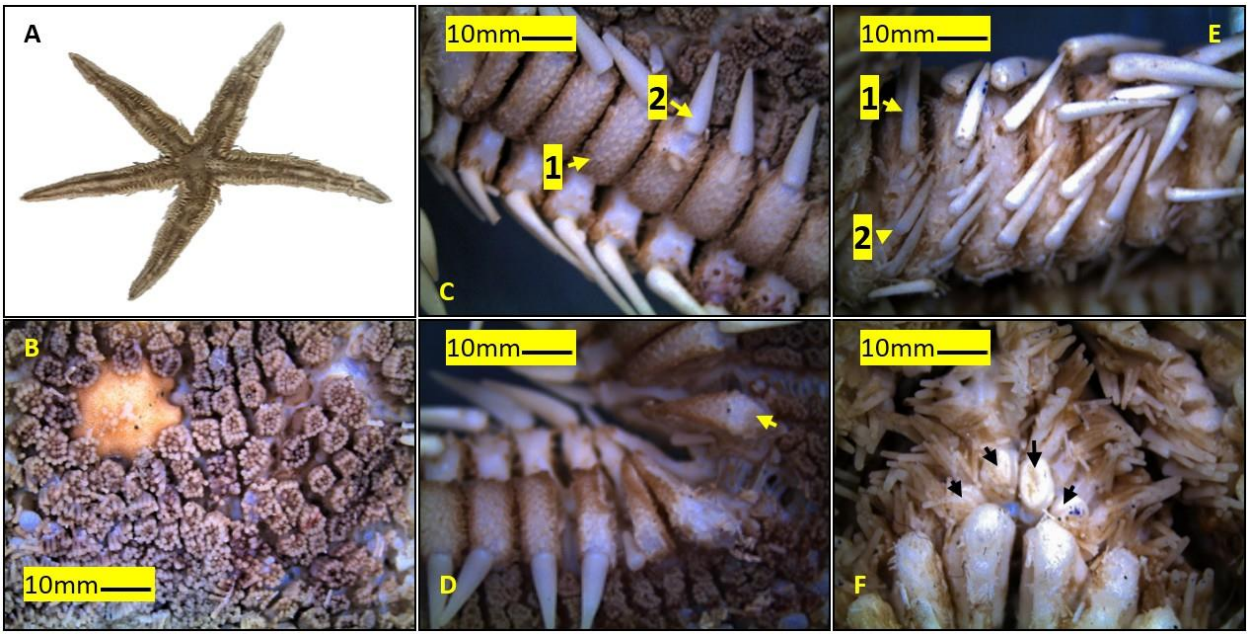

FIGURE 2. *Astropecten hemprichi.* A, Abactinal surface. B, Madreporite. C, 1) Supero marginal plates. 2) Supero marginal spine. D, Absence of spine in two first Supero marginal plates. E, 1) Infero marginal spines. 2) Ventral spines on Infero marginal plates. F, Actinal plates.

***Astropecten hemprichi* (Müller & Troschel,1842) (Fig. 2)**
Synonym: *Astropecten bonnieri* Koehler, 1905.

Remarks: five rays; R/r= 83/13. *Astropecten hemprichi* have long arms with 40 supero marginal plates. Disk paxillae bear numerous spinelet around the conspicuous madreporite. Supero marginal plates fringe with adradial (inner part) spines. These plates cover with dense squammules. This specimen has marginal spines on all of the outer edges of infero marginal plates with two rows ventral spines. Four actinal plates on interradius part of actinal surface. Ambulacral groove border with two rows of spines. Adambulacral spines were larger than the furrow spines and middle furrow spines were longer than remaining spines.
This species identified by two distinctive features. The first is the lack of supero marginal spines on first two plates. The next is brown stripes along interradius on abactinal surface.

Material examined: one specimen was collected from 10 m depth in sandy subtidal at Suru beach (27˚07′N, 56˚15′E).

General distributions: West, North and East of Indian Ocean, East Africa and Madagascar, Red Sea (Clark & Rowe, 1971); Southeast Coast of India (Chamundeeswari *et al.*, 2013); Persian Gulf (Price, 1981).

***Astropecten indicus* (Döderlein, 1888) (Fig. 3)**
Synonyms: *Astropecten pleiacanthus* Bedford, 1900**.**

Remarks: five rays; R/r=40/12 mm. Paxillae arrange regularly on abactinal surface of arms. Three to four actinal plates are at interradial area. The width of supero marginal plates is more than the length, when viewed from above. The supero marginal spines conspicuously arise on inner margin of the proximal supero marginal plates, (R= 40mm). Smaller specimens have a series of short spines on middle part of the supero marginal plates after the first ones. Ambulacral groove border with two rows of spines. Subambulacral spines are larger than the furrow spines and middle furrow spines are larger than other ones.

TABLE 1. Summary of identified asteroids in the Persian Gulf.

Species	Mortensen (1940)	Clark & Row (1971)	Price (1983)	Price & Rezai (1996)	Pourvali (2015)
Luidia hardwicki		●	●		●
Luidia maculata		●	●		
Luidia prionota		●			
Astropecten hemprichi			●		
Astropecten indicus	●	●	●		
Astropecten monacanthus			●		●
Astropecten phragmorous	●	●	●		●
Astropecten polyacanthus	●	●	●		●
Astropecten pugnax		●	●		
Anthenea rudis		●			
Stellaster equestris	●	●			
Pentaceraster mammillatus	●	●	●		
Leiaster leachi					
Linckia guildingi		●			
Linckia multifora	●	●	●		
Asteropsis carinifera			●		
Asterina cephea var. *iranica*[*]	●				
Asterina burtoni		●	●		
Aquilonastra samyni					●
Aquilonastra iranica					●
Acanthaster planci				●	
Euretaster cribrosus			●		

[*]is raised to species status (*Aquilonastra iranica)* by O'Loughlin and Waters in 2004.

TABLE 2. Identified asteroids in this study.

Species	n	Type of bed	Location
Astropecten hemprichi	1	Sandy	Subtidal/Suru beach
Astropecten indicus	4	Sandy	Subtidal/Hormus Island
Astropecten polyacanthus phragmorous	3	Muddy	Intertidal/Hormus Island
Astropecten polyacanthus polyacanthus	4	Muddy	Intertidal/Hormus Island
Astropecten sp.	1	Muddy	Intertidal/Hormus Island
Luidia hardwicki	7	Sandy	Subtidal/Suru beach Hormus Island
Aquilonastra iranica	2	Rocky	Subtidal/Qeshm Island
Aquilonastra watersi	10	Rocky	Subtidal/Qeshm Island
Linckia laevigata	5	Coral reef	Intertidal/Qeshm Island
Linckia multifora	2	Coral reef	Subtidal/Kish Island
Linckia sp.	10	Coral reef	Subtidal/Hengam Island
Culcita novaeguineae	1	Coral reef	Subtidal/Kish Island
Pentaceraster mammillatus	2	Coral reef	Subtidal/Hengam Island

Material examined: four specimens were collected from 10 m depth in sandy subtidal at Hormuz Island (27˚05′N, 56˚03′E).

General distributions: Arabian coast, West India and Pakistan, North and East of Indian Ocean (Clark & Rowe, 1971); Southeast Coast of India (Prabhu and Bragadeeswaran, 2012; Chamundeeswari *et al.*, 2013); Persian Gulf (Mortensen, 1940; Clark & Rowe, 1971; Price, 1981).

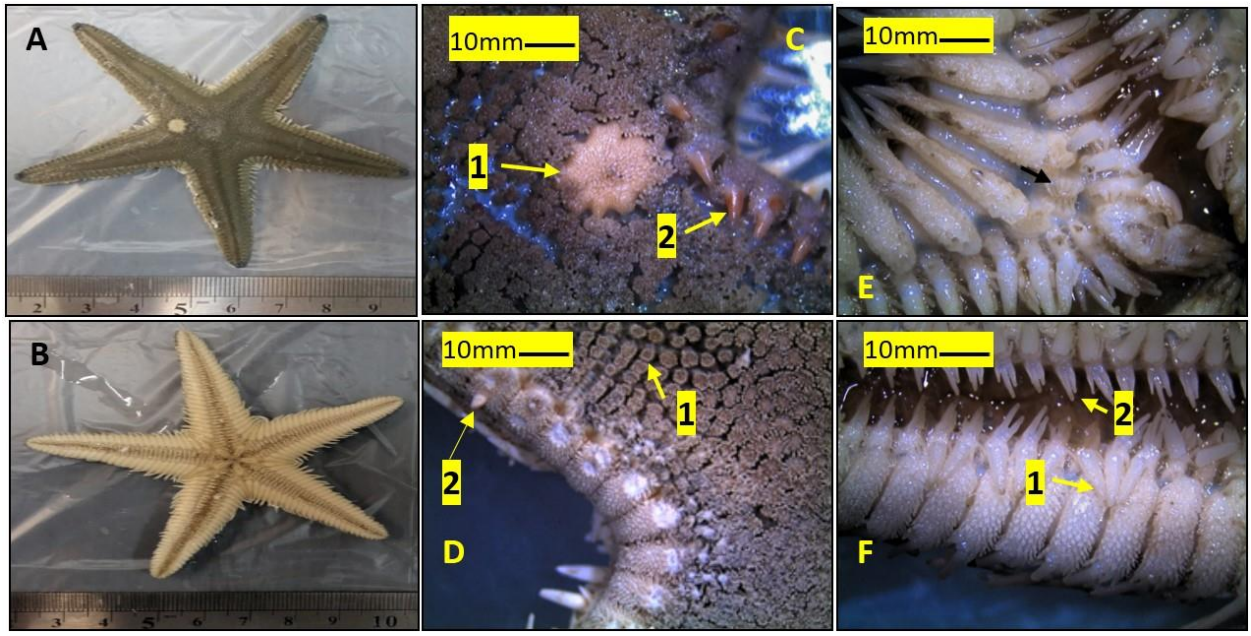

FIGURE 3. *Astropecten indicus.* A, Abactinal surface. B, Actinal surface. C, 1) Madreporites. 2) Supero marginal spines in the interradial part (R=40). D, 1) Regular paxillae. 2) Supero marginal spines on middle part of arm (R<40). E, Actinal plates. F, 1) Subambulacral spines. 2) Furrow spines.

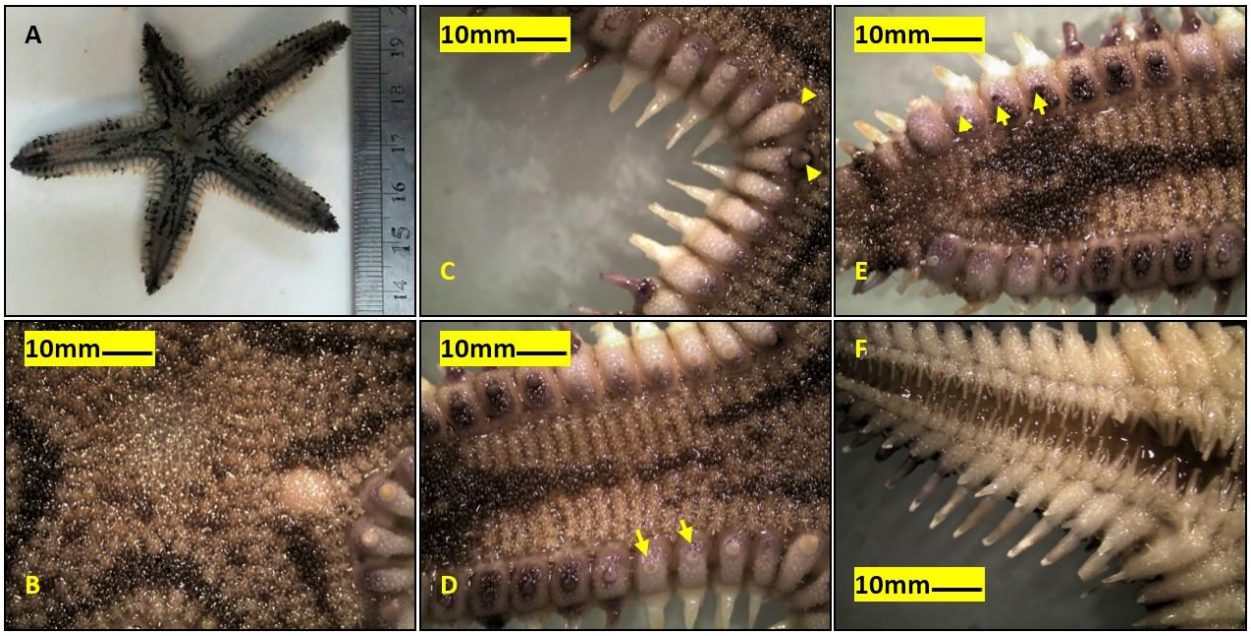

FIGURE 4. *Astropecten polyacanthus phragmorous.* A, Abactinal surface. B, Madreporites. C, Consecutive supero marginal spine on proximal part. D, Consecutive supero marginal spine on middle part of arm. D, Consecutive supero marginal spine on end of arm. F, Infero marginal plates and Furrow spines.

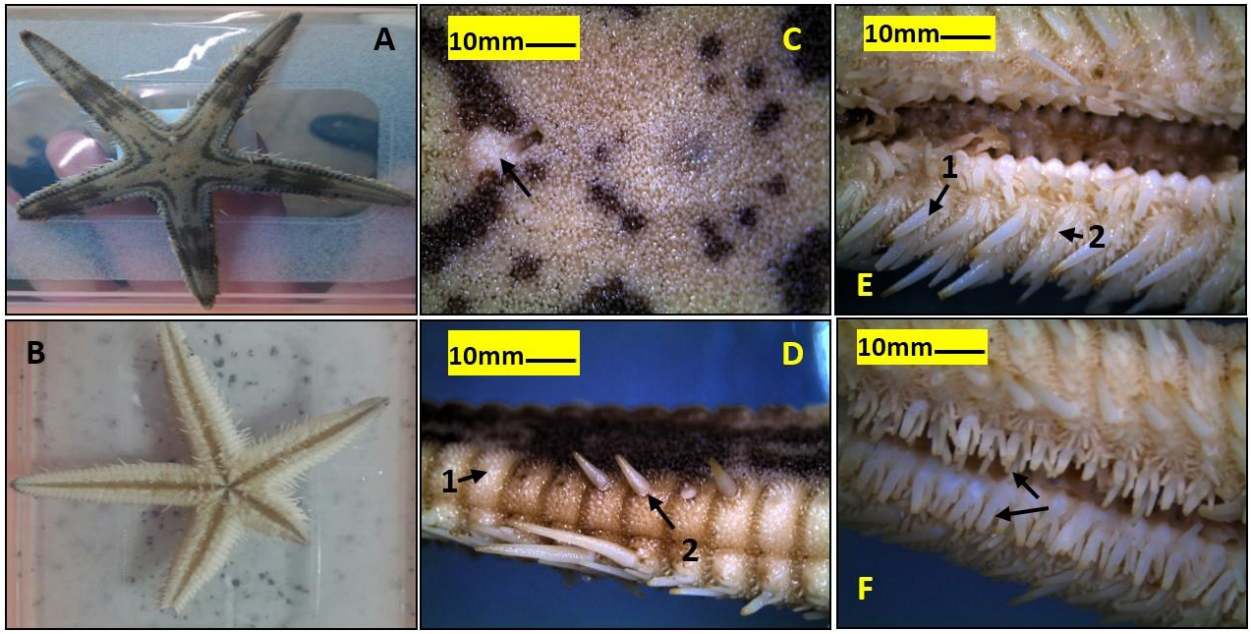

FIGURE 5. *Astropecten polyacanthus polyacanthus*. A, Abactinal surface. B, Actinal surface. C, Madreporites. D, 1) Supero marginal plates. 2) Supero marginal spines (some pages do not have spines). E, 1) Infero marginal spines. 2) Spinelets. F, 1) Adambulacral spines in two series.

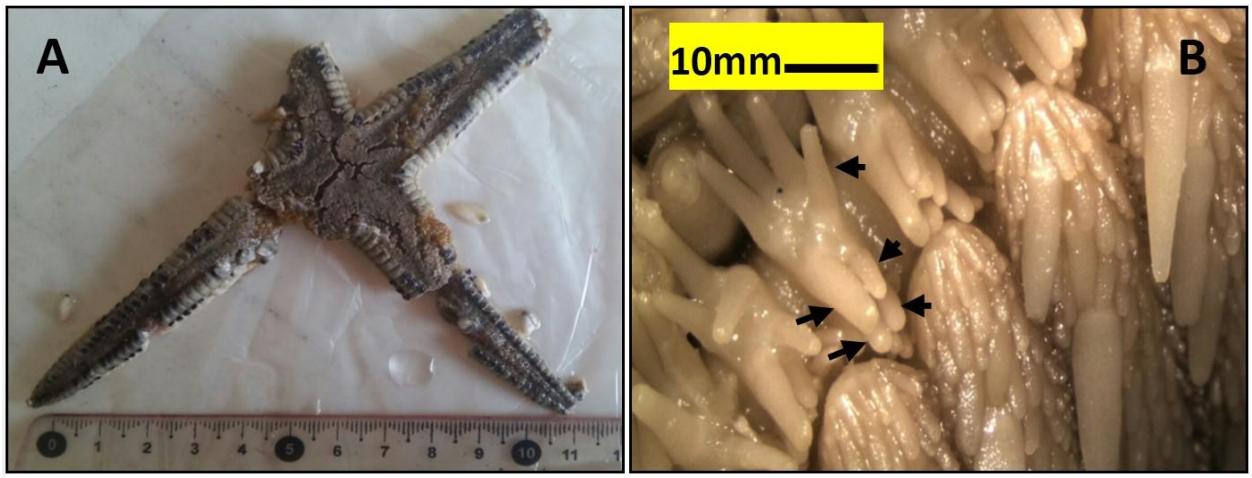

FIGURE 6. *Astropecten* sp. A, Abactinal surface. B, Adambulacral spines in more than two series.

***Astropecten polyacanthus phragmorous* (Fisher, 1913) (Fig. 4)**

Remarks: five rays; R/r=55/12 mm. Paxillae have one single central spinelet (adradial paxillae) or granule (carinal rows and disk paxillae) surrounded by six to eight peripheral ones. Madreporite sometimes conceal by the paxillae. The width of supero marginal plates is less than their length, when viewed from above. Most of the supero marginal plates cover by granules and bear conspicuous spines on upper edge. The supero marginal spines have one row consecutive supero marginal spine without any gap. Infero marginal plates have a series of large spines on margin and two rows of shorter spines on ventral part. The color of live specimens is light brown with dark spot.

Material examined: three specimens were collected from muddy intertidal at Hormuz Island (27˚05′N, 56˚27′E).

General distributions: Philippine Islands (Clark & Rowe, 1971); Persian Gulf (Mortensen, 1940; Clark & Rowe, 1971; Price, 1981; Pourvali, 2015).

***Astropecten polyacanthus polyacanthus* (Muller and Troschel, 1842) (Fig. 5)**

Synonyms*:* *Astropecten chinensis* Grube, 1866; *Astropecten edwardsi* Verrill, 1867; *Astropecten ensifer* Grube, 1866; *Astropecten hystrix* Müller & Troschel, 1842; *Astropecten samoensis* Perrier, 1869.

Remarks: five rays; R/r=51/11 mm. The difference in *Astropecten polyacanthus polyacanthus* and *A. polyacanthus phragmorous* is presence or abscence of spines on supero marginal plates. The supero marginal spines are reduced after the ones on proximal supero marginal plates in this specimen. Three acute spines present on each infero marginal plate with slender spinelets around them. Adambulacral plates have two series of spines with same length and width.

Material examined: four specimens were collected from muddy intertidal at Hormuz Island (27˚05′N, 56˚27′E).

General distributions: West, North and East of Indian Ocean, Mascarene Islands, East Africa & Madagascar, Red Sea, Arabian Coast, North Australia, Philippine Islands, China and South Japan, South Pacific Islands and Hawaiian Islands (Clark & Rowe, 1971); Persian Gulf (Mortensen, 1940; Clark & Rowe, 1971; Price, 1981; Pourvali, 2015).

***Astropecten* sp. (Fig. 6)**

Remarks: four rays; R/r=80/15 mm. The color form of this specimen is like *Astropecten polyacanthus* but the subambulacral spines are more than two series. This sample in terms of supero marginal spins is similar to *Astropecten polyacanthus polyacanthus* subspecies.

Material examined: one specimen was collected from muddy intertidal at Hormuz Island (27˚05′N, 56˚27′E).

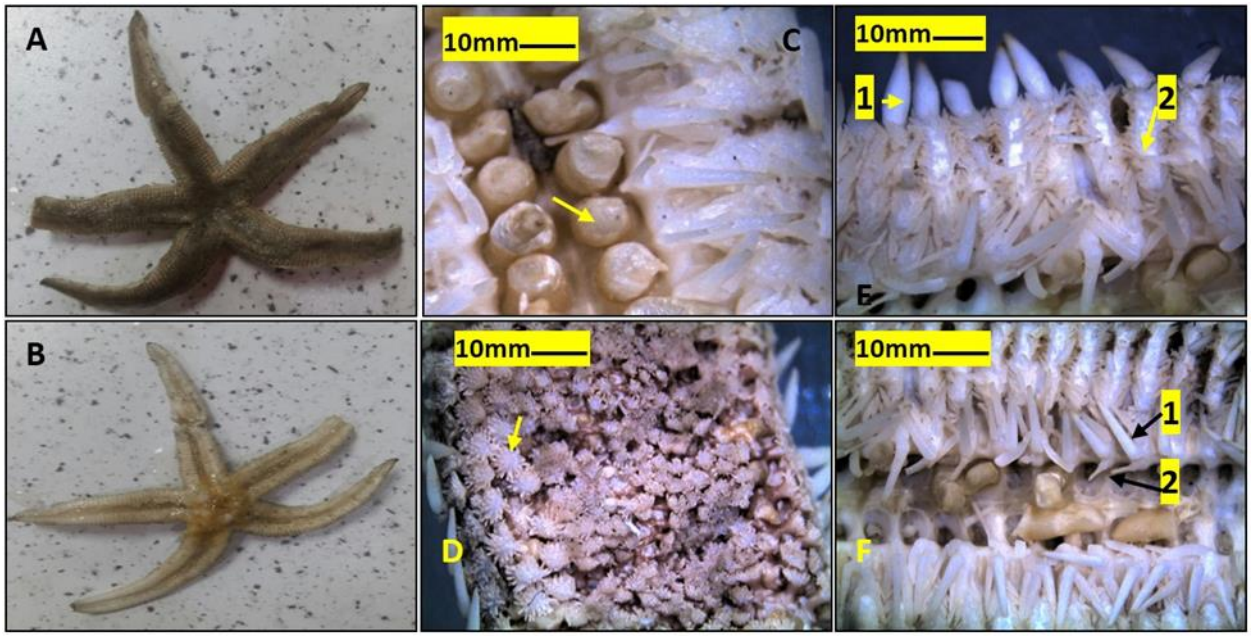

FIGURE 7. *Luidia hardwicki*. A, Abactinal surface. B, Actinal surface. C, Podia. D, Lateral paxilla cover supero marginal plates. E, 1) Infero marginal plates. 2) Spinelets on ventral part. F, 1) subambulacral spines. 2) Furrow spines.

Family Luidiidae Sladen, 1889
Genus *Luidia* Forbes, 1839
***Luidia hardwicki* (Gray, 1840) (Fig. 7)**

Synonyms: *Petalaster hardwicki* Gray, 1840; *Luidia forficifer* Sladen, 1889.

Remarks: five rays; R/r= 70/13 mm. Arms are flattened and the color in live specimens on center disk and carinal lines constricted are darker than other areas. Madreporite hidden by paxillae. Large paxillae with 10-15 central granules and 20-25 peripheral granular spinelets are in regular rows on lateral parts and transverse rows. Small ones occur with fewer granules on disk center and carinal lines. Supero marginal plates cover by lateral paxillae. Infero marginal plates have one row of well-defined marginal spine on outer edge and numerous spinelets on ventral part. The Length of lateral infero marginal spines is equal to the length of two consecutive infero marginal plates. Adambulacral plates have three spines; two straight subambulacral spines and curved furrow ones.

Material examined: five specimens were collected from 10 m depth in sandy subtidal at Hormuz Island (27˚05′N, 56˚03′E) and 2 specimens from Suru beach (27˚07′N, 56˚15′E).

General distributions: West, North and East of Indian Ocean, North Australia, China and South Japan (Clark & Rowe, 1971); Singapore (Vanden Spiegel *et al.*, 1998); Anambas (Purwati & Lane, 2004); Persian Gulf (Mortensen and Heding, 1940; Clark & Rowe, 1971; Price, 1981; Pourvali, 2015) and the Gulf of Oman (Fatemi and Fatemi, 2018)

Order Valvatida Perrier 1884
Family Asterinidea Gray, 1840
Genus *Aquilonastra* O'Loughlin & Waters, 2004

***Aquilonastra iranica* (Mortensen, 1940). (Fig. 8)**

Synonyms*: Asterina cephea* var. *iranica* Mortensen, 1940; *Asterina burtoni* Clark and Rowe, 1971, Price, 1983; *Asterina burtoni burtoni* var. *iranica* Clark, 1993; *Aquilonastra iranica* O'Loughlin and Waters, 2004.

Remarks: five rays; R/r= 20/10. The 5 proximal abactinal plates have two populae in the carinal parts. There are not any secondary plates between the abactinal plates. Abactinal plates have short, thick and conical spinelets in small clusters. There are about 12 spinelets in proximal abactinal plates. Actinal plates have about 4-6 thick and conical spinelets on interradial part. Each supermarginal plates with six spinelets located in the edge of abactinal surface. There are about six spinelets on distal interradial plates and 7 oral, 6 suboral and 6 furrow spines on actinal surface. The color of abactinal surface is Grayish with red or brown spots.

Material examined: two specimens were collected from rocky subtidal at Qeshm Island (26˚53′N, 56˚10′E).

General distributions: Iranian Gulf, Arabian Sea, West Pakistan, (O'Loughlin *et al.*, 2004); Persian Gulf (Mortensen, 1940; Pourvali, 2015).

***Aquilonastra watersi* (O'Loughlin and Rowe, 2006) (Fig. 9)**
Synonyms: *'Asterina'* sp. 1. Rowe and Richmond, 2004; *'Asterina'* sp. 2. Rowe and Richmond, 2004; *Asterina cephea*. Loriol, 1885.

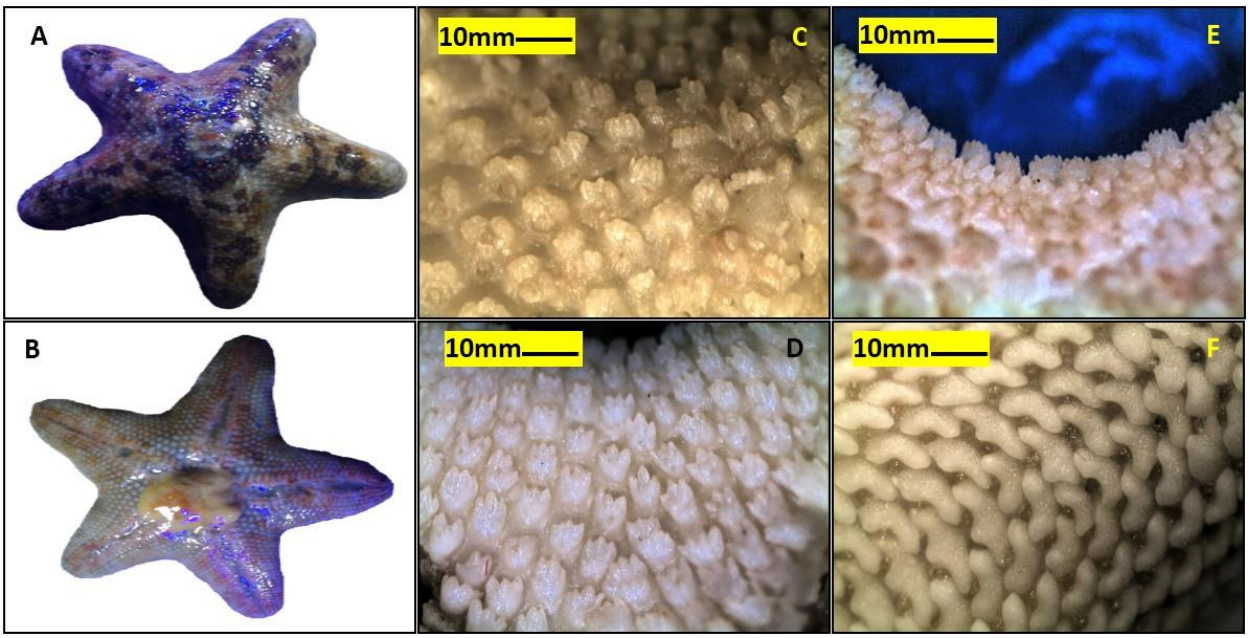

FIGURE 8. *Aquilonastra iranica.* A, Abactinal surface. B, Actinal surface. C, Abactinal plate spinelets. D, Actinal plate spinelets. E, Superomarginal plates in edge of abactinal surface. F, 2 papulate in a carinal plate and lacking secondary plates.

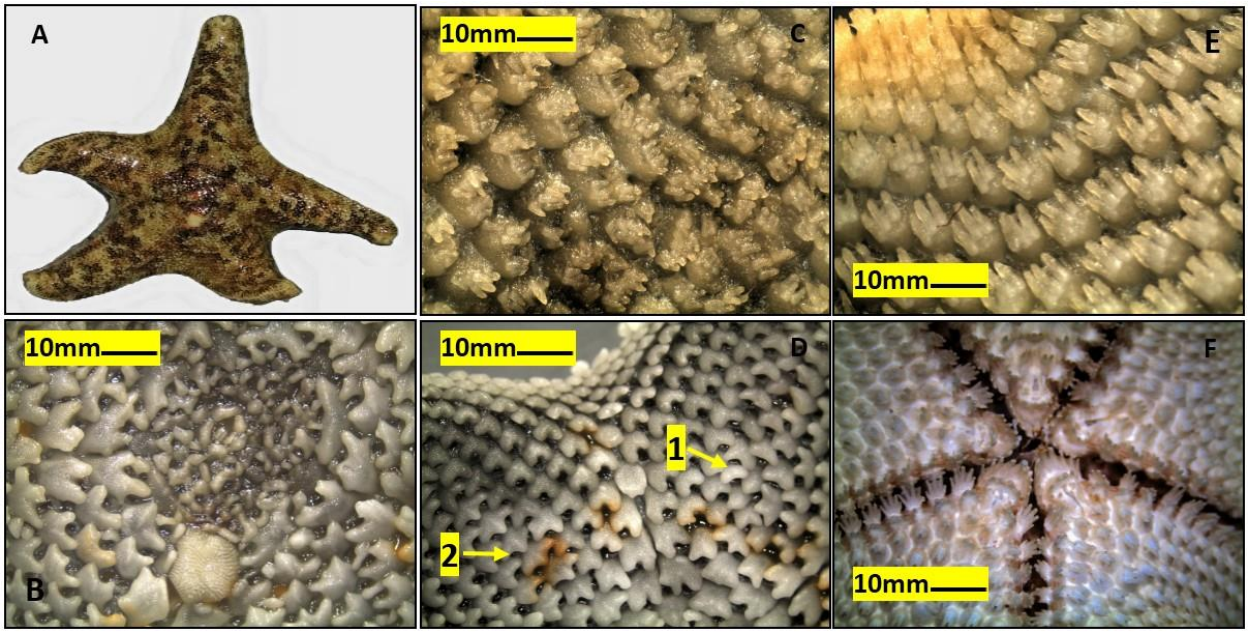

FIGURE 9. *Aquilonastra watersi.* A, Abactinal surface. B, Madreporites. C, Abactinal plate spinelets. D, 1) Secondary plate. 2) 2 papulate in a carinal plate. E, Actinal plate spinelets. F) Oral, suboral, furrow and subambulacral spines.

Remarks: five rays; R/r= 26/13. The arms are conical shaped and circulated at the tip. There is a conspicuous madreporite in the abactinal surface. The 6-7 proximal abactinal plates have two populae in the carinal parts. There are small secondary plates between the abactinal plates. The proximal abactinal plates are arranged in irregular series. Each Abactinal plate has small, thin and long spinelet in four clusters. There are 15 spinelets in per cluster. There are about 3-5 spinelets on distal interradial plates and

six oral, six suboral, five furrows and five subambulacral spines on actinal surface. These species were in two color patterns: gray with red spots and gray with green spots. *A. watersi* was distinguished by small secondary plates between the abactinal plates and daboule papulate in a carinal plate. This species is reported for the first time from the Persian Gulf.

Material examined: 10 specimens were collected from rocky subtidal at Qeshm Island (26˚53′N, 56˚10′E).

General distributions: Arabian Sea, Oman, Red Sea, Egypt, West Indian Ocean, Mauritius, Rodrigues (O'Loughlin *et al.*, 2004).

Family Ophidiasteridae Verrill 1870
Genus *Linckia* Nardo 1834

***Linckia laevigata* (Linnaeus, 1758) (Fig. 10)**

Synonyms*: Asterias laevigata* Linnaeus, 1758*; Linckia browni* Gray, 1840*; Linckia crassa* Gray, 1840*; Linckia hondurae* Domantay & Roxas, 1938*; Linckia laevigata f. hondurae* Domantay & Roxas, 1938*; Linckia miliaris* Muller & Troschel, 1840*; Linckia rosenbergi* von Martens, 1866*; Linckia suturalis* von Martens, 1866*; Linckia typus* Nardo, 1834*;Ophidiaster clathratus* Grube, 1865*; Ophidiaster crassa* Gray, 1840*; Ophidiaster laevigatus* Linnaeus, 1758*; Ophidiaster miliaris* Müller & Troschel, 1842*; Ophidiaster propinquus* Livingstone, 1932*; Asterias laevigata* Linnaeus, 1758.

Remarks: 5-6 ray; R/r= 45/5 mm. These starfishes have small disks with two madreporites. The arms are cylindrical and blunt at the tips. All plates covered by granules on actinal and abactinal surface. Popular areas have 5-15 pores on abactinal surface. The popular pore areas of supreo and infero-marginal plates are larger than surrounding plates. The granules on swollen areas are larger than depression areas. Subambulacral spines or tubercles separated from furrow spines by the granules. The furrow spines are in two sizes with unequal lengths. The color is blue with bluish-green spots. This is the first report of *Linckia laevigata* from the Persian Gulf and Iranian waters.

Material examined: five specimens were collected from intertidal area at Qeshm Island (26˚41′N, 55˚55′E).

General distributions: West, North and East of Indian Ocean, Mascarene Islands, East Africa & Madagascar, North Australia, Philippine Islands, China and South Japan, South Pacific Islands and Hawaiian Islands (Clark & Rowe, 1971).

***Linckia multifora* (Lamarck, 1816) (Fig. 11)**

Synonyms: *Asterias multifora* Lamarck, 1816; *Linckia costae* Russo, 1893; *Linckia leachi* Gray, 1840; *Linckia typus* Gray, 1840; *Ophidiaster multiforis* Lamarck, 1816.

Remarks: 5-6 rays; R/r= 50/5mm. The arms are more slender and tipped with unequal length in these specimens. The ratio of R in r often exceeded from 10 mm. This specimen has two madreporites and a variegated color of brownish with red spots. The granules, popular pore areas, subambulacral spines and furrow spines are like *Linckia laevigata.*

Material examined: two specimens were collected from 4.5 m in coral reefs at Kish Island (26˚30′N, 54˚03′E).

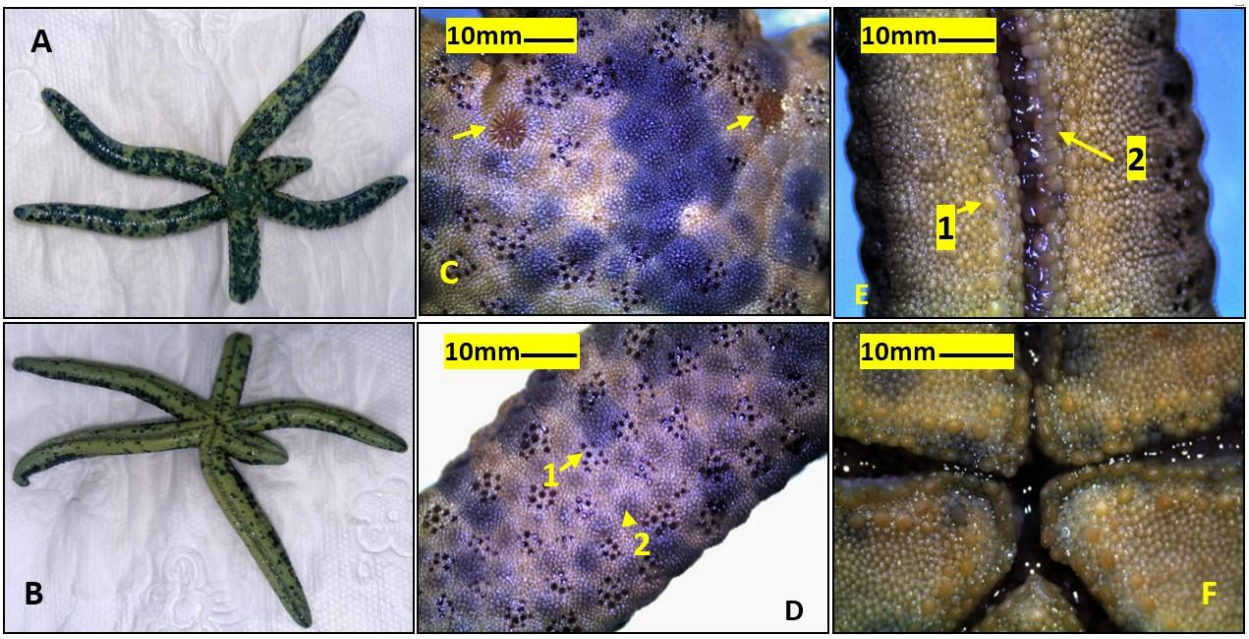

FIGURE 10. *Linckia laevigata*. A, Abactinal surface. B, Actinal surface. C, Madreporites. D, 1) Popular pore areas. 2) Granules. E, 1) Subambulacral spines. 2) Furrow spines. F, Abactinal spines.

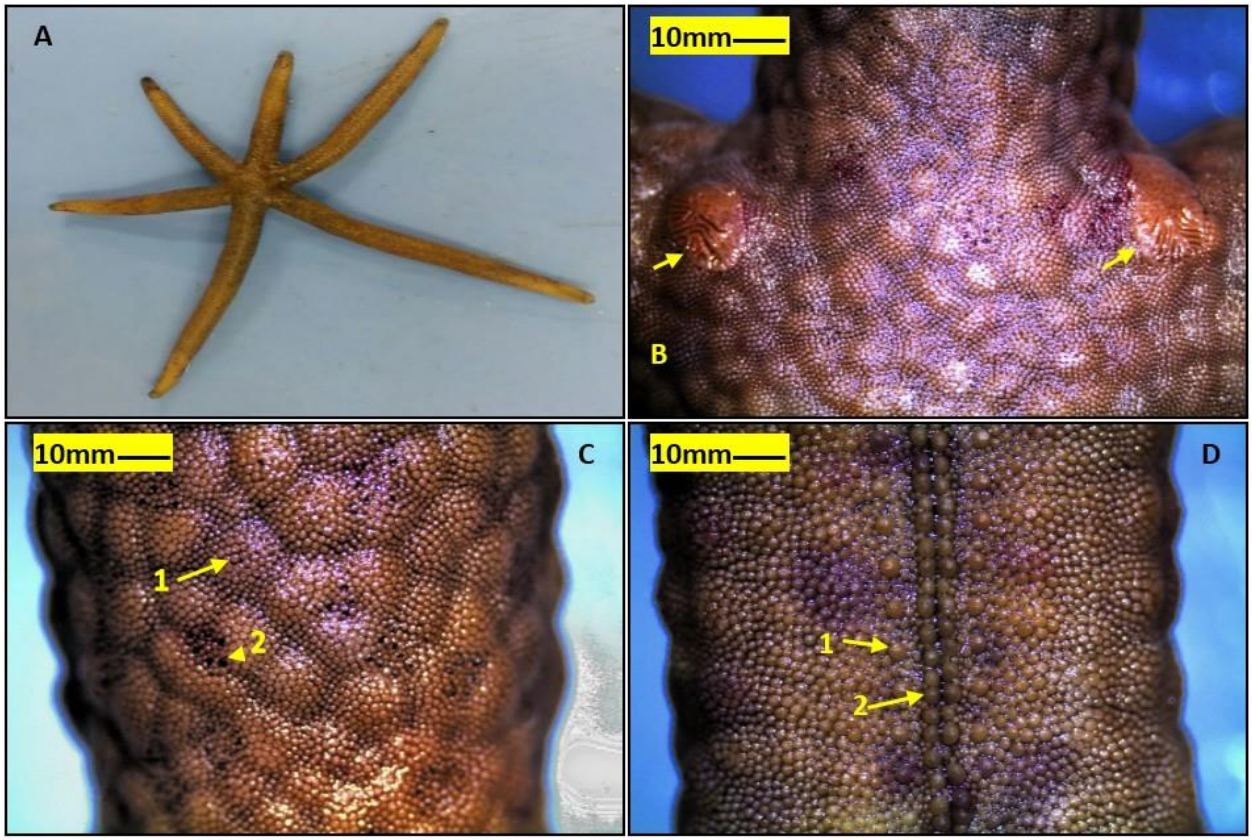

FIGURE 11. *Linckia multifora*. A, Abactinal surface. B, Madreporites. C, 1) Granules 2) Popular pore areas. D, 1) Subambulacral spines. 2) Furrow spines.

General distributions: West, North and East of Indian Ocean, Mascarene Islands, East Africa & Madagascar, Red Sea, Arabian Coast, North Australia, Philippine Islands, China and South Japan, South Pacific Islands and Hawaiian Islands (Clark & Rowe, 1971); Persian Gulf (Mortensen and Heding, 1940; Clark & Rowe, 1971; Price, 1981).

***Linckia* sp. (Fig. 12)**

Remarks: five rays; R/r= 47/5 mm. The shape and length of arms are an intermediate form between *Linckia laevigata* and *Linckia multifora.* This specimen has two madreporites. This specimen is similar to other species of *Linckia* in granules, subambulacral and furrow spines. The color is orange with green spots in live sample.

Material examined: 10 specimens were collected from coral reefs at Hengam Island (26˚40′N, 55˚54′E).

Family Oreasteridae Fisher, 1911
Genus *Culcita* Agassiz, 1836

***Culcita novaeguineae,* (Muller & Troschel, 1842) (Fig. 13)**

Synonyms: *Anthenea spinulosa* Gray, 1847; *Culcita acutispinosa* Bell, 1883; *Culcita grex* Muller & Troschel, 1842; *Culcita pentangularis* Gray, 1847; *Culcita plana* Hartlaub, 1892; *Goniaster multiporum* Hoffman in Rowe, 1974; *Goniaster sebae* Muller & Troschel, 1842; *Goniodiscides sebae* Muller & Troschel, 1842; *Hippasteria philippinensis* Domantay & Roxas 1938; *Hosia spinulosa* Gray, 1847; *Pentagonaster spinulosus* Gray, 1847; *Randasia granulata* Gray, 1847; *Randasia spinulosa* Gray, 1847.

Remarks: Outline of the body pentagonal to circular. The body is cushion-like without prominent tubercles. Actinal plates have polygonal granules. The color is light greenish black. It is common in reef flats at low tide.

Material examined: one specimen was found at 12m depth in coral reefs at Kish Island (26˚34′N, 53˚53′E).

General distributions: East Indies, North Australia, Philippine Islands, China and South Japan, South Pacific Islands and Hawaiian Islands (Clark & Rowe, 1971). India (Raghunathan, *et al.*, 2013).

Genus *Pentaceraster* Döderlein, 1916.
***Pentaceraster mammillatus* (Audouin, 1826) (Fig. 14)**

Synonyms: *Asterias mammillata* Audouin, 1826; *Oreaster mammillatus* Audouin, 1826; *Oreaster verrucosus* Müller & Troschel, 1842; *Pentaceros mammillatus* Audouin, 1826; *Pentaceros verrucosus* Muller & Troschel, 1842.

Remarks: five rays; R/r= 150/60 mm. A large starfish with well-developed arms. The plates form regular series in the abactinal and actinal surfaces. Most spinose specimens have spines constricted at the base with a tubercle at the tip. In specimens with less spine, the lateral spines are smaller than the carinal spines. Actinal surfaces cover with polygonal and rounded granules. The supero- and infero-marginal plates are very similar. The adambulacral plates have eight slender furrow spines that the centers are longer than sides. These plates bear two or three subambulacral spines with unequal lengths. The oral plates have twelve furrow spines, increasing in length towards the mouth, and three or four large subambulacral spines.

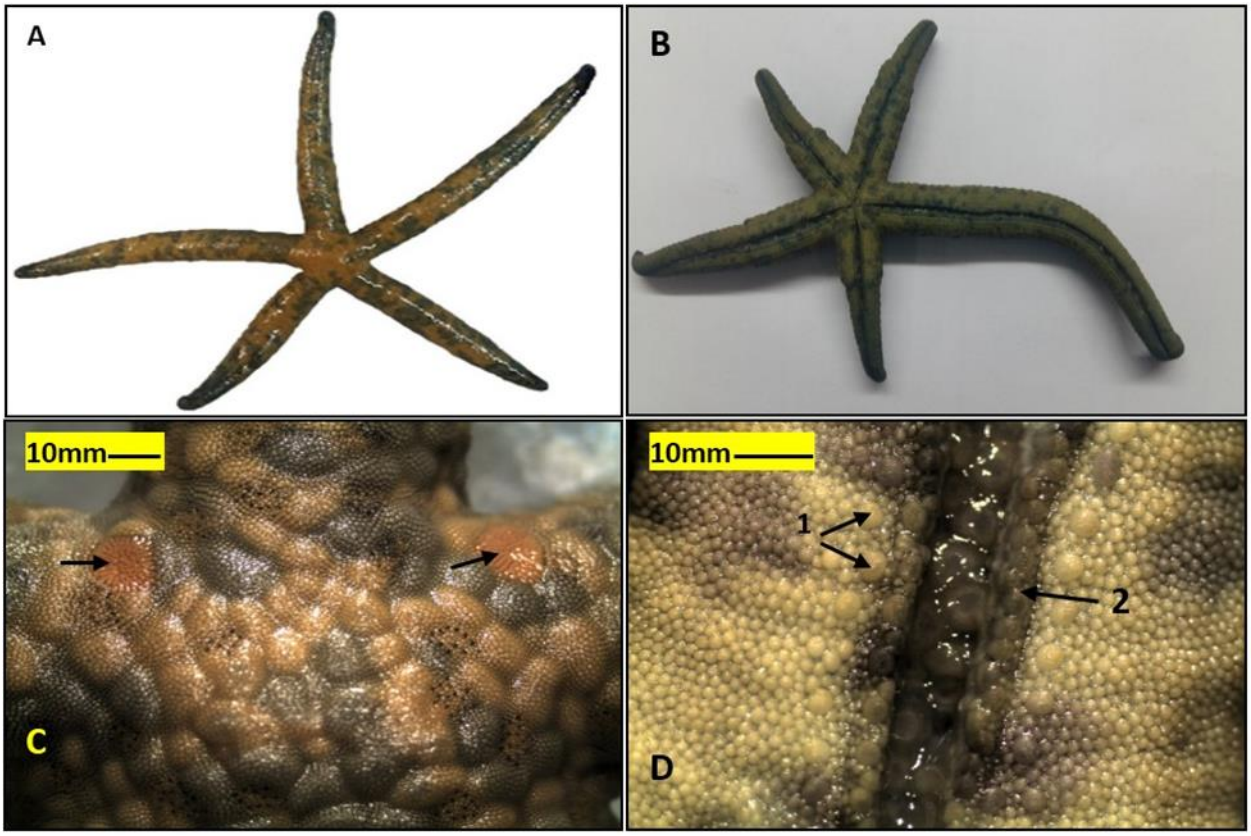

FIGURE 12. *Linckia* sp. A, Abactinal surface. B, Actinal surface. C, Madreporites. D, 1) Ambulacral spines. 2) Furrow spines.

FIGURE 13. *Culcita novaeguineae* in natural habitat. Actinal plates with polygonal granules.

Material examined: two specimens were collected from coral reefs at Hengam Island (26˚38′N, 55˚54′E).

General distributions: East Africa and Madagascar, Red Sea, Arabian coast (Clark & Rowe, 1971); Mozambique (Walenkamp, 1990); Persian Gulf (Mortensen and Heding, 1940; Clark & Rowe, 1971; Price, 1981).

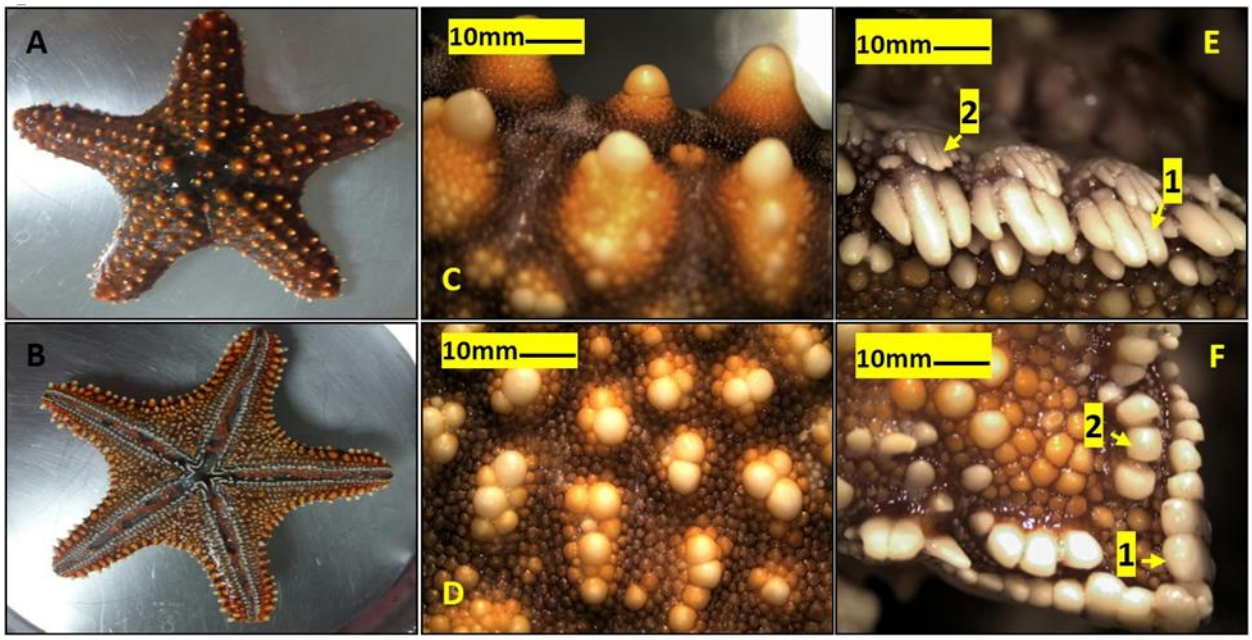

FIGURE. 14 *Pentaceraster mammillatus*. A, Abactinal surface. B, Actinal surface. C, Supero- and infero-marginal plates. D, Granules in the actinal surface. E, 1) Subambulacral spines. 2) Furrow spines at the adambulacral plates. F, 1) Furrow spines. 2) Subambulacral spines at the oral plates.

DISCUSSION

In this survey, 11 species of asteroids were identified which two species of *Linckia laevigata* (Linnaeus, 1758) and *Aquilonastra watersi* (O'Loughlin and Rowe, 2006) are new records in the Persian Gulf.

The genus *Linckia* distinguishes by cylindrical arms, small oral discs, granules and popular pores on aboral surface. Although Clark and Row (1971) suggested color in life is useful for identifying *Linckia* species, but there is considerable diversity in color of some specimens. They suggested *Linckia* species which have colors of blue and green-blue with an R/r=5-10/1 ratio, are named *Laevigata* and the specimens that were red or yellow, with an R/r= 10/1 ratio of more than 10, are called *multifora*. Previous studies demonstrated that *L. Laevigata* with color variation is common in the Indo-West Pacific. Williams (2000) displayed the species of *L. Laevigata* and *L. multifora* can be distinguished when alive by color pattern, number of madreporites and the ratio of arm length to breadth. In our study, since all specimens of *Linckia* with different color patterns have 2 madreporites, so determination of species boundary needs more research. Molecular analysis can aim to clarify the specimens like *Linckia* sp (Figure 12) with phenotypic diversity. Since molecular analysis along with morphological studies can aim to clarify the specimens like Linckia *sp* (Figure 12), we found this species is *Linckia Laevigata* in our previous literature (Adeli *et al*.,2020).

Among the families of Asteroidea, Astropectiniidae has the most genus and species after Goniasteridae (Mah and Blake, 2012). The genus *Astropecten* with 150 species has the most speciose genus and abundant species in shallow waters. Zulliger and Lessios (2010) identified 40 species in the widespread tropical genus *Astropecten* and discovered species complexes and likely cryptic species. In these previous studies in morphological identification of species of *Astropecten* (Gondim, *et al.,* 2014) several taxonomic characters such as paxillae and the superomarginal plates with the number and shape of the superomarginal spines were used to distinguish the species of *Astropecten*. The character of adambulacral spines is similar among these specimens. *Astropecten* sp. (Figure 6) differs from other species of *Astropecten polyacanthus* for the number of subambulacral spines and arm length. We thought it was *Astropecten hemprichi* for having a long arm, but the character of color pattern similar to *Astropecten polyacanthus* rejected this assumption. However, there is high morphological diversity in this genus. This phenotypic variability leads to different subspecies and it is difficult to identify

morphologically. Our molecular results (Adeli et al.,2020) showed this species belongs to *Astropcten polyacanthus.*

Conclusion

Eleven species were identified in this study including: *Astropecten hemprichi* (Müller & Troschel, 1842), *Astropecten indicus* (Döderlein, 1888), *Astropecten polyacanthus polyacanthus* (Muller and Troschel, 1842), *Astropecten polyacanthus phragmorous* (Muller and Troschel, 1842), *Luidia hardwicki* (Gray, 1840), *Aquilonastra iranica* (Mortensen, 1940), *Aquilonastra watersi* (O'Loughlin and Rowe, 2006), *Linckia laevigata* (Linnaeus, 1758), *Linckia multifora* (Lamarck, 1816), *Culcita novaeguineae* (Muller & Troschel, 1842) and *Pentaceraster mammillatus* (Audouin, 1826). Although this study has increased knowledge of the biodiversity of asteroids especially in the northern islands of Persian Gulf, the present records are thought to be incomplete. The absence of species from the other starfish families indicates that more sampling is needed, especially in deeper waters and suggests the possibility of additional starfish taxa being present.

LITERATURE CITED

Adeli, B., Ghavam Mostafavi P. and Fatemi M.R., 2020. Morphological identification and phylogenetic analysis of Asteroidea in the northern coast of the Persian Gulf. Iranian Journal of Fisheries Sciences 19, 3034-3049.

Chamundeeswari K.; Saranya S., Shanker S., Varadharajan D., and Rajagopal S., 2013. Incidental Catch and New Distributional Records of Asteroids by Bottom Trawling Activities from Southeast Coast of India. Journal of Aquatic Research. 4: 198.

Clark, A.M. and Rowe, F.W.E., 1971. Monograph of Shallow-water Indo-West Pacific Echinoderms. London: British Museum (Natural History), 238 pp.

Fatemi, Y. and Fatemi, R., 2018. New data on the genus Luidia Forbes, 1839 (Asteroidea Luidiidae) from the Gulf of Oman and first record of Luidia maculate Müller et Troschel, 1842 in this region. Biodivers, 9, 143–148.

Mah, C.L., and Blake, D.B., 2012. Global Diversity and Phylogeny of the Asteroidea (Echinodermata). PLoS ONE 7, e35644.

Mortensen, T., and Heding, S.G., 1940. Echinoderm from the Iranian Gulf. In Danish scientific investigation in Iran, Part II. Copenhagen: Einar Munksgaard, pp. 55–137.

O'Loughlin, P. M. and Rowe, Francis W.E. 2006. A systematic revision of the asterinid genus Aquilonastra O'Loughlin, 2004 (Echinodermata: Asteroidea). Memoirs of Museum Victoria, 63, 257–287.

O'Loughlin, P.M. and Waters, J.M., 2004. A molecular and morphological revision of genera of Asterinidae (Echinodermata: Asteroidea). Memoirs of Museum Victoria 61, 1–40.

Price, A.R.G., 1981. Studies on the echinoderm fauna of the western Arabian Gulf. Journal of Natural History 15, 1-15.

Price, A.R.G., 1982. Echinoderm of Saudi Arabia. Comparison between Echinoderm faunas of Arabian Sea, SE Arabia, Red Sea, Gulfs of Aqaba and Suez. Fauna of Saudi Arabia, 4, 3–21.

Price A.R.G., 1983. Echinoderms of Saudi Arabia. Echinoderm of the Gulf, Fauna of Saudi Arabia 5, 28–108.

Price A.R.G. and Rezai H., 1996. New echinoderm records for the Gulf including crown-of-thorns starfish, Acanthaster planci (Linnaeus), and their biogeographical significance. Fauna of Saudi Arabia 15, 386–390.

Pourvali, N., 2015. Intertidal echinoderms (Asteroidea, Echinoidea, Ophiuroidea) from Hormuz Island in the strait of Hormuz (Persian Gulf, Iran). Marine Biodiversity Research 8, e50.

Prabhu k. and Bragadeeswaran, S., 2012. Abnormal starfish Astropecten indicus along Southeast coast of India. Biotemas, 25, 295-298.

Purwati, P. and Lane, D.J.W., 2004. Asteroidea of the Anambas expedition 2002. Raffles Bulletin of Zoology 11, 89–102.

Raghunathan, C., Sadhukhan, K., Mondal, T., Sivaperuman, C., and Venkataraman, K., 2013. A Guide to Common Echinoderms of Andaman and Nicobar Islands: 1-210.

VandenSpiegel, D., Lane, D. J.W., Stampanato, S., and Jangoux, M., 1998. The asteroid fauna (Echinodermata) of Singapore, with a distribution table and an illustrated identification to the species. Raffles Bulletin of Zoology 46, 431-470.

Walenkamp, J.H.C., 1990. Systematics and zoogeography of Asteroidea (Echinodermata) from Inhaca Island, Mozambique. Zoologische Verhandelingen 261 p.

Williams, S.T., 2000. Species boundaries in the starfish genus Linckia. Marine Biology 136, 137–148.

Zulliger, D.E. and Lessios, H.A., 2010. Phylogenetic relationships in the genus Astropecten Gray (Paxillosida: Asteropectinidae) on a global scale: molecular evidence for morphological convergence, speciescomplexes and possible cryptic speciation. Zootaxa, 2504, 1–19.

Iranian Journal of Animal Biosystematics (IJAB)
Vol.18, No.1, 25-33, 2022
DOI: 10.22067/ijab.2022.70618.1018

IJAB
ISSN: 1735-434X (print); 2423-4222 (online)

RESEARCH ARTICLE Open access

Molecular and morphological diversity of *Baetis braaschi* Zimmermann, 1980 (Ephemeroptera: Baetideae); with notes on species' description

Mina Moazzen[1], Alireza Keikhosravi[1*], Atabak Roohi Aminjan[2]
[1]Department of biology, Faculty of science, Hakim Sabzevari University, Sabzevar, Iran and
[2]Department of Biology, Faculty of Science, Bu-Ali Sina University, Hamedan, Iran

(Received: *20 July 2021*; Accepted: 28 *April 2022*)

Abstract
Although mayflies are the key elements to assess the health value of freshwaters, their biodiversity in the Middle East, in particular in Iran, is poorly studied. *Baetis braaschi* belongs to the subgenus *Rhodobaetis* Jacob, 2003, with a wide distribution in Europe and Western Asia. The taxonomy of *B. braaschi* has always been source of disagreement as many species have so far been described by researchers and were synonymized later. The species, *Baetis braaschi*, is investigated here, using molecular and morphological data using collected specimens from different area in Iran and compared with its conspecific from Eastern Europe. Although Iranian specimens showed 99% molecular similarity with their conspecifics in Eastern Europe, e.g., Ukraine and Georgia, the morphological results showed that Iranian specimens of *Baetis braaschi* has significant morphological differences with conspecific specimens from Eastern Europe. Patterns of head, femora and size of the first and second teeth of mandibles in *B. braaschi* are varied from Europe to Iran.

Key words: mayflies, cox1, Iran, distribution, redescription

INTRODUCTION

Mayflies are aquatic insects belonging to the order Ephemeroptera; the order is one of the oldest orders of insects that emerged in the Carboniferous Period (Brittain, 1982). The order Ephemeroptera, as a diverse group, includes more than 3000 species, 400 genera, and 42 families (Barber-James et al., 2007; Gattolliat et al., 2012). High ecological sensitivity to freshwater pollutants, present the order Ephemeroptera as key element in health indicator of freshwaters (Gattolliat & Sartori, 2008; Resh & Unzicker, 1975). In contrast to Europe, the mayfly's fauna of the Middle East has been less studied, particularly in Iran (Bojková et al., 2018). Among identified mayflies from Iran, species of the genus *Baetis* are distributed in most rivers of Iran (Mohammadian, 2005). According to the recent checklist of mayflies of Iran, 46 species and 25 genera are present in the country, of which 12 nominal species belong to the genus *Baetis* (Bojková et al., 2018).

Baetis braaschi belongs to the subgenus *Rhodobaetis* Jacob, 2003, with a wide distribution in Europe and Western Asia (Soldán & Godunko, 2008). It is considered as a resistant species in unpleasant

Corresponding Author: A.keikhosravi@hsu.ac.ir

environment conditions (Sroka & Godunko, 2012). Taxonomy of the species has always been source of disagreement (e.g. Godunko et al., 2004; Sroka & Godunko, 2012). *Baetis braaschi* was first described by Zimmermann (1980), based on three larva specimens that found by Dietrich Braasch from the southern part of the Crimea (Ukraine) in 1970. In 1982, *Baetis stipposus* was described from Uzbekistan, Kazakhstan, Turkmenistan, and Tajikistan (Kluge, 1982). Novikova (1987) recorded *B. stipposus* from Ukraine and suggested the species *B. stipposus* is the junior synonym can be synonymized with *B. bisri* (Thomas & Dia, 1983) from southwestern Lebanon (Novikova, 1987). Godunko et al. (2004) redescribed the larvae, imago and subimago of *B. braaschi* using the specimens collected from Crimea and synonymized it with *B. stipposus*, giving priority to the first one. Sroka et al., (2012) studied intraspecific variability in a rich set of material of *B. braaschi* from the three distant regions (Crimean Peninsula, Eastern Ukraine and the Caucasus Mountains within Georgia) and a former study conducted by Kluge (1982). We studied *B. braaschi* in Iran and compare the molecular and morphological findings with the most recent revision by Sroka et al. (2012) and redescription by Godunko et al. (2004).

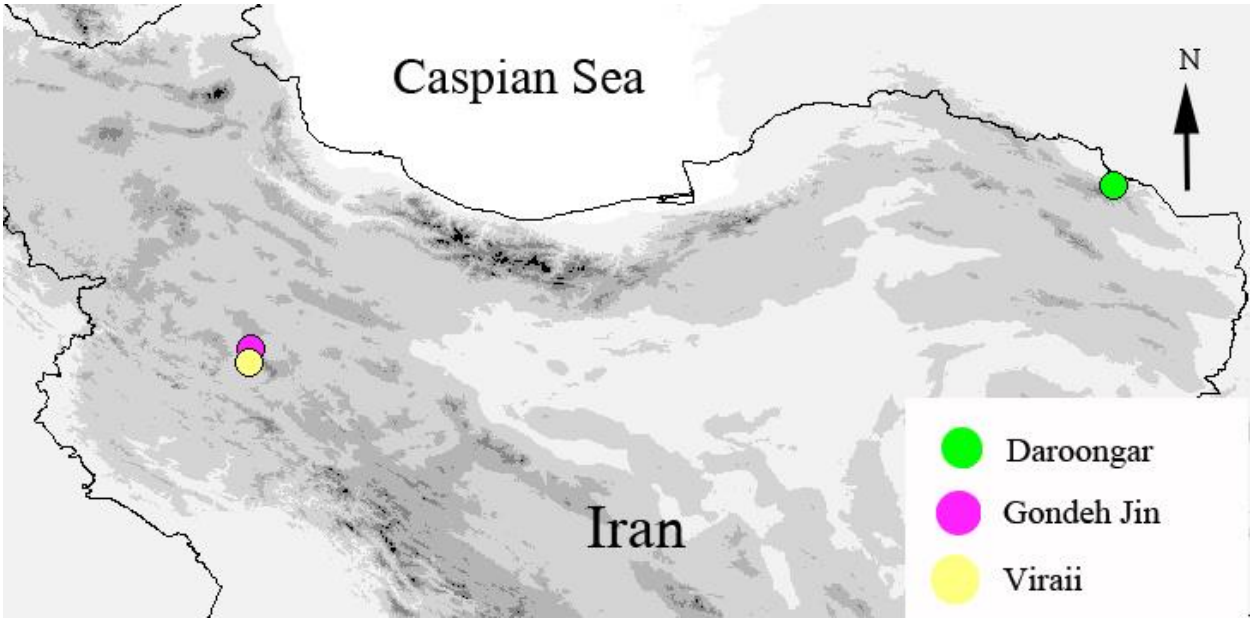

FIGURE 1. Sampling localities of *Baetis braaschi* in Iran.

MATERIAL AND METHODS

Material sampling and examination

Specimens were collected simply by hand from stony and/or sandy bottom of some selected rivers in different areas of Iran (Fig. 1). Details of sampling localities and number of specimens are provided herein: 1) **Iran**, *Khorasan Razavi Prov*. Dargaz City, Daroongar River (37°02'05"N 59°32'32"E); No. 12; 2); 5 November 2016; H. Malvandi leg. **Iran**, *Hamadan Prov*. Asadabad County, Viraii River (34°43'03"N 48°13'15"E). No. 11; and 3); 20 August 2018; A. Roohi Aminjan leg. **Iran**, *Hamadan Prov*. Bahar County, Gondeh Jin River (34°54'05"N 48°15'27"E); No. 7; 20; August 2018; A. Roohi Aminjan leg. Collected specimens were in larval stage and preserved in 80% ethanol.

Morphological study

Morphological characters were investigated in detail in lab under a stereomicroscope Olympus SZ30 and microscope Olympus BH2. Macrophotographs of larvae were taken using camera Nikon D3S. Characteristics of larvae were examined based on Sroka et al. (2012), Godunko et al. (2004), and Kluge (1982).

TABLE 1. List of DNA sequences of *B. braaschi* used for molecular analysis.

LOCALITY OF SEQUENCES	GENBANK ACCESSION NUMBER
GEORGIA	JN164278
	JN164285
	JN164295
	JN164282
	JN383392
	JN383391
	JN383390
	JN383389
	JN383388
	JN383387
	JN383386
UKRAINE	JN164280
	JN164283
	JN164284
	JN164281
	JN383383
	JN383384
IRAN	Pending

Molecular study

Three legs from one side of the larvae were separated and kept in absolute ethanol for DNA extraction. DNA was extracted using modified Puregene method (Gentra Systems). Mitochondrial gene Cox1 (cytochrome oxidase subunit I ~650 base pairs) was partially amplified with polymerase chain reaction (PCR) with the primer combination COL6 (5′-TYTCHACAAAYCATAAAGAYATYGG-3′) (Schubart, 2009) and COH6 (5′-TADACTTCDGCRTGDCCAAARAAYCAT-3′) (Schubart & Huber, 2006). The PCR conditions were as follows: initial denaturation step at 94°C for 4 min followed by 36 cycles including denaturation for 45s at 94°C, annealing for 45s at 50°C, extension for 1 min at 72°C; a final extension at 72°C for 5 min. PCR products were outsourced for sequencing to Macrogen (South Korea) using primer COL6. DNA sequences were manually edited using Chromas version 2.6.6 (https://technelysium.com.au/wp/chromas/) and aligned using program BioEdit version 7.2.5 (Hall et al., 1999). In order to fully understand the intraspecific diversity, 17 sequences of *B. braaschi*, previously used by different studies, were borrowed from the Genbank (Table 1). Haplotype network was constructed using PopArt software version 1.7 (Leigh & Bryant, 2015).

RESULTS

Systematic account

Baetis braaschi Zimmermann, 1980
Baetis stipposus KLUGE, 1982: 18 syn. n.
Baetis stipposus KLUGE: NOVIKOVA, 1987
Baethis tiposus: KISELEVA & VASYUTA, 1986 partim; KISELEVA, 1987 partim
Baethisgr steposus: KISELEVA, 1992 partim
Baethis stiposus: KISELEVA, 1997 partim
Baetis braaschi ZIMMERMANN: GODUNKO, PROKOPOV, 2000; JACOB, 2003
Baetis braachi ZIMM.: PROKOPOV, 2000
Baetis braaschi ZIMM.: PROKOPOV, 2000
Baetis braaschi: PROKOPOV, 2001
Baetis braaschi GODUNKO et al., 2004

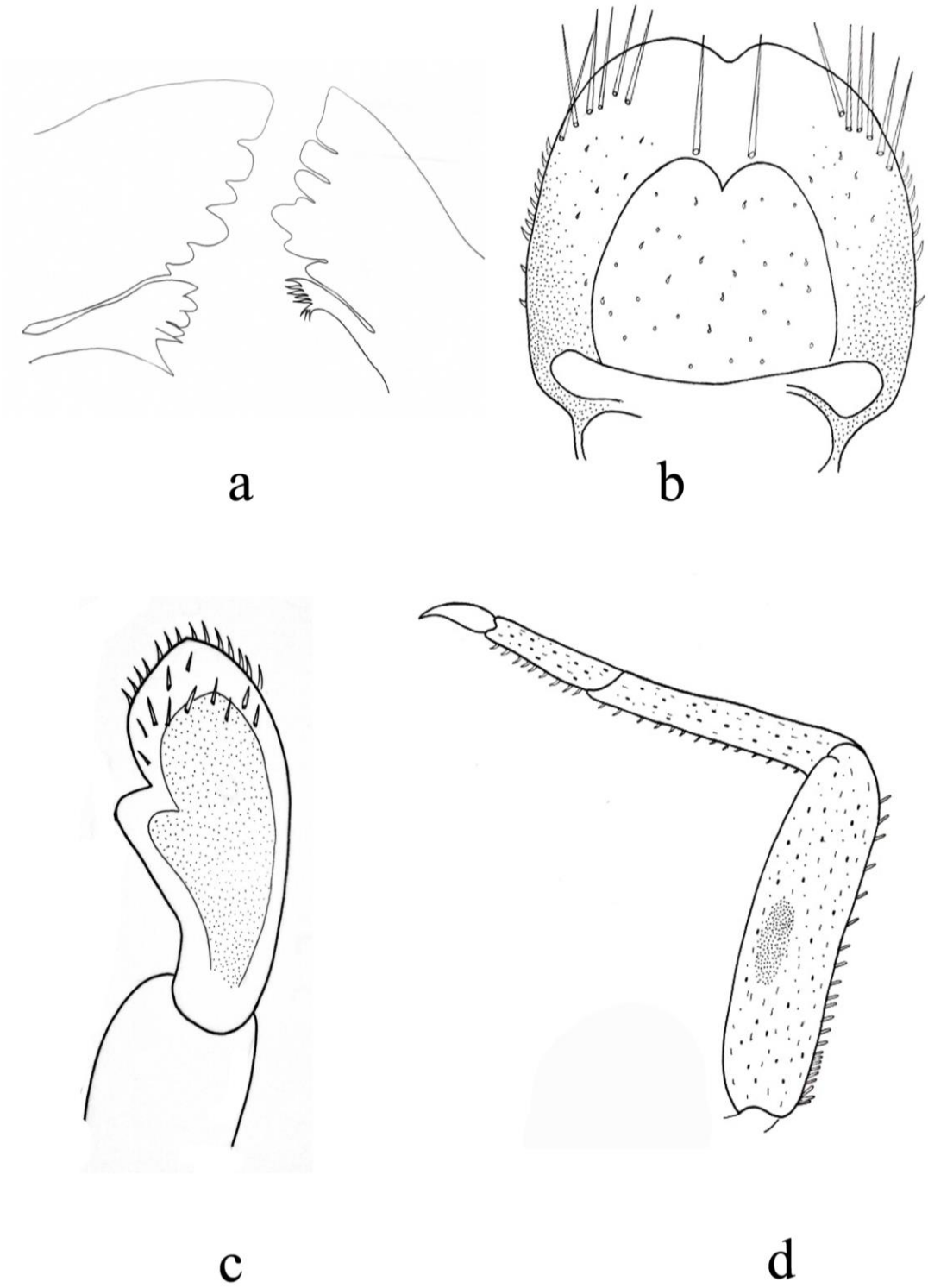

FIGURE 2. *Baetis braaschi*. larva: a, mandibles; b, labrum; c, labial palp; d, hind leg and tarsal claw.

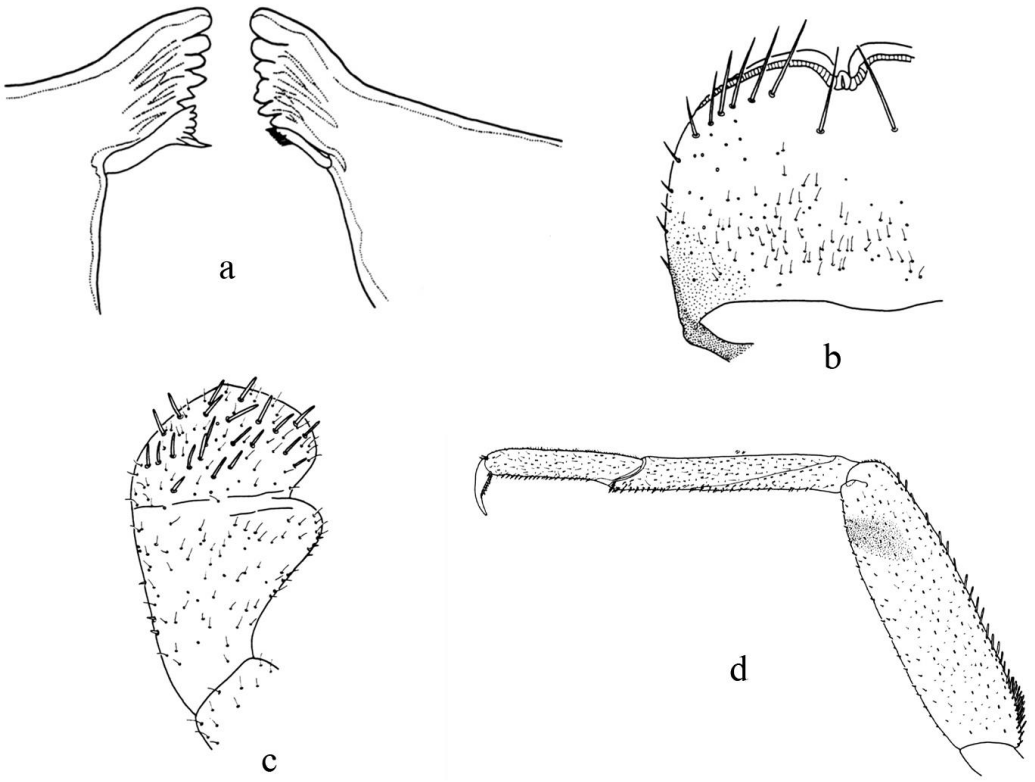

FIGURE 3. *Baetis braaschi* redescribed by Godunko (2004). a, mandibular; b, labrum; c, maxillary palp; d, hind leg

Morphological findings

Mature larva. Length: body 2.5-11 mm; cerci 2.5-4.5 mm. General color of body brown, Head dark brown without spots, antennae dark brown. Pronotum and mesonotum dark brown with clear longitudinal light brown stripes. Labrum wide (the width/length ratio less than 1.70) with 1+ 5-6 long bristles each side and few small marginal bristles. Labrum surface with numerous fine hairs (Fig 2-b). Right mandible with 7 teeth and left mandible 6 teeth. Prostheca present on left and right mandible, prostheca on both mandibles distinctly asymmetrical (Fig. 2-a). Outermost tooth on mandibles about twice the width of the second tooth (Fig. 2-a). Segment 3 of labial palps distinctly wide and slightly pointed at the apex with numerous bluntly pointed bristles (Fig. 2-c). Glossae and paraglossae relatively wide, inner margin of glossae with 9-16 bristles and paraglossae with three rows of bristles on apex. Legs uniformly light brown, femora with distinct elliptical brown band medially at center, (Fig. 2–d), tibia darker in distal and tarsus darker in apex. Bristles on upper margin of femur clearly longer than the bristles on lower edge of femur, these bristles blunt at the tip. Hairs and spines there are in both margins. External and inner margin of tibia with same spines and hairs, but hairs in external margin are more. Inner margin of tarsi with spines, while external margin with spines and hairs. Spines of inner margins distinctly longer and more than external margin of tarsi. Surface of femora, tibiae and tarsi with pointed and quadrangular bristles and many fine hairs. Tarsal claws sub-terminal without short hair bristles. Tarsal claw pointed, dark brown, darker than tarsi, with 11-20 teeth (Fig. 2-d). Abdominal tergite brown, segments I, X and IX are light and on them not seen any pattern. On abdominal terga II, III, IV, VI, VII and VIII there are two light round spots with a light stripe between them. In the tergite V spots are larger and combined. Sterna light, yellowish without spots. There are 7 pairs of gills brown on abdominal segments 1-7. Gills 1 and 7 symmetrical, with almost

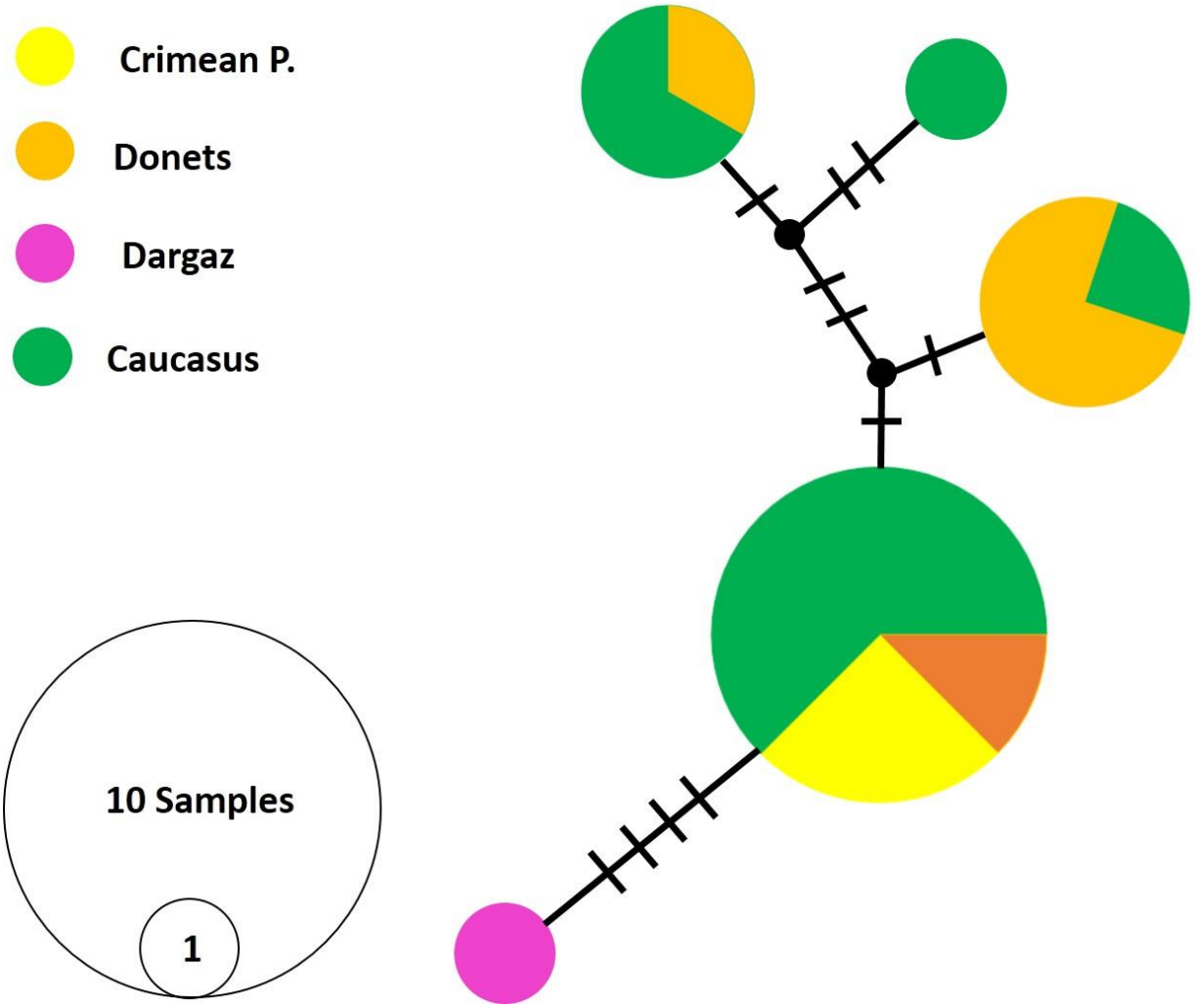

FIGURE 4. Parsimony network of *Baetis braaschi* specimens from Iran, Ukraine and Georgia

same size, gills 2-6 asymmetric and relatively large, external margin of all gills finely serrated, with fine hair, without strong spines. Cerci and terminal filament light brown, without a dark band or rings. Terminal filament slightly shorter than cerci, its length 2/3 –3/4 the length of cerci.

*Remarks***.** In most specimens the outermost tooth on mandibles is twice the width of the second tooth (Fig. 2-a), but in some specimens the first outermost tooth and second tooth mandibles have the same width and length, so width and length of the first and second tooth mandibles are variable. In species redescribed by Godunko (2004), head carries dark spot while in Iranian specimens head is without spot; moreover in type description, femora dorsally have distinct brown spot distally (Fig. 3-d), whereas in Iranian specimens it is elliptical and located medially (Fig. 2–d). Pattern of head, femurs and width and length of first and second tooth (Fig. 3-a) in *B. braaschi* can be variable from Eastern Europe to Iran and Eastern Asia.

Molecular findings

We used molecular data to understand if such morphological differences are in line with molecular finding or not? The morphological results showed that species of *Baetis braaschi* has significant morph

differences with its conspecific specimens from Ukraine and Georgia. The parsimony network indicated a high intra-specific diversity among specimens of *B. braaschi* from different localities. The Iranian specimen comprise a unique haplotype, not shared by the other haplotypes from different localities. *Baetis Braaschi* from Iran is distinctly differentiated (uncorrected p-distance, 1%) from its closest haplotype from Ukraine and Georgia. (Fig. 4).

DISCUSSION

In described specimens of *B. braaschi* by Sroka et al. (2012), head presented dark spot, while in Iranian specimens it is absent. In original description of species, mentioned that femora have distinct brown spot distally, whereas in Iranian specimens, femora have distinct elliptical brown band centrally in dorsal part of the legs (Fig. 2–d). Therefore, pattern of head, femora and size of first and second teeth in the specimens of *B. braaschi* is variable from Eastern Europe to Iran.

Due to extensive distribution of *B. braaschi* from Eastern Europe to Iran (Sroka et al., 2012), it can be suggested this species have even wider distribution to Eastern Asia and Europe. Such high intraspecific molecular variation in freshwater benthos, with almost the same distribution, is also presented in other freshwater organisms; e.g., *Potamon ibericum* (Parvizi et al., 2018). All examined specimens in the current study were collected in larval stage, therefore description of imago and subimago stages from Iran is demanded. Considering the limited study done on Iranian mayflies (Moazzen et al., 2021) and their importance in freshwater food webs and as pollution indicator in assessing the health of the freshwater ecosystems, it is proposed to conduct comprehensive study on fauna of mayflies in Iran. In addition, the region severely suffers from water shortage in last couple of decades and there has been important warning that some unique and endemic freshwater species are critically endangered (Kiabi et al., 1999; Coad, 1980).

ACKNOWLEDGMENTS

This research was supported by Hakim Sabzevari University. In addition, the first author is very grateful to Dr. Michel Sartori (Museum of Zoology Lausanne, Switzerland), Dr. Roman J. Godunko and Dr. Tomas Soldan (Institute of Entomology, Biology Centre, Czech Academy of Sciences, Branišovská) and Dr. Arne Haybach (Department Fauna and Ecology of the Federal Institute of hydrology Koblenz, Germany), for their helpful comments.

LITERATURE CITED

Barber-James H, Gattolliat J, Sartori M, & Hubbard M. 2008. Global diversity of mayflies (Ephemeroptera, Insecta) in freshwater, *Hydrobiologi*a, 595: 339–350.

Barber-James HM, Gattolliat J-L, Sartori M, Hubbard MD. 2007. Global diversity of mayflies (Ephemeroptera, Insecta) in freshwater. Freshwater Animal Diversity Assessment, *Springer*: 339-350. https://doi.org/10.1007/978-1-4020-8259-7_37

Bojková, J., Sroka, P., Soldán, T., Namin, J.I., Staniczek, A.H., Polášek, M., Hrivniak, Ľ., Abdoli, A. & Godunko, R.J. 2018. Initial commented checklist of Iranian mayflies, with new area records and description of *Procloeon caspicum* sp. n. (Insecta, Ephemeroptera, Baetidae). *ZooKeys*, 749: 87-123.

Brittain, J. E. 1982. Biology of mayflies. *Annual review of entomology*, 27: 119-147. https://doi.org/10.1146/annurev.en.27.010182.001003

Coad, B. W. 1980. Environmental change and its impact on the freshwater fishes of Iran. *Biological Conservation*, 19(1): 51-80.

Gattolliat, J.-L. & Sartori, M. 2008. Order Ephemeroptera. *Arthropod Fauna of the UAE*, 1: 47-83.

Gattolliat, J.-L., Vuataz, L. & Sartori, M. 2012. First contribution to the mayflies of Jordan: (Insecta: Ephemeroptera). *Zoology in the Middle East*, 56: 91-110. https://doi.org/10.1080/09397140.2012.10648945

Godunko, R. J., Propokov, G. A., Kluge, N, J. & Novikova, E, A. 2004. Mayflies of the Crimean Peninsula. II. *Baetis braaschi* Zimmermann, 1980 (= B. *stipposus* Kluge, 1982 syn. n.) (Ephemeroptera: Baetidae). *Acta zoologica cracoviensia*, 47: 155-166.

Hall, T. A. 1999. BioEdit: a user-friendly biological sequence alignment editor and analysis program for Windows 95/98/NT. Nucleic acids symposium series, [London]: Information Retrieval Ltd., c1979-c2000.

Kiabi, B. H., Abdoli, A., & Naderi, M. 1999. Status of the fish fauna in the south Caspian Basin of Iran. *Zoology in the Middle East*, 18 (1): 57-65.

Kluge, N. 1982. New and little-known mayflies from the genus *Baetis* of the group rhodani (Ephemeroptera, Baetidae) from Central Asia and Kazakhstan. *Vestnik zoologii= Zoological record*.

Leigh, J. W. and D. Bryant 2015. PopArt: full-feature software for haplotype network construction. Methods in Ecology and Evolution, 6: 1110-1116.

Merritt, R. W. and K. W. Cummins 1996. An introduction to the aquatic insects of North America, Kendall Hunt.

Moazzen, M., Keikhosravi, A. & Rastegar-Pouyani, E. 2021. Description of *Electrogena sartorii* sp. nov., a new representative of the genus *Electrogena* Zurwerra amp; Tomka, 1985 (Ephemeroptera: Heptageniidae), from Iran using molecular and morphological data. Zootaxa, 5026 (4), 555-566

Mohammadian, H. 2005. Aquatic Insects of Iran. First volume. Ephemeroptera, Sepehr Publisher, Tehran (in Persian).

Novikova, E., A 1987. The mayflies of the family Betide (Ephemera) of USSR fauna. Dissertation nab oilskin hen Stephen candidate biologic auk. Leningrad Outdriven Universities, Leningrad. [unpublished manuscript in Russian].

Parvizi, E., Naderloo, R., Keikhosravi, A., Solhjouy-Fard, S. & Schubart, C.D. 2018. Multiple Pleistocene refugia and repeated phylogeographic breaks in the southern Caspian Sea region: Insights from the freshwater crab *Potamon ibericum*. *Journal of biogeography*, 45: 1234-1245. https://doi.org/10.1111/jbi.13195

Prokopov, G. & Godunko, R. 2007. The catalog of the mayflies (Insecta: Ephemeroptera) of Crimea, p. 140-152. In: Natural Reserves of the Crimea–2007. Materials of the IV International Scientific and Practical Conference (November 2, 2007). Part 2. *Zoology*

Resh, V. H. and J. D. Unzicker 1975. Water quality monitoring and aquatic organisms: the importance of species identification. *Journal* (*Water Pollution Control Federation*), 47: 9-19.

Schubart, C. D. 2009. Mitochondrial DNA and decapod phylogenies: the importance of pseudogenes and primer optimization. *Decapod crustacean phylogenetic*, 18: 47-65. https://doi.org/10.1201/9781420092592-c4

Schubart, C.D. & Huber, M. 2006. Genetic comparisons of German populations of the stone crayfish, *Austropotamobius torrentium* (Crustacea: Astacidae). *Bulletin Francais de la Peche et de la Pisciculture*, 1019-1028. https://doi.org/10.1051/kmae:2006008

Soldán, T. and R. J. Godunko 2008. Two new species of the genus *Baetis* Leach, 1815 (Ephemeroptera: Baetidae) from Cyprus. *Annales Zoological, Museum and Institute of Zoology, Polish Academy of Sciences*.

Sroka, P. & Godunko, R.J. 2012 Mayflies of the Caucasus Mountains. I. A new species of the genus *Electrogena* Zurwerra & Tomka, 1985. *Zootaxa*, 3222: 28-45. https://doi.org/10.11646/zootaxa.3222.1.2

Thomas, A. and A. Dia 1983. *Baetis bisri* n. sp., Ephemeroptera nouveau du Liban (Baetidae). *Annales de Limnologie-International Journal of Limnology*, EDP Sciences.

Iranian Journal of Animal Biosystematics (IJAB)
Vol.18, No.1, 35-64, 2022
DOI: 10.22067/ijab.2022.68045.1001

IJAB
ISSN: 1735-434X (print); 2423-4222 (online)

RESEARCH ARTICLE Open access

Checklist of Aquatc beetles (Coleoptera: Adephaga, Polyphaga) in Azerbaijan Republic

Nataly Snegovaya*, Lale Shirinova
Institute of Zoology, National Academy of Science of Azerbaijan (IZB), A. Abbaszade st.115, pr.1128, bl.504, Az 1004, Baku, Azerbaijan.

(Received: *5 January 2021*; Accepted: *7 May 2022*)

Abstract
In this checklist 163 aquatic beetles species from 11 families belonging to 46 genera that have been recorded from Azerbaijan are presented. Dytiscidae includes maximum numbers of species This study is based on a generalization of all available literature data.

Key words: aquatic beetles, Azerbaijan, fauna, distribution.

INTRODUCTION

Aquatic beetles are an integral part of the fauna of fresh and brackish water bodies. All aquatic beetles play an essential role in ecosystems, for example as food for vertebrates (freshwater fish, amphibians, waterfowl and waterside birds) and macro invertebrates. Beetles live in all types of water bodies, some species live in caves in underground waters, some have mastered thermal springs, super-saline lakes and a number of other extreme biotopes. Even the marine environment is inhabited by representatives of this group, successfully breeding in shallow, wave-protected sea bays and lagoons. A number of water beetle families belong to the suborder ADEPHAGA, most of which are predators. In total, 11 modern families belong to the suborder Adepahaga, 8 of which are represented in full or predominantly by aquatic beetles. These are Amphizoidae, Meruidae, Aspidytidae, Hygrobiidae, Haliplidae, Gyrinidae, Noteridae, and Dytiscidae (Löbl, Smetana, 2003). The aquatic group of beetles from the suborder POLYPHAGA includes 14 out of 150 families of beetles that are considered to be true aquatic and are somehow related to the aquatic environment - Helophoridae, Epimetopidae, Hydrochidae, Spercheidae, Hydrophilidae, Hydraenidae, Scirtidae, Elmidae, Dryopidae, Lutroseidae, Putogidae, Georissidae and Eulichadidae (Löbl, Smetana, 2004).

No faunistic survey of the fauna of water beetles in Azerbaijan has been conducted so far. A number of works dating back to the first half of the 20th century provide the first data on this group in Azerbaijan. These are the famous work of Jacobson "Beetles of Russia and Western Europe" (1905), as well as several works by Zaitsev (1927, 1928, 1945, 1946, 1947, 1953). In addition to these works, there is information on this group in the writings of Bogachev (1951), which provides an overview of the water beetles of Azerbaijan. The list of species of aquatic beetles in the Caucasus, indicating the species found in Azerbaijan, is given by Kasymov in his monographs (1965, 1972), where he refers to the works of Zaitsev (1927, 1928, 1945, 1946, 1947, 1953), Veisig (1939), Bogachev (1951). Modern catalogs on aquatic beetles (Przewoźny, 2019; Nilsson & Hájek, 2019; Przewoźny, 2019; Hájek & Fery, 2019) also provide data on Azerbaijan, in addition, some information on this group is also contained in the “Catalog

Corresponding Author: snegovaya@yahoo.com

of Palaearctic Coleoptera" (Löbl & Smetana, 2003). Gentili and Shaverdo (2016) provide data on the genus *Laccobius* Erichson 1837 in the Transcaucasian countries.
This checklist summarizes all currently available information on water beetles in Azerbaijan based on literature data.

MATERIAL AND METHODS

The first checklist of the Azerbaijanian aquatic beetles was assembled using published records. For each species country and total distribution is indicated. The list of species is given according to the nomenclature used in the catalogs Löbl, Smetana, 2003, 2004; Nilsson, A.N., Hájek, J. 2021. The abbreviation of the countries in the "General distribution" section is taken from the sources Löbl & Smetana, 2003, 2004; Nilsson & Hájek, J. 2021, Przewoźny, 2019, Hájek & Fery, 2019.

RESULTS

The aquatic beetle fauna of Azerbaijan consists of 163 species belonging to 46 genera, and 11 families under 2 suborders. The suborder Polyphaga includes 72 species and the suborder Adephaga 91 species. Dytiscidae Leach, 1815 includes maximum numbers of species (72 species), followed by Hydrophilidae Latreille, 1802 (40 species), Hydraenidae Mulsant, 1844 (15 species), Helophoridae Leach, 1815 (10 species), Gyrinidae Latreille, 1810 (9 species), Haliplidae Aubé, 1836 (8 species), Dryopidae Billberg, 1820 (3 species), Noteridae Thomson, 1857 and Hydrochidae Thomson, 1859 (2 species each), Spercheidae Erichson, 1837 and Georissidae Laporte, 1840 (1 species each) (Fig. 1).

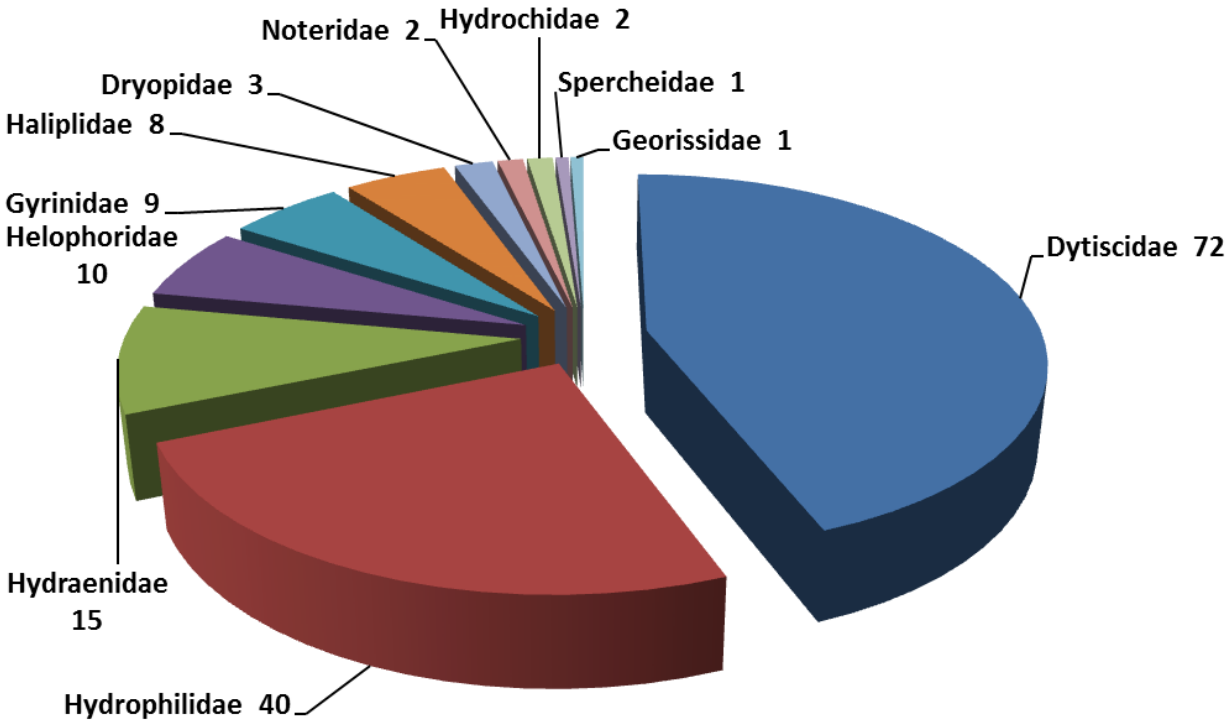

FIGURE 1. Number of species in Family of aquatic beetles (Coleoptera) from Azerbaijan.

Order COLEOPTERA
Suborder ADEPHAGA
Family GYRINIDAE Latreille, 1810
Subfamily GYRININAE Latreille, 1810
Genus *Aulonogyrus* Motschulsky, 1853
Subgenus *Aulonogyrus* Motschulsky, 1853
***Aulonogyrus (Aulonogyrus) concinnus* (Klug, 1834)**
Aulonogyrus concinnus (Kl.): Kasymov, 1972: 120
Distribution in Azerbaijan: Astara, Agjabedi (*Ağcabədi)* (Kasymov, 1972).
General distribution: E: BE BH BU CR CT CZ FR GE GG GR IT MC NL PL PT SK SP ST "Transcaucasia" N: AG A: AF CY IN IQ KZ LE MG QIN SA SY TD TR UZ XIN (Löbl, Smetana, 2003).

Genus *Gyrinus* O.F. Müller, 1764
Subgenus *Gyrinus* O.F. Müller, 1764
***Gyrinus (Gyrinus) substriatus* Stephens, 1829**
Gyrinus substratus Steph.: Kasymov, 1972: 120
Gyrinus (Gyrinus) substriatus Stephens, 1829: Löbl, Smetana, 2003: 28
Gyrinus (Gyrinus) substriatus Stephens, 1829: Hájek, Fery, 2019: 5
Distribution in Azerbaijan: Agstafa (*Ağstafa*) (Kasymov, 1972).
General distribution: E: AB AR AU BE BH BU BY CR CT CZ DE EN FI FR GB GE GR HU IT LS MC NL NR NT PL PT SK SL SP ST SV SZ UK YU "Transcaucasia" N AG MO TU A: IN IQ IS SY TR "Southern Siberia" (Löbl, Smetana, 2003).

***Gyrinus (Gyrinus) colymbus* Erichson, 1837**
Gyrinus colymbus E.: Kasymov, 1972: 120
Distribution in Azerbaijan: Lenkoran (*Lənkəran*) (Zaytsev, 1928; Kasymov, 1972).
General distribution: E: AR AU BH BU BY CR CZ DE FR GE GR HU İT MC PL SK ST SZ YU A: CY İN KZ LE SY TR (Löbl, Smetana, 2003).

***Gyrinus (Gyrinus) dejeani* Brulle, 1832**
Gyrinus dejeani Br.: Kasymov, 1972: 120
Gyrinus dejeani Brulle, 1832: Hájek, Fery, 2019: 4
Distribution in Azerbaijan: Talysh (Zaytsev, 1953; Kasymov, 1972; Hájek, Fery, 2019).
General distribution: E: BH BU CR FR GR İT MC PT SL SP YU N: AG CI EG MO TU A: CY IQ IS LE SYTR (Löbl, Smetana, 2003).

***Gyrinus (Gyrinulus) minutus* Fabricius, 1798**
Gyrinus minutus Fabr.: Kasymov, 1972: 120
Distribution in Azerbaijan: Mingechaur (*Mingəçevir*), Goygol (*Göygöl*) and Ordekgel (*Ördəkgöl*) lake, Mingechaur careers, fish factory pools in Neftchala (*Neftçala*), Mingechevir and Varvara water reservoirs (Kasymov, 1965 a).
General distribution: E: AU BE BH BY CR CZ DE EN FI FR GB GE HU IR IT NL NR NT PL SK SL SP SV SZ UK A: ES FE HEI JA JIL LIA MG WS NAR (Löbl, Smetana, 2003).

***Gyrinus (Gyrinus) caspius* Menetries, 1832**
Gyrinus caspius Men.: Kasymov, 1972: 120
Gyrinus caspius Menetries, 1832: Löbl, Smetana, 2003: 27
Gyrinus caspius Menetries, 1832: Hájek, Fery, 2019: 4
Distribution in Azerbaijan: Lenkoran, Kura (*Kür*), Alazan, Iori (*Qabırrı*) rivers, Mingechevir and Varvara water reservoirs, Karachay (*Garaçay*) river near Agjabedi, Ust-Kura and Ali-Bayramli (now

Shirvan (*Şirvan*) fish factory, Barda (*Bərdə*) distr., Astara, Mingechaur careers (Kasymov, 1972; Hájek, Fery, 2019).
General distribution: E: AB AR BE BH BU BY CR CT DE EN FR GE GG GR İT LT NL NR PL PT SP SL ST SV UK YU N: AG MO A: CY İN IQ IS KZ LE SY TM TR XIN (Löbl, Smetana, 2003).

***Gyrinus (Gyrinus) suffriani* Scriba, 1855**
Gyrinus suffriani Scr.: Kasymov, 1972: 120
Gyrinus suffriani Scriba, 1855: Löbl, Smetana, 2003: 28
Gyrinus suffriani Scriba, 1855: Hájek, Fery, 2019: 5
Distribution in Azerbaijan: Varvara water reservoir, Kura River near Mingechevir, fish factory pools in Neftchala, Karkarchay and Khalifachay (*Xalifaçay*) near Shusha (*Şuşa*) (Kasymov, 1972).
General distribution: E: AB AU BE BU CR CZ DE FI FR GE HU IT NL PL NR ST SV SZ A: IS LE SYTR (Löbl, Smetana, 2003).

***Gyrinus (Gyrinus) distinctus* Aube, 1864**
Gyrinus distinctus Aubi.: Kasymov, 1972: 121
Distribution in Azerbaijan: Karkarchay, Ganjachay (*Gəncəçay*), Mingechaur careers, Mingechevir and Varvara water reservoirs (Kasymov, 1972).
General distribution: E: AU AZ BE BH BU BY CR CT CZ DE Fi FR GB GE GR HU İT MC NL NR NT PL PT SK SP ST SV SZ YU "Transcaucasia" N: EG LB A: AF CY IN IQ IS KA KI KZ LE MG NMO SY TR UZ XIN XIZ (Löbl, Smetana, 2003).

***Gyrinus (Gyrinus) mithrae* Zaitzev, 1908: 243**
Gyrinus mithrae Zaitzev, 1908b: 243
Gyrinus (Gyrinus) mithrae Zaitzev, 1908: Löbl, Smetana, 2003: 27
Gyrinus (Gyrinus) mithrae Zaitzev, 1908: Hájek, Fery, 2019: 4
Distribution in Azerbaijan: Azerbaijan **(**Hájek, Fery, 2019).
General distribution: Azerbaijan, Iran (Hájek, Fery, 2019).

FAMILY HALIPLIDAE Aubé, 1836
Genus *Haliplus* Latreille, 1802
Subgenus: *Haliplus* Latreille, 1802
***Haliplus (Haliplus) ruficollis* (De Geer, 1774)**
Haliplus ruficollis Deg: Kasymov, 1972: 114
Distribution in Azerbaijan: Astara (Kasymov, 1972)
General distribution: E: AU BE BH BU BY CR CZ DE FI FR GB GE GR HU IR IT LA LU MC NL NRNT PL RO SK SL SP ST SV SZ UK YU A: AF IN IQ KZ TD TR UZ WS (Löbl, Smetana, 2003).

***Haliplus (Haliplus) fluviatilis* Aube, 1836**
Haliplus fluviatilis Aube: Kasymov, 1972: 114
Distribution in Azerbaijan: Lenkoran (Veysig, 1939; Kasymov, 1972).
General distribution: E: AU BE BH BU BY CR CT CZ DE FI FR GB GE GR HU IR IT LA LU MC NL NT PL RO SK SP ST SV UK YU A: AF KI KZ TR WS fulvicollis Erichson, 1837: 186 E: BE BH BU BY CR CT CZ DE FI FR GE GG GR IT NL NR NT PL SK ST SV UK YU "Transcaucasia" A: KZ WS (Löbl, Smetana, 2003).

Subgenus *Liaphlus* Guignot, 1928
***Haliplus (Liaphlus) flavicollis* Sturm, 1834**
Haliplus flavicollis expallidus Zait.: Kasymov, 1972: 114
Haliplus flavicollis Sturm: Kasymov, 1972: 114

Distribution in Azerbaijan: Lenkoran, Garayazi (Jandargol (Candargöl) lake (Veysig, 1939; Kasymov, 1972)
General distribution: Austria, Belgium, Bosnia Herzegovina, Bulgaria, Byelorussia, Croatia, Czech Republic, Denmark, Finland, France, Germany, Great Britain, Greece, Hungary, Iran, Iraq, Ireland, Italy, Kazakhstan, Latvia, Luxembourg, Macedonia, Mongolia, Netherlands, Norway, Poland, Romania, Russia (Central, North and South European Territory, West Siberia), Slovakia, Slovenia, Spain, Sweden, Switzerland, "Transcaucasia", "Turkestan", Turkey, Ukraine, former Yugoslavia (Vondel 2005), Georgia, Montenegro, Serbia (Vondel 2013), Uzbekistan (Vondel 2007).

***Haliplus (Liaphlus) maculatus* Motschulsky, 1860**
Haliplus maculatus Motschulsky, 1860: Vondel, 1991: 117
Distribution in Azerbaijan: Geok Tepe (*Göktəpə*) (Vondel, 1991)
General distribution: E: AU CZ GR HU RO ST YU A: AF KI KZ IS SY TM TR (Löbl, Smetana, 2003).

***Haliplus (Liaphlus) fulvus* (Fabricius, 1801)**
Haliplus fulvus (Fabr.): Kasymov, 1972: 114
Distribution in Azerbaijan: Astara, Lenkoran (Kasymov, 1972).
General distribution: E: AL AU BE BH BU BY CR CT CZ DE FA FI FR GB GE GR HU IC IR IT LA MC NL NR NT PL PT SK SL SP ST SV UK YU "Caucasus" N: AG MO A: ES IQ KZ TR WS NAR (Löbl, Smetana, 2003).

***Haliplus (Liaphlus) dalmatinus* Müller, 1900**
Haliplus fulvus dalmatinus Müller: Kasymov, 1972: 114
Distribution in Azerbaijan: Kura River valley in Azerbaijan (Kasymov, 1972).
General distribution: E: AL CR GR A: TR (Löbl, Smetana, 2003).

***Haliplus (Liaphlus) variegatus* Sturm, 1834**
Haliplus variegatus Sturm: Kasymov, 1972: 114
Distribution in Azerbaijan: Astara, Neftchala (Kasymov, 1972)
General distribution: E: AU BE BH BU BY CR CT CZ DE FI FR GB GE GR HU IR IT LA MC NL NR PL RO SK SL SP ST SV SZ UK YU N: AG A: IS KI TR (Löbl, Smetana, 2003).

Genus *Peltodytes* Régimbart, 1879
***Peltodytes caesus* (Duftschmid, 1805)**
Peltodytes caesus Duft.: Kasymov, 1972: 113
Peltodytes caesus Duftschmid, 1805: Löbl, Smetana, 2003 33
Distribution in Azerbaijan: Astara, Lenkoran (Kasymov, 1972)
General distribution: E: AB AL AU BE BH BU BY CR CZ DE FR GB GE GR HU İT LU MCNLPLPTROSKSPSTSVSZUKYU N: MO A: AF IN IQ IS KI KZ NW SY TD TM TR UZ (Löbl, Smetana, 2003).

Family NOTERIDAE Thomson, 1857
Subfamily NOTERINAE Thomson 1860
Tribe Noterini Sharp, 1882
Genus *Noterus* Clairville, 1806
***Noterus crassicornis* (O.F. Muller, 1776)**
Noterus crassicornis (O.F. Muller, 1776): Kasymov, 1972: 114
Distribution in Azerbaijan: Astara, Lenkoran (Kasymov, 1972).
General distribution: Austria, Belgium, Bosnia Hercegovina, Bulgaria, Byelorussia, Croatia, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Great Britain, Hungary, Iran, Ireland,

Italy, Kashmir, Latvia, Lithuania, Luxembourg, Macedonia, Moldavia, Netherlands, Norway, Poland, Russia (East Siberia, Central European Territory, North European Territory, South European Territory, West Siberia), Slovakia, Slovenia, Sweden, Turkey, Ukraine, Yugoslavia (Nilsson, 2014).

***Noterus clavicornis* (De Geer, 1774)**
Noterus clavicornis (Deg.): Kasymov, 1972: 114
Noterus clavicornis (De Geer, 1774): Löbl, Smetana, 2003: 34
Distribution in Azerbaijan: Lenkoran (Zaytsev, 1946, 1953), Neftchala (Kasymov, 1972).
General distribution: E: AB AL AR AU BE BH BU BY CR CT CZ DE EN FIFR GB GE GG GR HUIR IT LA LS LT LU MC MD NL NR PL PT SK SL SP ST SV SZ UK YU A: ES HEI IN IQ IS JO KA KZ LE MG SHA SY TM TR WS XIN (Löbl, Smetana, 2003).

Family DYTISCIDAE Leach, 1815
Subfamily Agabinae Thomson, 1867
Tribe Agabini Thomson, 1867
Genus *Agabus* Leach, 1817
Subgenus *Acatodes* Thomson, 1859
***Agabus (Acatodes) amoenus* Solsky, 1874**
Gaurodytes amoenus Solsky, 1874 (Kasymov, 1972: 117)
Distribution in Azerbaijan: Agstafa, Garayazi (Jandargol (Candargöl) (Kasymov, 1972).
General distribution: E: GG ST UK A: KZ UZ (Löbl, Smetana, 2003).

Subgenus *Agabus* Leach, 1817
***Agabus (Agabus) undulatus* (Schrank, 1776)**
Colymbetes ruficeps Ménétriés, 1832:141
Eriglenus undulatus (Schrank, 1776): Kasymov, 1972: 118
Agabus (Agabus) undulatus (Schrank, 1776): Löbl, Smetana, 2003: 37
Distribution in Azerbaijan: Lenkoran (Kasymov, 1972).
General distribution: E: AB AL AR AU BE BH BU BY CR CT CZ DE EN FR GB GE GG HU IT LA LT LU NL NR PL SK SL ST SV SZ UK A: KI (Löbl, Smetana, 2003).

Subgenus *Gaurodytes* Thomson, 1859
***Agabus (Gaurodytes) biguttatus* (Olivier, 1795)**
Gaurodytes biguttatus (Ol.) (Kasymov, 1972: 117)
Agabus (Gaurodytes) biguttatus (Olivier, 1795): Löbl, Smetana, 2003: 38
Distribution in Azerbaijan: Goygol distr. (Kasymov, 1972).
General distribution: E: AB AL AR AU BE BH BU BY CR CT CZ FR GB GE GG GR HU IRITLSLUMCNLPLPTROSKSLSPSTSZUKYU N: AG CI EG LB MO TU A: AF CY HP IN IQ IS JO KA KI LE PA SA SCH SI SY TM TR UZ WS XIN (Löbl, Smetana, 2003).

***Agabus (Gaurodytes) bipustulatus* (Linnaeus, 1767)**
Gaurodytes bipustulatus (L.): Kasymov, 1972: 117
Agabus (Gaurodytes) bipustulatus (Linnaeus, 1767): Löbl, Smetana, 2003: 38
Distribution in Azerbaijan: Mingechevir and Varvara water reservoirs, Gakh (*Qax*), Astara (Kasymov, 1972).
General distribution: E: AB AL AN AR AU AZ BE BH BU BY CR CT CZ DE EN FA FI FR GB GE GG GR HU IC IR IT LA LS LT LU MC NL NR NT PL PT RO SK SL SP ST SV SZ TR UK YU N: AG LB MO TU A: AF CY IN IS KI KZ LE SY TD TR UZ WS XIN "Manchuria" AFR (Löbl, Smetana, 2003).

***Agabus (Gaurodytes) conspersus* (Marsham, 1802)**
Agabus luniger Kolenati, 1845:82
Agabus conspersus (Marsham, 1802): Kasymov, 1972: 118.
Agabus conspersus (Marsham, 1802): Löbl, Smetana, 2003: 39
Distribution in Azerbaijan: Agstafa, Garayazi (Jandargol (Candargöl) , Shusha (Kasymov, 1972).
General distribution: E: AB AL AR BE BU CR DE FR GB GE GG GR HU IR IT MC NL PLPTSPSTSVUKYU N: AG CI EG LB MO TU A: AF CY HP IN IQ JO KA KI KU KZ LE PA QIN SI SY TD TM TR UZ WS XIN XIZ ZHE (Löbl, Smetana, 2003).

***Agabus (Gaurodytes) dilatatus* (Brullé, 1832)**
Gaurodytes dilatatus (Br.) (Kasymov, 1972: 117)
Distribution in Azerbaijan: Ordubad (Kasymov, 1972).
General distribution: E: BU GG GR IT MC ST TR UK N: AG EG MO TU A: CY IQ IS KI LE SI SY TR UZ (Löbl, Smetana, 2003).

***Agabus (Gaurodytes) guttatus* (Paykull, 1798)**
Gaurodytes guttatus (Payk.) (Kasymov, 1972: 117)
Distribution in Azerbaijan: Lenkoran (Kasymov, 1972).
General distribution: E: AN AU BE BH BU BY CR CT CZ DE EN Fi FR GB GE HU İR İT LS LU MC NL NR NT PL RO SK SL SP ST SV SZ UK YU A: HP TR WS (Löbl, Smetana, 2003).

***Agabus (Gaurodytes) faldermanni* Zaitzev, 1927**
Agabus faldermanni Zaitzev, 1927:22
Gaurodytes faldermanni Zaitz. (Kasymov, 1972: 118)
Agabus (Gaurodytes) faldermanni Zaitzev, 1927: Löbl, Smetana, 2003: 39
Distribution in Azerbaijan: Nagorno-Karabakh (*Dağlıg Garabağ*) (Zaitzev, 1927), Azerbaijan (Kasymov, 1972).
General distribution: E: AB A: IN IS LE S Y TR (Löbl, Smetana, 2003).

***Agabus (Gaurodytes) nebulosus* (Forster, 1771)**
Gaurodytes nebulosus (Forst.): Kasymov, 1972: 117
Agabus (Gaurodytes) nebulosus (Forster, 1771): Löbl, Smetana, 2003: 40
Distribution in Azerbaijan: Neftchala (Kasymov, 1972).
General distribution: E: AB AL AR AU BE BH BU CR CT CZ DE EN FR GB GE GG GR HU IR IT LA LT LU MA MC NL NR PL PT SK SL SP ST SV SZ YU N: AG CI EG LB MO MR TU A: CYINIS JO LE SY TM TR (Löbl, Smetana, 2003).

Genus *Ilybius* Erichson, 1832
***Ilybius ater* De Geer, 1774**
***Ilybius** ater* De Geer, 1774: Nilsson, Hájek, 2021: 9
General distribution: **E:** AB AL AU BE BH BU BY CR CZ DE EN FI FR GB GE GG GR HU IR IT LA LS LT LU NL NR PL RO RU (CT NT ST) SK SL SP SV SZ UK **A:** IN TR RU (ES WS) (Nilsson, Hájek, 2021).

***Ilybius chalconatus* (Panzer, 1796)**
Gaurodytes chalconatus (Panz) (Kasymov, 1972:118)
Ilybius chalconatus (Panzer, 1796): Löbl, Smetana, 2003: 42
Distribution in Azerbaijan: Lenkoran, Astara (Kasymov, 1972).
General distribution: E: AB AU BE BH BU CR CZ DE EN Fi FR GB GE GR HU İR İT LA LT LU MC MD NL PL PT SK SL SP SV SZUKYU N: AG MO A: IN IS SY TM TR (Löbl, Smetana, 2003).

***Ilybius cinctus* Sharp, 1878**
***Ilybius** cinctus* Sharp, 1878: Nilsson, Hájek, 2021: 9
General distribution: **E:** AB GG RU (ST) UK **A:** CH (GAN GUX HEB HEI HUB JIA JIL LIA SCH SHA TIA XIN YUN) KZ MG RU (ES) UZ (Nilsson, Hájek, 2021).

***Ilybius erichsoni* Gemminger & Harold, 1868**
***Ilybius** erichsoni* Gemminger & Harold, 1868: Nilsson, Hájek, 2021: 10
General distribution: **E:** AB BY DE EN FI GE HU IT LA LT NR PL RU (CT NT) SV SZ **A:** IN JA KZ MG RU (ES FE WS) **NAR** (Nilsson, Hájek, 2021).

***Ilybius fuliginosus fuliginosus* Fabricius, 1792**
Ilybius fuliginosus (Fabricius, 1792): Kasymov, 1972: 118
Ilybius fuliginosus fuliginosus Fabricius, 1792: Nilsson, Hájek, 2021: 10
Distribution in Azerbaijan: Agstafa (Kasymov, 1972).
General distribution: E: AB AL AN AR AU BE BH BU BY CR CZ DE EN FI FR GB GE GG GR HU IR IT LA LS LT LU MC MD ME NL NR PL RO RU (CT NT ST) SB SK SL SP SV SZ UK N: MO A: IN KI KZ RU (WS) TR (Nilsson, Hájek, 2021).

***Ilybius lenkoranensis* Fery & Nilsson, 1993**
***Ilybius** lenkoranensis* Fery & Nilsson, 1993: Nilsson, Hájek, 2021: 10
General distribution: **E:** AB **A:** IN (Nilsson, Hájek, 2021).

***Ilybius subaeneus* Erichson, 1837**
***Ilybius** subaeneus* Erichson, 1837: Nilsson, Hájek, 2021: 11
General distribution: **E:** AB AR AU BE BY CR CZ DE EN FI FR GB GE GG HU IR IT LA LT LU MD NL NR PL RO RU (CT NT ST) SK SV SZ UK **A:** KI KZ MG RU (ES WS) NAR (Nilsson, Hájek, 2021).

Genus *Platambus* Thomson, 1859
***Platambus lunulatus* (Fischer von Waldheim, 1829)**
Colymbetes lunulatus Fischer von Waldheim, 1829:26
Platambus lunulatus (Fischer von Waldheim, 1829): Kasymov, 1972: 118
Platambus lunulatus (Fischer von Waldheim, 1829): Nilsson, Hájek, 2021: 12
Distribution in Azerbaijan: Shusha, Goygol distr., Zagatala (Kasymov, 1972).
General distribution: E: AB AR GG GR RU (ST) TR N: EG A: IN LE TR (Nilsson, Hájek, 2021).

***Platambus maculatus* (Linnaeus, 1758)**
Platambus maculatus caucasicus Zaitzev, 1927:18
Platambus maculatus (Linnaeus, 1758): Kasymov, 1972: 118.
Distribution in Azerbaijan: Zagatala (Kasymov, 1972).
General distribution: E: AL AN AR AU BE BH BU BY CR CZ DE EN FI FR GB GE GG GR HU IT LA LS LT LU MC ME NL NR PL RO RU (CT NT ST) SB SK SL SP SV SZ UK A: IN RU (WS) TR (Nilsson, Hájek, 2021).

Subfamily COLYMBETINAE Erichson, 1837
Tribe Colymbetini Erichson, 1837
Genus *Colymbetes* Clairville, 1806
***Colymbetes fuscus* (Linnaeus, 1758)**
Colymbetes fuscus (Linnaeus, 1758): Kasymov, 1972: 119
Distribution in Azerbaijan: Lenkoran, Mingechevir (Kasymov, 1972).

General distribution: E: AR AU BE BH BU BY CR CZ DE EN FI FR GB GE GR HU IR IT KZ LA LS LT LU MA MC MD ME NL NR PL PT RO RU (CT NT ST) SK SL SP SV SZ TR UK YU N: AG EG LB MO TU A: AF CH (XIZ) CY IN IS KA KZ LE RU (WS) SI SY TM TR UZ (Nilsson, Hájek, 2021).

***Colymbetes semenowi* Jakovlev, 1896**
Colymbetes *semenowi* Jakovlev, 1896: Nilsson, Hájek, 2021: 14
General distribution: **E:** AB GG RU (ST) UK **A:** AF CH (XIN XIZ) IN KI KZ TM (Nilsson, Hájek, 2021).

Genus *Rhantus* Dejean, 1833
Subgenus *Rhantus* Dejean, 1833
***Rhantus frontalis* (Marsham, 1802)**
Rhantus suturalis Lacordaire in Boisduval & Lacordaire, 1835: 311
Rhantus suturalis Lac.: Zaytsev, 1927: 290
Rhantus suturellus Lac. Kasymov, 1972: 118
Rhantus frontalis (Marsham, 1802): Nilsson, Hájek, 2021: 15
Distribution in Azerbaijan: Lenkoran (Zaytsev, 1927).
General distribution: E: AB AR AU BE BH BY CR CZ DE EN FI FR GB GE GG HU IR IT KZ LA LS LT LU MD NL NR PL RO RU (CT NT ST) SB SK SL SV SZ UK A: KZ MG RU (ES WS) TR (Nilsson, Hájek, 2021).

***Rhantus suturalis* (W.S. Macleay, 1825)**
Colymbetes pulverosus Stephens, 1828: 69
Rhantus pulverosus Steph.: Kasymov, 1972: 118
Rhantus suturalis (W.S. Macleay, 1825): Nilsson, Hájek, 2021: 15
Distribution in Azerbaijan: Mingechevir (Kasymov, 1965 a), Astara (Kasymov, 1972).
General distribution: E: AB AL AR AU AZ BE BH BU BY CR CZ DE EN FI FR GB GE GG GR HU IR IT LA LS LT LU MA MC ME NL NR PL PT RO RU (CT ST) SB SK SL SP SV SZ UK N: EG LB MO TU A: AF AP3 CH (BEI FUJ GAN GUA GUI GUX HEB HEI HUB JIA JIL LIA MAC NMO QIN SCH SHN SHX TAI XIZ YUN ZHE) CY HP IN IQ IS JA JO KA KI KU KZ MG NC NP PA RU (ES FE WS) SA SC SD SI TD TM TR UZ AUR ORR (Nilsson, Hájek, 2021).

Subfamily COPELATINAE Branden, 1885
tribe Copelatini Branden, 1885
genus *Liopterus* Dejean, 1833
***Liopterus haemorrhoidalis* Fabricius, 1787**
Liopterus haemorrhoidalis Fabricius, 1787: Nilsson, Hájek, 2021: 17
General distribution: **E:** AB AR AU BE BH BU BY CR CZ DE EN FI FR GB GE GG GR HU IR IT LA LS LT LU MC ME NL PL RO RU (CT NT ST) SB SK SL SP SV SZ UK **N:** AG **A:** IN IS TD TM TR (Nilsson, Hájek, 2021).

Subfamily CYBISTRINAE Sharp, 1880
Tribe Cybistrini Sharp, 1882
Genus *Cybister* Curtis, 1827
Subgenus *Cybister* Curtis, 1827
***Cybister lateralimarginalis lateralimarginalis* De Geer, 1774**
Cybister lateralimarginalis (De Geer, 1774): Kasymov, 1972: 120
Cybister lateralimarginalis lateralimarginalis De Geer, 1774: Nilsson, Hájek, 2021: 18
Distribution in Azerbaijan: Lenkoran, Neftchala, Shamakhi (*Şamaxı*), Geokchay (*Gökçay*), Geoktepe, Hajikend (*Hacıkənd*), Ganja (*Gəncə*) (Zaytsev, 1946), Neftchala, Astara, Mingechevir and Varvara water reservoir (Kasymov, 1972).

General distribution: E: AB AR AU BE BH BU BY CR CZ DE EN FR GB GE GR HU IT KZ LA LT LU MC MD ME NL PL PT RO RU (CT NT ST) SB SK SL SP SV SZ UK N: AG EG LB MO TU A: CY IN IS JO KI KU KZ LE SY (Nilsson, Hájek, 2021).

***Cybister tripunctatus lateralis* Fabricius, 1798**
Cybister gotschii Hochhuth, 1846: 214
Cybister tripunctatus gotschi Hochhuth, 1846: Kasymov, 1972: 120
Cybister tripunctatus lateralis Fabricius, 1798: Nilsson, Hájek, 2021: 19
Distribution in Azerbaijan: Niznyaya Kura (*Aşağı Kür*) (Bogachev, 1951), Mingechevir, Mingechevir water reservoir (Kasymov, 1965a), Lenkoran, Neftchala, Ganja (Zaytsev, 1953).
General distribution: E: AB RU (ST) A: AE AF AP3 BT CH (GUA FUJ HAI HEB HEI HUB HUN JIA NAC SCH TAI YUN XIZ ZHE) CY HP IN IQ JA KA KI MG NP OM PA RU (FE) SD SY TD TM TR UP UZ ORR (Nilsson, Hájek, 2021).

Subfamily DYTISCINAE Leach, 1815
Tribe Aciliini Thomson, 1867
Genus *Acilius* Leach, 1817
Subgenus *Acilius* Leach, 1817
***Acilius (Acilius) sulcatus* (Linnaeus, 1758)**
Acilius sulcatus (Linnaeus, 1758): Kasymov, 1972: 119
Acilius (Acilius) sulcatus (Linnaeus, 1758): Nilsson, Hájek, 2021: 19
Distribution in Azerbaijan: Lenkoran, Ali-Bayramli (now Shirvan), Mingechevir, Astara (Kasymov, 1972).
General distribution: E: AB AL AR AU BE BH BU BY CR CZ DE EN FI FR GB GE GG HU IR IT LA LS LT LU ME NL NR PL PT RO RU (CT NT ST) SB SK SL SP SV SZ UK N: AG A: IN KI KZ MG RU (ES FE WS) TR (Nilsson, Hájek, 2021).

Genus *Graphoderus* Dejean, 1833
***Graphoderus austriacus* (Sturm, 1834)**
Graphoderes austriacus (Sturm, 1834): Kasymov, 1972: 119.
Graphoderus austriacus (Sturm, 1834): Nilsson, Hájek, 2021: 20
Distribution in Azerbaijan: Agstafa (Kasymov, 1972).
General distribution: E: AB AR AU BE BH BU BY CR CZ DE FR GE HU IT KZ LA LT MD NL PL RO RU (CT ST) SB SK SL SV SZ UK A: IN KI KZ MG RU (ES FE WS) TM TR (Nilsson, Hájek, 2021).

***Graphoderus cinereus* Linnaeus, 1758**
Graphoderus cinereus Linnaeus, 1758: Nilsson, Hájek, 2021: 20
General distribution: E: AB AR AU BE BH BU BY CR CZ DE EN FI FR GB GE GG GR HU IT KZ LA LT LU MC MD NL NR PL RO RU (CT ST) SB SK SL SP SV SZ UK A: IN KZ MG RU (WS) TR (Nilsson, Hájek, 2021).

Tribe Dytiscini Leach, 1815
Genus *Dytiscus* Linnaeus, 1758
***Dytiscus circumflexus* Fabricius, 1801**
Dytiscus circumflexus Fabricius, 1801: Kasymov, 1972: 119
Dytiscus circumflexus Fabricius, 1801: Nilsson, Hájek, 2021: 21
Distribution in Azerbaijan: Varvara water reservoir, Kura near Mingechevir (Kasymov, 1965a), Lenkoran, Ganja, Ali-Bayramli (now Shirvan) (Kasymov, 1972).

General distribution: E: AB AR AU BE BH BU BY CR CZ DE EN FR GB GE GG GR HU IR IT LA LT LU MA MD NL PL PT RO RU (ST) SB SK SL SP SV UK N: AG EG LB MO TU A: CY IN IS? KI? KZ LE RU (WS) SY TR (Nilsson, Hájek, 2021).

***Dytiscus dimidiatus* Bergsträsser, 1777**
Dytiscus dimidiatus Bergsträsser, 1777: Nilsson, Hájek, 2021: 21
General distribution: E: AB AL AR AU BE BH BU BY CR CZ DE EN FI FR GB GE GG GR HU IT LA LT LU MC MD ME NL PL RO RU (CT NT ST) SK SL SV SZ UK YU A: IN KI SY TR (Nilsson, Hájek, 2021).

***Dytiscus marginalis marginalis* Linnaeus, 1758**
Dytiscus marginalis Linnaeus, 1758: Kasymov, 1972: 119
Dytiscus marginalis marginalis Linnaeus, 1758: Nilsson, Hájek, 2021: 21
Distribution in Azerbaijan: Lenkoran (Veysig, 1939), Mingechevir (Kasymov, 1972).
General distribution: E: AB AL AU BE BH BU BY CR CZ DE EN FI FR GB GE GG GR HU IR IT LA LS LT LU MC ME NL NR PL PT RO RU (CT NT ST) SK SL SP SV SZ UK YU A: KI KZ RU (ES WS) TR (Nilsson, Hájek, 2021).

***Dytiscus persicus* Wehncke, 1876**
Dytiscus persicus Wehncke, 1876: Kasymov, 1972: 119
Distribution in Azerbaijan: Goygol distr. (Bogachev, 1951), Ajikend (Kasymov, 1972).
General distribution: E: AR GG RU (ST) UK A: AF IN TR UZ (Nilsson, Hájek, 2021).

Tribe Eretini Crotch, 1873
Genus *Eretes* Laporte, 1833
***Eretes griseus* Fabricius, 1781**
Eretes griseus Fabricius, 1781: Nilsson, Hájek, 2021: 22
General distribution: **E:** AB AR AZ BH BU CR CZ FR GG GR HU IT ME PT RO RU (ST) SB SL SP UK **N:** AG EG LB MO TU **A:** AF BT CH (BEI FUJ HAI HEB HEI HUB JIA LIA MAC SCH SHA SHG SHN SHX TAI XIZ YUN ZHE) IN IQ JA JO HP KA KU NP OM PA RU (FE) SC SI SY TR UP YE AFR AUR ORR (Nilsson, Hájek, 2021).

***Eretes sticticus* (Linnaeus, 1767)**
Eretes sticticus (Linnaeus, 1767): Kasymov, 1972: 119
Distribution in Azerbaijan: Mingechevir, Neftchala (Kasymov, 1965 a), Lenkoran, Geoktepe, Agstafa, Garayazi (Jandargol (Candargöl) (Kasymov, 1972).
General distribution: E: BU CR CZ GR HU RU (ST) SK SP N: AG CI EG LB MO MR TU A: AE AF CY IN IS JO KI KZ QA SA SI TD TM TR YE AFR NAR NTR (Nilsson, Hájek, 2021).

Tribe Hydaticini Sharp, 1882
Genus *Hydaticus* Leach, 1817
Subgenus *Hydaticus* Leach, 1817
***Hydaticus (Hydaticus) schelkovnikovi* Zaitzev, 1913**
Hydaticus schelkovnikovi Zaitzev, 1913:197
Hydaticus schelkovnikovi Zaitzev, 1913: Kasymov, 1972: 119
Hydaticus (Hydaticus) schelkovnikovi Zaitzev, 1913: Nilsson, Hájek, 2021: 22
Distribution in Azerbaijan: Elisavetpol prov. (Now Ganja) (Zaitzev, 1913); Agstafa, Garayazi (Jandargol (Candargöl) (Kasymov, 1972).
General distribution: AB AR GG RU (ST) A: IN (Nilsson, Hájek, 2021).

Subgenus *Prodaticus* Sharp, 1882

***Hydaticus (Prodaticus) grammicus* (Germar, 1827)**
Hydaticus grammicus (Germar, 1827): Kasymov, 1972: 119
Hydaticus (Prodaticus) grammicus (Germar, 1827): Nilsson, Hájek, 2021: 23
Distribution in Azerbaijan: Mingechevir (Kasymov, 196 a), Lenkoran, Geoktepe, Ganja, Agstafa, Garayazi (Jandargol (Candargöl) (Kasymov, 1972).
General distribution: E: AB AR AU BH BU CR FR GE GG HU IT MC PL RO RU (ST) SK SL SZ TR UK YU A: AF CH (BEI HAI HEB HEI HUB JIA JIL LIA SCH YUN) IN JA KI KZ NC TM UZ (Nilsson, Hájek, 2021).

***Hydaticus (Prodaticus) leander* Rossi, 1790**
Hydaticus leander Rossi, 1790: Kasymov, 1972: 119.
Hydaticus (Prodaticus) leander Rossi, 1790: Nilsson, Hájek, 2021: 23
Distribution in Azerbaijan: Azerbaijan (Zaitsev, 1927).
General distribution: E: AB AL FR GR IT ME PT SP N: AG EG LB MO TU A: CY IN IQ IS JO SI SY TM TR AFR (Nilsson, Hájek, 2021).

***Hydaticus (Prodaticus) ponticus* Sharp, 1882**
Hydaticus ponticus Sharp, 1882: Shaverdo et al.., 2021
Distribution in Azerbaijan: Gobustan (Shaverdo et al.., 2021)
General distribution: N: EG LB A: IN IQ KZ PA SA SI SY TD TM TR ORR (Nilsson, Hájek, 2021).

Subfamily Hydroporinae Aubé, 1836
Tribe Bidessini Sharp, 1882
Genus *Bidessus* Sharp, 1882
***Bidessus alienus* Zimmermann, 1919**
Bidessus alienus Zimmermann, 1919: Kasymov, 1972: 115
Bidessus alienus Zimmermann, 1919: Nilsson, Hájek, 2021: 24
Distribution in Azerbaijan: Lenkoran (Zaytsev, 1927), Barda (Kasymov, 1972).
General distribution: E: AB CR MC MD RU (ST) A: IN KZ RU (WS) TM (Nilsson, Hájek, 2021).

***Bidessus nasutus* Sharp, 1887**
Bidessus nasutus Sharp, 1887: Kasymov, 1972: 115
Bidessus nasutus Sharp, 1887: Nilsson, Hájek, 2021: 25
Distribution in Azerbaijan: Lenkoran (Zaytsev, 1927).
General distribution: E: AB AR AU BH BU CR CZ HU MD RO RU (ST) SB SK UK A: IN IS KI KZ MG RU (WS) TM TR (Nilsson, Hájek, 2021).

Genus *Hydroglyphus* Motschulsky, 1853
Hydroglyphus geminus (Fabricius, 1792)
Bidessus pusillus (Fabr.): Kasymov, 1972: 115
Hydroglyphus geminus (Fabricius, 1792): Nilsson, Hájek, 2021: 24
Distribution in Azerbaijan: Lenkoran, Astara, Ganja distr., Sheki (*Şəki*) (Kasymov, 1972).
General distribution: E: AB AL AR AU BE BH BU BY CR CZ DE EN FI FR GB GE GG GR HU IT LA LS LT LU MC MD ME NL NR PL PT RO RU (CT NT ST) SB SK SL SP SV SZ TR UK N: AG CI EG LB MO TU A: AF BT CH (GUI GUX HEI HEN JIL LIA SCH YUN) CY HP IN IQ IS JO KA KI KZ LE MG NC NP PA RU (ES WS) SA SC SI SY TD TM TR UP UZ ORR (Nilsson, Hájek, 2021).

***Hydroglyphus signatellus* (Klug, 1834)**
Bidessus signatellus (Klug, 1834): Kasymov, 1972: 115
Hydroglyphus signatellus (Klug, 1834): Nilsson, Hájek, 2021: 26

Distribution in Azerbaijan: Agstafa, Garayazi (Jandargol (Candargöl) (Kasymov, 1972).
General distribution: E: AB AR BH CR FR GG GR IT ME RU (ST) SP N: AG EG LB MO TU A: AE AF CY IN IQ IS JO KI KU KZ OM PA SA SI SY TD TM TR UZ YE AFR (Nilsson, Hájek, 2021).

Tribe Hydroporini Aubé, 1836
Genus *Deronectes* Sharp, 1882
***Deronectes parvicollis* (Schaum, 1864)**
Deronectes parvicollis (Schaum): Kasymov, 1972: 117
Distribution in Azerbaijan: Agstafa, Garayazi (Jandargol (Candargöl) (Kasymov, 1972).
General distribution: E: AR BU GG GR MC RO YU A: IN TR (Nilsson, Hájek, 2021).

Genus *Nebrioporus* Régimbart, 1906
***Nebrioporus airumlus* (Kolenati, 1845)**
Potamonectes airumlus (Kol.): Kasymov, 1972: 117
Nebrioporus airumlus (Kolenati, 1845): Nilsson, Hájek, 2021: 30
Distribution in Azerbaijan: Agstafa, Garayazi (Jandargol (Candargöl) (Kasymov, 1972).
General distribution: E: AB AR GG PL RU (ST) UK A: AF CH (BEI GAN GUI HEB HEI HEN JIA LIA NMO SCH SHA SHN SHX XIN YUN) HP IN IS KA KI KZ MG PA RU (ES WS4) TD TM TR UZ (Nilsson, Hájek, 2021).

***Nebrioporus depressus* (Fabricius, 1775)**
Potamonectes depressus (Fabr.): Kasymov, 1972: 117
Distribution in Azerbaijan: Barda (Kasymov, 1972).
General distribution: E: BY CZ DE EN FI GB GE HU IR LA LT NR PL RU (CT NT ST) SL SV UK A: MG RU (ES WS) NAR (Nilsson, Hájek, 2021).

***Nebrioporus steppensis* (Motschulsky, 1860)**
Potamonectes cerisyi steppensis Motsch.: Kasymov, 1972: 117
Distribution in Azerbaijan: Talysh (Zaytsev, 1953; Kasymov, 1972).
General distribution: E: KZ RU (ST) (Nilsson, Hájek, 2021).

***Nebrioporus stearinus stearinus* (Kolenati, 1845)**
Hydroporus variegatus Aubé, 1838a:236
Potamonectes variegatus (Aube) (Zaytsev, 1953: 203)
Potamonectes variegatus (Aube): Kasymov, 1972: 117
Nebrioporus stearinus stearinus (Kolenati, 1845): Nilsson, Hájek, 2021: 32
Distribution in Azerbaijan: Kura (Zaytsev, 1953; Kasymov, 1972).
General distribution: E: AB AR N: EG A: AF IN IS LE SY TR (Nilsson, Hájek, 2021).

subtribe Hydroporina Aubé, 1836
Genus *Hydroporus* Clairville, 1806
***Hydroporus erythrocephalus* Linnaeus, 1758**
Hydroporus erythrocephalus Linnaeus, 1758: Nilsson, Hájek, 2021: 35
General distribution: E: AB AU BE BH BU BY CR CZ DE EN FA FI FR GB GE GG HU IR IT LA LT LU ME NL NR PL RO RU (CT NT ST) SK SL SV SZ UK A: IN KZ RU (ES WS) TR (Nilsson, Hájek, 2021).

***Hydroporus memnonius* Nicolai, 1822**
Hydroporus memnonius Nic.: Kasymov, 1972: 116
Hydroporus memnonius Nicolai, 1822: Nilsson, Hájek, 2021: 37
Distribution in Azerbaijan: Lenkoran (Zaytsev, 1927).

General distribution: E: AB AU BE BH BU BY CR CZ DE EN FA FI FR GB GE GR HU IR IT LA LS LT LU NL NR PL RU (CT NT ST) SK SL SP SV SZ UK N: AG EG MO TU A: TR (Nilsson, Hájek, 2021).

***Hydroporus palustris* (Linnaeus, 1760)**
Hydroporus palustris L.: Kasymov, 1972: 116
Hydroporus palustris (Linnaeus, 1760): Nilsson, Hájek, 2021: 38
Distribution in Azerbaijan: Astara (Kasymov, 1972).
General distribution: E: AB AN AR AU BE BH BU BY CR CZ DE EN FA FI FR GB GE GG GR HU IR IT LA LS LT LU MC ME NL NR PL RO RU (CT NT ST) SK SL SP SV SZ UK YU A: IN MG RU (ES WS) TR (Nilsson, Hájek, 2021).

***Hydroporus planus* (Fabricius, 1782)**
Hydroporus planus (Fabr.): Kasymov, 1972: 116
Hydroporus planus (Fabricius, 1782): Nilsson, Hájek, 2021: 38
Distribution in Azerbaijan: Ganja, Mingechevir and Varvara water reservoirs (Kasymov, 1972).
General distribution: E: AB AL AR AU BE BH BU BY CR CZ DE EN FI FR GB GE GG GR HU IR IT LA LT LU MC NL NR PL PT RO RU (CT NT ST) SK SL SP SV SZ TR UK YU N: AG MO A: IN IQ KI KZ LE RU (WS) TM TR (Nilsson, Hájek, 2021).

***Hydroporus tessellatus* (Drapiez, 1819)**
Hydroporus tessellatus Drap.: Kasymov, 1972: 116
Hydroporus tessellatus (Drapiez, 1819): Nilsson, Hájek, 2021: 40
Distribution in Azerbaijan: Lenkoran (Kasymov, 1972).
General distribution: E: AB AL BE BH BU CR FR GB GG GR IR IT LA MA MC ME NL PT RU (ST) SP N: AG EG MO TU A: CY IN IQ IS JO LE SY TR (Nilsson, Hájek, 2021).

***Hydroporus transgrediens* Gschwendtner, 1923**
Hydroporus discretus ponticus Zaitzev, 1927: 16
Hydroporus discretus ponticus Zaitz: Kasymov, 1972: 116
Hydroporus transgrediens Gschwendtner, 1923: Nilsson, Hájek, 2021: 40
Distribution in Azerbaijan: E: AB AR GG RU (ST) UK A: IN KI TM TR (Nilsson, Hájek, 2021).
General distribution: E: AB AR GG RU (ST) UK A: IN KI TM TR (Nilsson, Hájek, 2021).

***Hydroporus pubescens* (Gyllenhal, 1808)**
Hydroporus pubescens Gyll.: Kasymov, 1972: 116
Hydroporus melanocephalus Marsham, 1802:423
Hydroporus pubescens (Gyllenhal, 1808: Nilsson, Hájek, 2021: 39
Distribution in Azerbaijan: Lenkoran (Zaytsev, 1927).
General distribution: E: AB AL AU BE BH BU CR CZ DE EN FA FI FR GB GE GG GR IR IT LA LT LU MC ME NL NR PL PT RO RU (CT NT ST) SB SK SL SP SV SZ TR UK N: AG LB MO TU A: CY IN IS JO LE SY TR (Nilsson, Hájek, 2021).

***Hydroporus talyschensis* Bilyashiwsky, 2004**
Hydroporus talyschensis Bilyashiwsky, 2004: 45
Hydroporus talyschensis Bilyashiwsky, 2004: Nilsson, Hájek, 2021: 39
Distribution in Azerbaijan: Lenkoran (Bilyashiwsky, 2004)
General distribution: E: AB (Nilsson, Hájek, 2021).

subtribe Siettitiina Smrž, 1982
Genus *Porhydrus* Guignot, 1945
***Porhydrus lineatus* (Fabricius, 1775)**
Porhydrus lineatus (Fabr.): Kasymov, 1972: 117
Porhydrus lineatus (Fabricius, 1775: Nilsson, Hájek, 2021: 42
Distribution in Azerbaijan: Astara (Kasymov, 1972).
General distribution: E: AB AL AU BE BH BU BY CR CZ DE EN FI FR GB GE GG GR HU IR IT LA LT LU MC MD ME NL NR PL RO RU (CT NT ST) SK SL SV SZ TR UK YU A: IN RU (WS) (Nilsson, Hájek, 2021).

tribe Hydrovatini Sharp, 1880
Genus *Hydrovatus* Motschulsky, 1853
***Hydrovatus cuspidatus* Kunze, 1818**
Hydrovatus cuspidatus Kunze, 1818: Kasymov, 1972
Hydrovatus cuspidatus Kunze, 1818: Nilsson, Hájek, 2021: 43
Distribution in Azerbaijan: Agstafa, Garayazi (Jandargol (Candargöl), Lenkoran, Astara (Kasymov, 1972).
General distribution: E: AB AL AR AU BE BU CR CZ DE FI1 FR GE GG GR HU IT LU MC MD NL PL PT RO RU (CT ST) SB SK SL SP SV SZ UK N: AG EG LB MO TU A: CY IN IQ IS JO KI LE SI SY TM TR UZ AFR (Nilsson, Hájek, 2021).

tribe Hygrotini Portevin, 1929
Genus *Hygrotus* Stephens, 1828
Subgenus *Coelambus* Thomson, 1860
***Hygrotus (Coelambus) confluens* (Fabricius, 1787)**
Coelambus confluens (Fabr): Kasymov, 1972: 116
Hygrotus (Coelambus) confluens (Fabricius, 1787: Nilsson, Hájek, 2021: 44
Distribution in Azerbaijan: Agstafa, Garayazi (Jandargol (Candargöl), Lenkoran (Kasymov, 1972).
General distribution: E: AB AL1 AR AU AZ BE BH BU BY CR CZ DE EN FR GB GE GG GR HU IR IT LS LU MA MC MD ME NL NR PL PT RU (CT ST) SK SL SP SV SZ UK YU N: AG CI EG LB MO MR TU A: AE AF CY HP IN IQ IS JO KA KZ KU MG PA RU (ES) SA SI SY TM TR UZ YE AFR (Nilsson, Hájek, 2021).

***Hygrotus (Coelambus) enneagrammus* Ahrens, 1833**
Hygrotus (Coelambus) enneagrammus Ahrens, 1833: Nilsson, Hájek, 2021: 44
General distribution: E: AB BU GE GG KZ PL RO RU (ST) UK A: AF CH (XIN) IN KI KU KZ MG PA RU (WS) SY TD TM TR UZ (Nilsson, Hájek, 2021).

***Hygrotus (Coelambus) flaviventris* Motschulsky, 1860**
Hygrotus (Coelambus) flaviventris Motschulsky, 1860: Nilsson, Hájek, 2021: 44
General distribution: **E:** AB AR GE GG PL RU (ST) **A:** CH (QIN XIN) KA KI KZ MG PA RU (WS) (Nilsson, Hájek, 2021).

***Hygrotus (Coelambus) pallidulus* (Aubé, 1850)**
Coelambus pallidulus (Aube): Kasymov, 1972: 116
Hygrotus (Coelambus) pallidulus (Aubé, 1850): Nilsson, Hájek, 2021: 44
Distribution in Azerbaijan: Lenkoran (Zaytsev, 1927, 1953).
General distribution: E: AB AU BU FR GG GR HU IT RO SP UK N: AG CI1 EG LB MO TU A: IN SI SY TM TR (Nilsson, Hájek, 2021).

Subgenus *Hygrotus* Stephens, 1828
***Hygrotus (Hygrotus) inaequalis* Fabricius, 1777**
Hygrotus (Hygrotus) inaequalis Fabricius, 1777: Nilsson, Hájek, 2021: 45
General distribution: E: AB AR AU BE BH BU BY CR CZ DE EN FI FR GB GE GG GR HU IR IT LA LS LT LU MC MD ME NL NR PL PT RO RU (CT NT ST) SB SK SL SP SV SZ UK N: AG MO A: CH (HEI JIL LIA NMO SHA) IN IS JA KI KZ LE MG RU (ES FE WS) SY TR (Nilsson, Hájek, 2021).

***Hygrotus (Hygrotus) musicus* (Klug, 1834)**
Hypophorus musicus (Klug.): Kasymov, 1972: 115
Hygrotus (Hygrotus) musicus (Klug, 1834): Nilsson, Hájek, 2021: 45
Distribution in Azerbaijan: Agstafa, Garayazi (Jandargol (Candargöl) , Kura valley, Lenkoran, Astara (Kasymov, 1972).
General distribution: E: AB AR BU CR GG GR IT MA RU (ST) SP UK N: AG CI EG LB MO TU A: AE AF CH (XIN) CY IN IQ IS JO KI KU KZ NP PA SA SI SY TD TM TR UP UZ YE ORR (Nilsson, Hájek, 2021).

***Hygrotus (Hygrotus) versicolor* Schaller, 1783**
Hygrotus (Hygrotus) versicolor Schaller, 1783: Nilsson, Hájek, 2021: 45
General distribution: E: AB AU BE BH BU BY CR CZ DE EN FI FR GB GE HU IR IT LA LT LU NL NR PL RO RU (CT NT ST) SB SK SL SV SZ UK A: RU (WS) (Nilsson, Hájek, 2021).

Subgenus *Leptolambus* Villastrigo, Ribera, Manuel, Millán & Fery, 2017
***Hygrotus (Leptolambus) impressopunctatus* Schaller, 1783**
Hygrotus (Leptolambus) impressopunctatus Schaller, 1783: Nilsson, Hájek, 2021: 46
General distribution: E: AB AR AU BE BH BU BY CR CZ DE EN FI FR GB GE GG HU IR IT LA LS LT LU MC MD NL NR PL RO RU (CT NT ST) SB SK SL SP SV SZ UK A: AF CH (GAN HEB HEI LIA NMO QIN SCH SHA XIN) IN JA KA KI KZ MG RU (ES FE WS) TM TR UZ NAR (Nilsson, Hájek, 2021).

***Hygrotus (Leptolambus) parallellogrammus* (Ahrens, 1812)**
Coelambus parallellogrammus (Ahr.): Kasymov, 1972: 116
Hygrotus (Leptolambus) parallellogrammus (Ahrens, 1812): Nilsson, Hájek, 2021: 46
Distribution in Azerbaijan: Lenkoran (Kasymov, 1972).
General distribution: E: AB AL AU BE BH BU BY CR CZ DE EN FR GB GE GR HU IR IT LA LT LU MD NL NR PL RO RU (CT ST) SB SK SL SP SV SZ UK A: AF CH (BEI) ES IQ KI KZ MG RU (ES WS) TM TR UZ (Nilsson, Hájek, 2021).

***Hygrotus (Leptolambus) lernaeus* (Schaum, 1857)**
Coelambus lernaeus (Schaum): Kasymov, 1972: 116
Distribution in Azerbaijan: Lenkoran (Zaytsev, 1927, 1953).
General distribution: E: BU GG GR MC RO N: EG A: AF IS KI SY TR UZ (Nilsson, Hájek, 2021).

***Hygrotus (Leptolambus) polonicus polonicus* Aubé, 1842**
Hygrotus (Leptolambus) polonicus polonicus Aubé, 1842: Nilsson, Hájek, 2021: 46
General distribution: E: BU GG GR MC RO N: EG A: AF IS KI SY TR UZ (Nilsson, Hájek, 2021).

Tribe Hyphydrini Sharp, 1882
Genus *Hyphydrus* Illiger, 1802
***Hyphydrus ovatus* (Linnaeus, 1760)**
Hyphydrus ovatus (Linnaeus, 1760): Kasymov, 1972: 115

Distribution in Azerbaijan: Astara (Kasymov, 1972).
General distribution: E: AL AU BE BH BU BY CR CZ DE EN FI FR GB GE GG GR HU IR IT LA LS LT LU MC ME NL NR PL RO RU (CT NT ST) SB SK SL SV SZ UK A: IN KZ RU (ES WS) TR UZ (Nilsson, Hájek, 2021).

Subfamily LACCOPHILINAE Gistel, 1856
Tribe Laccophilini Gistel, 1856
Genus *Laccophilus* Leach, 1815
***Laccophilus hyalinus* (DeGeer, 1774)**
Laccophilus hyalinus (DeGeer, 1774): Kasymov, 1972: 14
Laccophilus hyalinus (DeGeer, 1774): Nilsson, Hájek, 2021: 51
Distribution in Azerbaijan: Lenkoran (Zaytsev, 1947), Ganja distr. (Kasymov, 1972).
General distribution: E: AB AL AR AU BE BH BU BY CR CZ DE EN FI FR GB GE GG GR HU IR IT LA LT LU MA MC MD ME NL NR PL PT RO RU (NT ST) SK SL SP SV SZ UK YU N: AG CI EG LB MO TU A: CY IN IQ IS JO KI LE RU (ES WS) SY TM TR UZ (Nilsson, Hájek, 2021).

***Laccophilus minutus* Linnaeus, 1758**
Laccophilus minutus Linnaeus, 1758: Kasymov, 1972: 114
Laccophilus minutus Linnaeus, 1758: Nilsson, Hájek, 2021: 51
Distribution in Azerbaijan: Lenkoran, Astara, Mingechevir (Kasymov, 1972).
General distribution: E: AB AL AR AU BE BH BU BY CR CZ DE EN FI FR GB GE GG GR HU IR IT LA LT LU MA MC MD ME NL NR PL PT RO RU (NT ST) SK SL SP SV SZ UK YU N: AG LB MO TU A: AF CH (XIN YUN) CY IN IQ IS JO KA KI KZ MG PA RU (ES WS) SY TD TM TR UZ ORR (Nilsson, Hájek, 2021).

***Laccophilus poecilus* Klug, 1834**
Dyticus variegatus Germar & Kaulfuss, 1816: t.6
Laccophilus variegatus Germ.: Kasymov, 1972: 114
Laccophilus poecilus Klug, 1834: Nilsson, Hájek, 2021: 51
Distribution in Azerbaijan: Lenkoran (Veysig, 1939), Baku, Goygol (Zaytsev, 1946, 1953), Ganja, Astara, Zagatala, Lenkoran (Kasymov, 1972).
General distribution: E: AB AL AR AU BE BH BU CR CZ EN FR GB GE GG GR HU IT LA LS LT LU MC ME NL NR PL RO RU (ST) SK SL SP SV SZ UK YU N: AG EG MO A: AF CH (XIN) CY IN IQ IS KI KU KZ LE RU (WS)4 SA SI SY TD TM TR UZ (Nilsson, Hájek, 2021).

SUBORDER POLYPHAGA Emery, 1886
Family HELOPHORIDAE Leach, 1815
Genus *Helophorus* Fabricius, 1775
Subgenus *Empleurus* Hope, 1838
***Helophorus (Empleurus) nubilis* Fabricius, 1777**
Helophorus nubilis Fabr.: Kasymov, 1972: 121
Distribution in Azerbaijan: Agstafa, Garayazi (Jandargol (Candargöl) (Kasymov, 1972).
General distribution: E: AU BH BU BY CR CT CZ DE EN FI FR GB GE GR HU IR IT LA LT MC NL NR NT PL PT RO SK SL SP ST SV SZ TR UK YU "Transcaucasus" A: IN TR (Przewoźny, 2019)

Subgenus *Eutrichelophorus* Sharp, 1915
***Helophorus* (*Eutrichelophorus) micans* Faldermann, 1835**
Helophorus micans Fald.: Kasymov, 1972: 121
Helophorus (*Eutrichelophorus) micans* Faldermann, 1835: Przewoźny, 2019: 3
Distribution in Azerbaijan: Agstafa, Garayazi (Jandargol (Candargöl) (Kasymov, 1972).

General distribution: Azerbaijan, Armenia, Austria, Bulgaria, Czech Republic, Great Britain, Hungary, Slovakia, Russia: South European territory, Ukraine, Afghanistan, Cyprus, Iran, Iraq, Israel, Pakistan, Tajikistan, Turkey, Uzbekistan (Przewoźny, 2019).

Subgenus *Helophorus* Fabricius, 1775
***Helophorus (Helophorus) maritimus* Rey, 1885**
Helophorus aquaticus maritimus Rey.: Kasymov, 1972: 121
Distribution in Azerbaijan: Agstafa, Garayazi (Jandargol (Candargöl) (Kasymov, 1972).
General distribution: Bosnia Herzegovina, Croatia, France, Macedonia, Montenegro, Spain, Tunisia (Przewoźny, 2019).

***Helophorus (Helophorus) syriacus* Kuwert, 1885**
Helophorus (Helophorus) syriacus Kuwert, 1885: Przewoźny, 2019: 4
General distribution: Azerbaijan, Iran, Israel, Kazakhstan, Saudi Arabia, Tajikistan, Turkmenia, Uzbekistan (Przewoźny, 2019).

Subgenus *Rhopalohelophorus* Kuwert, 1886
***Helophorus (Rhopalohelophorus) granularis* Linnaeus, 1760**
Helophorus granularia L.: Kasymov, 1972: 122
Distribution in Azerbaijan: Astara, Lenkoran, Agstafa, Garayazi (Jandargol (Candargöl) (Kasymov, 1972).
General distribution: Europa, Caucasus, Russia: South European Part, East and West Siberia, Turkey (Przewoźny, 2019).

***Helophorus (Rhopalohelophorus) hilaris* Sharp, 1916**
Helophorus eichleri d'Orchymont, 1926c: 391
Helophorus minutus eichleri Orch.: Kasymov, 1972: 122
Helophorus (Rhopalohelophorus) hilaris Sharp, 1916: Przewoźny, 2019: 6
Distribution in Azerbaijan: Agstafa, Garayazi (Jandargol (Candargöl) (Kasymov, 1972).
General distribution: Caucasus, Iran, Lebanon, Turkey (Przewoźny, 2019).

***Helophorus (Rhopalohelophorus) kerimi* Ganglbauer, 1901**
Helophorus kerimi Ganglbauer, 1901: 318
Helophorus (Rhopalohelophorus) kerimi Ganglbauer, 1901: Przewoźny, 2019: 6
Distribution in Azerbaijan: Azerbaijan **(**Przewoźny, 2019).
General distribution: Caucasus, East Siberia, Iran, Kyrgyzstan, Kazakhstan, Mongolia, China, West Siberia (Przewoźny, 2019).

***Helophorus (Rhopalohelophorus) maculatus* Motschulsky, 1860**
Helophorus maculatus Motschulsky, 1860a: 106
Helophorus (Rhopalohelophorus) maculatus Motschulsky, 1860: Przewoźny, 2019: 6
Distribution in Azerbaijan: Azerbaijan **(**Przewoźny, 2019).
General distribution: Caucasus, Iran, Kazakhstan, Turkey (Przewoźny, 2019).

***Helophorus (Rhopalohelophorus) brevipalpis brevipalpis* Bedel, 1881**
Helophorus ***(****Rhopalohelophorus****)*** *brevipalpis brevipalpis* Bedel, 1881: Przewoźny, 2019: 4
Distribution in Azerbaijan: Azerbaijan **(**Przewoźny, 2019).
General distribution: Caucasus, Europa, Cyprus, Iran, Iraq, Israel, Lebanon, Syria, Turkey (Przewoźny, 2019).

***Helophorus (Rhopalohelophorus) griseus* Herbst, 1793**
Helochares griseus F.: Kasymov, 1972: 123
Distribution in Azerbaijan: Astara (Kasymov, 1972).
General distribution: Armenia, Europa, Turkey (Przewoźny, 2019).

Family HYDROPHILIDAE Latreille, 1802
Subfamily Hydrophilinae Latreille, 1802
Tribe Berosini Mulsant, 1844
Genus *Berosus* Leach, 1817
Subgenus *Berosus* Leach, 1817
***Berosus (Berosus) signaticollis* Charpentier, 1825**
Berosus signaticollis Charp.: Kasymov, 1972: 124
Distribution in Azerbaijan: Agstafa, Garayazi (Jandargol (Candargöl), Karkarchay river near Agjabedi, Fish farm pond in Neftchala (Kasymov, 1972).
General distribution: Europa, Algeria, Morocco, Tunisia, Afghanistan, Iran, Kazakhstan, Tajikistan, Turkmenistan, Uzbekistan, West Siberia (Przewoźny, 2019).

Subgenus *Enoplurus* Hope, 1838
***Berosus (Enoplurus) spinosus* Steven, 1808**
Berosus spinosus Steven, 1808: 8
Berosus spinosus Stev.: Kasymov, 1972: 124
Berosus (Enoplurus) spinosus Steven, 1808: Przewoźny, 2019: 12
Distribution in Azerbaijan: Agstafa, Garayazi (Jandargol (Candargöl) (Kasymov, 1972).
General distribution: Azerbaijan, Europa, Tunisia, Afghanistan, Iran, Kyrgyzstan, Mongolia, Tajikistan, Turkmenistan, Turkey, Uzbekistan, West Siberia, China (Przewoźny, 2019).

***Berosus (Enoplurus) frontifoveatus* Kuwert, 1888**
Berosus frontifoveatus Kuwert, 1888: 131
Berosus (Enoplurus) frontifoveatus Kuwert, 1888: Przewoźny, 2019: 12
Distribution in Azerbaijan: Azerbaijan **(**Przewoźny, 2019).
General distribution: Azerbaijan, Europa, Egypt, Afghanistan, Iran, Kyrgyzstan, Turkmenistan, Turkey, West Siberia (Przewoźny, 2019).

Genus *Laccobius* Erichson, 1837
Subgenus *Compsolaccobius* Ganglbauer, 1904
***Laccobius (Compsolaccobius) decorus* Gyllenhal, 1827)**
Laccobius decorus (Gyllenhal, 1827): Gentili, Shaverdo, 2016: 175
Distribution in Azerbaijan: Karayazi Steppe (Gentili, Shaverdo, 2016).
General distribution: Europa, Afghanistan, East and West Siberia, Kyrgyzstan, Kazakhstan, Mongolia, China, Tajikistan, Turkmenista, Turkey, Uzbekistan (Przewoźny, 2019).

***Laccobius (Compsolaccobius) pallidissimus* Reitter, 1899**
Laccobius pallidissimus Rttr.: Kasymov, 1972: 123
Distribution in Azerbaijan: Agstafa, Garayazi (Jandargol (Candargöl) (Kasymov, 1972).
General distribution: Afghanistan, Kyrgyzstan, Kazakhstan, Tajikistan, Turkmenistan, Uzbekistan, China (Przewoźny, 2019).

Subgenus *Dimorpholaccobius* Zaitzev, 1938
***Laccobius (Dimorpholaccobius) bipunctatus* (Fabricius, 1775)**
Laccobius bipunctatus (F., 1775): Gentili, Shaverdo, 2016: 175
Laccobius (Dimorpholaccobius) bipunctatus (Fabricius, 1775): Przewoźny, 2019: 13

Distribution in Azerbaijan: Elisavethpol (now Ganja), Talysh, Lenkoran (Gentili, Shaverdo, 2016).
General distribution: Azerbaijan, Georgia, Europa, Morocco, Tunisia, Iran, Kazakhstan, Turkmenistan, Turkey, West Siberia, China (Przewoźny, 2019).

***Laccobius (Dimorpholaccobius) obscuratus* Rottenberg, 1874**
Laccobius obscuratus Rott. : Kasymov, 1972: 123
Laccobius obscuratus Rottenberg, 1874: Gentili, Shaverdo, 2016: 175
Laccobius (Dimorpholaccobius) obscuratus Rottenberg, 1874: Przewoźny, 2019: 14
Distribution in Azerbaijan: Agstafa, Garayazi (Jandargol (Candargöl) (Kasymov, 1972); Kirovabad (Ganja), Nakhchivan (*Naxçıvan*), Ordubad (Gentili, Shaverdo, 2016).
General distribution: Transcaucasia, Europa, Cyprus, Iran, Lebanon, Syria, Tajikistan, Turkmenistan (Przewoźny, 2019).

***Laccobius (Dimorpholaccobius) striatulus* Fabricius, 1801**
Laccobius striatulus F.: Kasymov, 1972: 123
Laccobius striatulus Fabricius, 1801: Gentili, Shaverdo, 2016: 176
Distribution in Azerbaijan: Agrichay, Sheki-Zagatala (Kasymov, 1972); Agrichay River (on road Sheki-Zakataly), Talysh, Lenkoran (Gentili, Shaverdo, 2016).
General distribution: Transcaucasia, Europa, Tunisia, Iran, Kyrgyzstan, Kazakhstan, Turkey, Uzbekistan, China (Przewoźny, 2019).

***Laccobius (Dimorpholaccobius) simulatrix* d'Orchymont, 1932**
Laccobius kuwerti Zaitzev, 1938: 117
Laccobius kuwerti Zaitz.: Kasymov, 1972: 123
Laccobius simulatrix d'Orchymont, 1932: Gentili, Shaverdo, 2016: 176
Laccobius simulatrix d'Orchymont, 1932: Przewoźny, 2019: 14
Distribution in Azerbaijan: Agstafa, Garayazi (Jandargol (Candargöl), Lenkoranchay, rice field in Lenkoran and Astara, Lerik, Agrichay river near Sheki (Kasymov, 1972); Kirovabad (Ganja), Agrichay River (near Sheki), Aresh (*Ağdaş*), Lerik, Lenkoranchay River, Pensar (*Pensər*), Shuva (*Şüvə*), Archivan (*Ərçivan*), Mashkhanskiy istil' (Maşxan), Dzhangamiran Village, Lenkoran, Nizhne–Nyugedniskiy (*Aşağı Nügədi*) (near Lenkoran), Astara, Shakhchinar (Şaxçinar), Razi, Karayazi (Gentili, Shaverdo, 2016).
General distribution: Transcaucasia, Europa, Afghanistan, Iran, Kazakhstan, Turkmenia, Turkey (Przewoźny, 2019).

***Laccobius (Dimorpholaccobius) scutellaris* Motschulsky, 1855**
Laccobius scutellaris Motschulsky, 1855: Gentili, Shaverdo, 2016: 175
Laccobius (Dimorpholaccobius) scutellaris Motschulsky, 1855: Przewoźny, 2019: 14
Distribution in Azerbaijan: Kirovabad (now Ganja) (Gentili, Shaverdo, 2016).
General distribution: Azerbaijan, Europa, Egypt, Tunisia, Cyprus, Iran, Israel, Lebanon, Turkey (Przewoźny, 2019).

***Laccobius (Dimorpholaccobius) sipylus* d'Orchymont, 1939**
Laccobius sipylus d'Orchymont, 1939: Gentili, Shaverdo, 2016: 176
Laccobius (Dimorpholaccobius) sipylus d'Orchymont, 1939: Przewoźny, 2019: 14
Distribution in Azerbaijan: Kirovabad (now Ganja) (Gentili, Shaverdo, 2016).
General distribution: Transcaucasia, Iran, Iraq, Lebanon, Turkey (Przewoźny, 2019).

***Laccobius (Dimorpholaccobius) sulcatulus* Reitter, 1909**
Laccobius sulcatulus Reitter, 1909: Gentili, Shaverdo, 2016: 176

Laccobius (Dimorpholaccobius) sulcatulus Reitter, 1909: Przewoźny, 2019: 14
General distribution: Transcaucasia, Iran, Tajikistan, Turkmenistan, Turkey (Przewoźny, 2019).

***Laccobius (Dimorpholaccobius) syriacus* Guillebeau, 1896**
Laccobius syriacus Guillebeau, 1896: Gentili, Shaverdo, 2016: 176
Laccobius (Dimorpholaccobius) syriacus Guillebeau, 1896: Przewoźny, 2019: 14
Distribution in Azerbaijan: Kirovabad (now Ganja), Aresh (now Agdash), Zeiva (*Zeyvə*), Geok-Tapa, Lenkoran (Gentili, Shaverdo, 2016).
General distribution: Transcaucasia, Europa, Algeria, Egypt, Afghanistan, Cyprus, Iran, Iraq, Kyrgyzstan, Kazakhstan, Lebanon, Syria, Tajikistan, Turkmenistan, Turkey (Przewoźny, 2019).

***Laccobius (Dimorpholaccobius) hindukuschi* Chiesa, 1966**
Laccobius hindukuschi Chiesa, 1966: 302
Laccobius (Dimorpholaccobius) hindukuschi Chiesa, 1966: Przewoźny, 2019: 13
Distribution in Azerbaijan: Azerbaijan (Przewoźny, 2019).
General distribution: Transcaucasia, Russia, Afghanistan, Iran, Iraq, Kyrgyzstan, Pakistan, Tajikistan, Turkmenistan, Turkey, Uzbekistan (Przewoźny, 2019).

***Laccobius (Dimorpholaccobius) azerus* Gentili, 2016**
Laccobius azerus Gentili, 2016: Gentili, Shaverdo, 2016: 180
Laccobius (Dimorpholaccobius) azerus Gentili, 2016
Distribution in Azerbaijan: Astara, Masally **(**Gentili, 2016).
General distribution: Azerbaijan, Iran (Przewoźny, 2019).

***Laccobius (Dimorpholaccobius) hoberlandti* Gentili, 1982**
Laccobius hoberlandti Gentili, 1982: 35
Laccobius hoberlandti Gentili, 1982: Gentili, Shaverdo, 2016: 175
Laccobius (Dimorpholaccobius) hoberlandti Gentili, 1982: Przewoźny, 2019: 13
Distribution in Azerbaijan: Lerik, Bilyasar (*Biləsər*) and Divigach (*Divağaç*) on Vasharu-Chai (*Vəşərüçay*) River, Alekseyevka (now Burjali (*Bürcəli*) (Lankaran rayon), Parakand (SW Lankaran), 20 km SW Lankaran (Gentili, Shaverdo, 2016).
General distribution: Azerbaijan, Iran, Turkey (Przewoźny, 2019).

***Laccobius (Dimorpholaccobius) meridionalis* Gentili, 1974**
Laccobius meridionalis Gentili, 1974: 560
Laccobius (Dimorpholaccobius) meridionalis Gentili, 1974: Przewoźny, 2019: 14
Distribution in Azerbaijan: Azerbaijan **(**Przewoźny, 2019).
General distribution: Azerbaijan, Afghanistan, Tajikistan (Przewoźny, 2019).
Subgenus *Microlaccobius* Gentili, 1974
***Laccobius (Microlaccobius) gracilis gracilis* Motschulsky, 1855**
Laccobius gracilis Motsch.: Kasymov, 1972: 123
Laccobius gracilis Motschulsky, 1855: Gentili, Shaverdo, 2016: 175
Laccobius (Microlaccobius) gracilis gracilis Motschulsky, 1855: Przewoźny, 2019: 15
Distribution in Azerbaijan: Agstafa, Garayazi (Jandargol (Candargöl) (Kasymov, 1972); Elisavethpol (now Ganja), Prishib, Arus, Talysh, Lenkoran (Lankaran) (Gentili, Shaverdo, 2016).
General distribution: Transcaucasia, Europa, Algeria, Canary Islands, Morocco, Tunisia, Iran, Israel, Turkey (Przewoźny, 2019).

***Laccobius (Microlaccobius) persicus* Gentili, 1974**
Laccobius persicus Gentili, 1974: Gentili, Shaverdo, 2016: 175
Laccobius (Microlaccobius) persicus Gentili, 1974: Przewoźny, 2019: 16

Distribution in Azerbaijan: Azerbaijan **(**Przewoźny, 2019).
General distribution: Azerbaijan, Iran, Turkey (Przewoźny, 2019).

***Laccobius (Microlaccobius) exilis* Gentili, 1974**
Laccobius exilis GENTILI, 1974: Gentili, Shaverdo, 2016: 175
Laccobius (Microlaccobius) exilis Gentili, 1974: Przewoźny, 2019: 15
Distribution in Azerbaijan: Lenkoran (Gentili, Shaverdo, 2016).
General distribution: Azerbaijan, Armenia, Afghanistan, Cyprus, Iran, Pakistan, China, Tajikistan, Turkmenistan, Uzbekistan (Przewoźny, 2019).

***Laccobius (Microlaccobius) alternus* Motschulsky, 1855**
Laccobius (Microlaccobius) alternus Motschulsky, 1855: Przewoźny, 2019: 15
Distribution in Azerbaijan: Azerbaijan **(**Przewoźny, 2019).
General distribution: Transcaucasia, Europa, Iran, Turkey (Przewoźny, 2019).

Tribe Hydrobiusini Mulsant, 1844
Genus *Hydrobius* Leach, 1815
***Hydrobius fuscipes* Linnaeus, 1758**
Hydrobius fuscipes L.: Kasymov, 1972: 122
Hydrobius fuscipes Linnaeus, 1758: Przewoźny, 2019: 16
Distribution in Azerbaijan: Agstafa, Garayazi (Jandargol (Candargöl), Astara (Kasymov, 1972).
General distribution: Azerbaijan, Europa, Algeria, Tunisia, Cyprus, Iran, Iraq, Israel, Far East, Kazakhstan, Mongolia, China, Syria, Turkey, Uzbekistan (Przewoźny, 2019).

Genus *Limnoxenus* Motschulsky, 1853
***Limnoxenus niger* Gmelin, 1790**
Limnoxenus niger Zchach.: Kasymov, 1972: 122
Distribution in Azerbaijan: Astara (Kasymov, 1972).
General distribution: Europa, Caucasus, Algeria, Morocco, Iran, Israel, Lebanon, Syria, Turkey (Przewoźny, 2019).

Tribe Hydrophilini Latreille, 1802
Genus *Hydrochara* Berthold, 1827
***Hydrochara flavipes* Steven, 1808**
Hydrophilus flavipes Stev. : Kasymov, 1972: 124
Hydrochara flavipes Steven, 1808: Przewoźny, 2019: 19
Distribution in Azerbaijan: Fish farm pond in Neftchala, Barda (Kasymov, 1972).
General distribution: Azerbaijan, Georgia, Europa, Egypt, Morocco, Afghanistan, Iran, Iraq, Kuwait, Kazakhstan, Tajikistan, Turkmenistan, Turkey, Uzbekistan, China (Przewoźny, 2019).

Genus *Hydrophilus* Geoffroy, 1762
Subgenus *Hydrophilus* Geoffroy, 1762
***Hydrophilus (Hydrophilus) piceus* Linnaeus, 1758**
Hydrous piceus L.: Kasymov, 1972: 123
Hydrophilus (Hydrophilus) piceus Linnaeus, 1758: Przewoźny, 2019: 20
Distribution in Azerbaijan: Lenkoran (Veysig, 1939), Neftchala, Mingechevir water reservoir (Kasymov, 1972).
General distribution: Azerbaijan, Europa, Algeria, Egypt, Iran, Far East, Israel, Kazakhstan, Kyrgyzstan, Lebanon, Syria, Tajikistan, Turkey, West Siberia (Przewoźny, 2019).

Subfamily Chaetarthriinae Bedel, 1881
Tribe Anacaenini M. Hansen, 1991
Genus *Anacaena* Thomson, 1859
***Anacaena limbata* Fabricius, 1792**
Anacaena limbata F.: Kasymov, 1972: 122
Distribution in Azerbaijan: Shusha (Kasymov, 1972).
General distribution: Europa, Caucasus, Algeria, Iran, Israel, Kazakhsatn, Syria, Turkey, West Siberia, Far East (Przewoźny, 2019).

Subfamily Enochrinae Short & Fikáček, 2013
Genus *Cymbiodyta* Bedel, 1881
***Cymbiodyta marginella* Fabricius, 1792**
Cymbiodyta marginella F.: Kasymov, 1972: 123
Cymbiodyta marginella Fabricius, 1792: Przewoźny, 2019: 23
Distribution in Azerbaijan: Agstafa, Garayazi (Jandargol (Candargöl) (Kasymov, 1972).
General distribution: Azerbaijan, Armenia, Europa, Kazakhstan, Turkey, Uzbekistan, West Siberia (Przewoźny, 2019).

Genus *Enochrus* Thomson, 1859
Subgenus *Enochrus* Thomson, 1859
***Enochrus* (*Enochrus) melanocephalus* Olivier, 1793**
Enochrus melanocephalus Ol.: Kasymov, 1972: 123
Distribution in Azerbaijan: Fish farm pond in Neftchala (Kasymov, 1972)
General distribution: Armenia, Europa, Algeria, Afghanistan, East Siberia, Far East, Israel, Kyrgyzstan, Turkey, Uzbekistan, Inner Mongolia (Przewoźny, 2019).

Subgenus *Lumetus* Zaitzev, 1908
***Enochrus (Lumetus) fuscipennis* Thomson, 1884**
Enochrus fuscipennis Thoms.: Kasymov, 1972: 123
Enochrus (Lumetus) fuscipennis Thomson, 1884: Przewoźny, 2019: 24
Distribution in Azerbaijan: Fish farm pond in Neftchala (Kasymov, 1972).
General distribution: Azerbaijan, Armenia, Europa, Tunisia, East and West Siberia, Iran, Kyrgyzstan, Kazakhstan, China, Turkey, Uzbekistan (Przewoźny, 2019).

***Enochrus (Lumetus) quadripunctatus* Herbst, 1797**
Enochrus quadripunctatus Hrbst.: Kasymov, 1972: 123
Distribution in Azerbaijan: Agstafa, Garayazi (Jandargol (Candargöl), Astara (Kasymov, 1972).
General distribution: Europa, East and West Siberia, Far East, China, Iran, Israel, Kirgyzstan, Kazakhstan, Mongolia, Tajikistan, Turkey (Przewoźny, 2019).

***Enochrus (Lumetus) testaceus* Fabricius, 1801**
Enochrus (Lumetus) testaceus Fabricius, 1801: Przewoźny, 2019: 24
Distribution in Azerbaijan: Azerbaijan **(**Przewoźny, 2019).
General distribution: Azerbaijan, Armenia, Europa, Tunisia, East and West Siberia, Far East, Iran, Japan, Kazakhstan, Turkey, China (Przewoźny, 2019).

***Enochrus (Lumetus) bicolor* Fabricius, 1792**
Enochrus bicolor F.: Kasymov, 1972: 123
Enochrus (Lumetus) bicolor Fabricius, 1792: Przewoźny, 2019: 23
Distribution in Azerbaijan: Agstafa, Garayazi (Jandargol (Candargöl) (Kasymov, 1972).

General distribution: Azerbaijan, Armenia, Europa, East and West Siberia, Far East, Iran, Japan, Kazakhstan, Mongolia, China, Nepal, South Korea, Tajikistan, Turkey, Uzbekistan, Algeria, Canary Islands, Egypt, Morocco, Tunisia (Przewoźny, 2019).

Subgenus *Methydrus* Rey, 1885
***Enochrus (Methydrus) nigritus* Sharp, 1873**
Enochrus nigritus Sharp, 1873: 262
Enochrus (Methydrus) nigritus Sharp, 1873: Przewoźny, 2019: 25
Distribution in Azerbaijan: Azerbaijan **(**Przewoźny, 2019).
General distribution: Azerbaijan, Armenia, Morocco, Tunisia, Europa, Iran, Kazakhstan, Turkey (Przewoźny, 2019).

***Enochrus (Methydrus) hesperidum* Sharp, 1870**
Enochrus hesperidum Sharp, 1870a: 6
Enochrus (Methydrus) hesperidum Sharp, 1870: Przewoźny, 2019: 25
Distribution in Azerbaijan: Azerbaijan **(**Przewoźny, 2019).
General distribution: Azerbaijan, Israel, Saudi Arabia, Yemen (Przewoźny, 2019).

Subfamily Acidocerinae Zaitzev, 1908
Genus *Helochares* Mulsant, 1844
Subgenus *Helochares* Mulsant, 1844
***Helochares (Helochares) obscurus* O.F. Müller, 1776**
Hydrophilus obscurus O.F. Müller, 1776: 69
Helochares (Helochares) obscurus O.F. Müller, 1776: Przewoźny, 2019: 26
Distribution in Azerbaijan: Azerbaijan **(**Przewoźny, 2019).
General distribution: Azerbaijan, Europa, Iran, Israel, Kazakhstan, Turkey, West Siberia, China (Przewoźny, 2019).

Subfamily SPHAERIDIINAE Latreille, 1802
Tribe Coelostomatini L. Heyden, 1891
Genus *Coelostoma* Brullé, 1835
Subgenus *Coelostoma* Brullé, 1835
***Coelostoma (Coelostoma) orbiculare* Fabricius, 1775**
Hydrophilus orbiculare Fabricius, 1775: 229
Coelostoma orbiculare Fabr.: Kasymov, 1972: 122
Coelostoma (Coelostoma) orbiculare Fabricius, 1775: Przewoźny, 2019: 27
Distribution in Azerbaijan: Astara (Kasymov, 1972).
General distribution: Azerbaijan, Armenia, Europa, East and West Siberia, China, Iran, Japan, Kazakhstan, Turkey (Przewoźny, 2019).

Tribe Megasternini Mulsant, 1844
Genus *Cercyon* Leach, 1817
Subgenus *Cercyon* Leach, 1817
***Cercyon (Cercyon) lateralis* Marsham, 1802**
Dermestes lateralis Marsham, 1802: 69
Cercyon (Cercyon) lateralis Marsham, 1802: Przewoźny, 2019: 30
Distribution in Azerbaijan: Azerbaijan **(**Przewoźny, 2019).
General distribution: Azerbaijan, Armenia, Europa, Canary Island, East and West Siberia, Far East, Kazakhstan, Tajikistan (Przewoźny, 2019).

***Cercyon (Cercyon) haemorrhoidalis* Fabricius, 1775**
Dermestes picinus Marsham, 1802: 69
Copelatus haemorrhoidalis (Fabr.): Kasymov, 1972: 117
Limnebius picinus Mrsh.: Kasymov, 1972: 121
Distribution in Azerbaijan: Agstafa, Garayazi (Jandargol (Candargöl) (Kasymov, 1972).
General distribution: **E**: AL AR AU AZ BH BU BY CR CT CZ DE EN FA FI FR GB GE GG GR HU IR IT LA LT ME NL NR NT PL PT SK SL SP ST SV SZ UK YU **N**: AG TU **A**: ES FE IS SY TR WS **AUR**i **NAR**i **NTR**i **ORR**i **(**Przewoźny, 2019).

Tribe Sphaeridiini Latreille, 1802
Genus *Sphaeridium* Fabricius, 1775
***Sphaeridium scarabaeoides* Linnaeus, 1758**
Dermestes scarabaeoides Linnaeus, 1758: 356
Sphaeridium scarabaeoides Linnaeus, 1758: Przewoźny, 2019: 35
Distribution in Azerbaijan: Azerbaijan **(**Przewoźny, 2019).
General distribution: Azerbaijan, Armenia, Europa, Tunisia, East and West Siberia, Far East, China, Israel, Japan, Kyrgyzstan, Kazakhstan, Tajikisnat, Turkey, Uzbakistan (Przewoźny, 2019).

***Sphaeridium substriatum* Faldermann, 1838**
Sphaeridium substriatum Faldermann, 1838: 8
Sphaeridium substriatum Faldermann, 1838: Przewoźny, 2019: 35
Distribution in Azerbaijan: Azerbaijan **(**Przewoźny, 2019).
General distribution: Azerbaijan, Armenia, Europa, Algeria, Egypt, Tunisia, East and West Siberia, Far East, Israel, Kazakhstan, Mongolia, China, Tajikistan, Turkmenistan, Turkey (Przewoźny, 2019).

Family DRYOPIDAE Billberg, 1820
Genus *Helichus* Erichson, 1847
***Helichus asiaticus* Motschulsky, 1845**
Helichus asiaticus Solsky: Kasymov, 1972: 124
Distribution in Azerbaijan: Agstafa, Garayazi (Jandargol (Candargöl), Agsu, Sheki, Lenkoran (Kasymov, 1972).
General distribution: Eastern Europe, Caucasus, Transcaucasia, Central Asia (Kasymov, 1972).

***Helichus solskyi* Zaitzev, 1908**
Helichus solskyi Zaitz.: Kasymov, 1972: 124
Distribution in Azerbaijan: Agstafa, Garayazi (Jandargol (Candargöl), Geoktepe, Ganja (Kasymov, 1972).
General distribution: Europa, Caucasus, Middle Asia, Iran, Mongolia (Kasymov, 1972).

***Helichus angulicollis* Reitter, 1887**
Helichus angulicollis Rttr.: Kasymov, 1972: 124
Distribution in Azerbaijan: Ganja, Geoktepe (Kasymov, 1972).
General distribution: Caucasus (Kasymov, 1972).

FAMILY HYDROCHIDAE Thomson, 1859
Genus *Hydrochus* Leach, 1817
***Hydrochus flavipennis* Küster, 1852**
Hydrochus flavipennis Küster, 1852: Przewoźny, 2019: 9
Distribution in Azerbaijan: Azerbaijan **(**Przewoźny, 2019).
General distribution: Azerbaijan, Europa, Tunisia, Iran, Turkey (Przewoźny, 2019).

***Hydrochus nodulifer* Reitter, 1897**
Hydrochus nodulifer Reitter, 1897: Przewoźny, 2019: 9
Distribution in Azerbaijan: Azerbaijan **(**Przewoźny, 2019).
General distribution: Azerbaijan, Iran, Turkey (Przewoźny, 2019).

Family SPERCHEIDAE Erichson, 1837
Genus *Spercheus* Kugelann, 1798
***Spercheus emarginatus* Schaller, 1783**
Dytiscus emarginatus Schaller, 1783: 327
Spercheus emarginatus Schaller, 1783: Przewoźny, 2019: 10
Distribution in Azerbaijan: Azerbaijan **(**Przewoźny, 2019).
General distribution: Azerbaijan, Europa, Far East, Iran, Kazakhstan, Tajikistan, Turkey (Przewoźny, 2019).

Family GEORISSIDAE Laporte, 1840
Genus *Georissus* Latreille, 1809
Subgenus *Neogeorissus* Sato, 1972
***Georissus (Neogeorissus) laesicollis* Germar, 1832**
Georissus (Neogeorissus) ***laesicollis*** Germar, 1832: Przewoźny, 2019: 9
Distribution in Azerbaijan: Azerbaijan **(**Przewoźny, 2019).
General distribution: Azerbaijan, Europa, Lebanon, Turkey (Przewoźny, 2019).

Family HYDRAENIDAE Mulsant, 1844
Subfamily Hydraeninae Mulsant, 1844
Genus Hydraena Kugelann, 1794
***Hydraena (Hydraena) anatolica* Janssens, 1963**
Hydraena (Hydraena) anatolica Janssens, 1963: Darilmaz, Ostovan, Ghahari, 2017: 241
General distribution: Armenia, Azerbaijan, Iran, Turkey (Darilmaz, Ostovan, Ghahari, 2017).

***Hydraena (Hydraena) dentipalpis* Reitter, 1888**
Hydraena (Hydraena) dentipalpis Reitter, 1888: Darilmaz, Ostovan, Ghahari, 2017: 241
General distribution: Armenia, Azerbaijan, Georgia, Iran, Russia (South European Territory), Turkey (Darilmaz, Ostovan, Ghahari, 2017).

***Hydraena (Hydraena) grandis* Reitter, 1885**
Hydraena (Hydraena) grandis Reitter, 1885: Darilmaz, Ostovan, Ghahari, 2017: 241
General distribution: Albania, Armenia, Azerbaijan, Bosnia-Herzegovina, Bulgaria, Greece, Iran, Macedonia, Romania, Serbia, Turkey (Darilmaz, Ostovan, Ghahari, 2017).

***Hydraena (Hydraena) janeceki* Jäach, 1987**
Hydraena (Hydraena) janeceki Jäch, 1987: Darilmaz, Ostovan, Ghahari, 2017: 241
General distribution: Azerbaijan, Iran (Darilmaz, Ostovan, Ghahari, 2017).

***Hydraena (Hydraena) proesei* Skale and Jäch, 2011**
Hydraena (Hydraena) proesei Skale and J**ä**ch, 2011: Darilmaz, Ostovan, Ghahari, 2017: 242
General distribution: Azerbaijan, Iran (Darilmaz, Ostovan, Ghahari, 2017).

Subfamily Ochthebiinae Thomson, 1859
Genus *Ochthebius* Leach, 1815
***Ochthebius (Asiobates) adventicius* Jäch, 1990**

Ochthebius (Asiobates) adventicius J**ä**ch, 1990: Darilmaz, Ostovan, Ghahari, 2017: 244
General distribution: Armenia, Azerbaijan, Georgia, Iran (Darilmaz, Ostovan, Ghahari, 2017).

***Ochthebius (Ochthebius) caucasicus* Kuwert, 1887**
Ochthebius caucasicus Kuw.: Kasymov, 1972: 121
Ochthebius (Ochthebius) caucasicus Kuwert, 1887: Darilmaz, Ostovan, Ghahari, 2017: 244
Distribution in Azerbaijan: Agstafa, Garayazi (Jandargol (Candargöl) (*Garayazı*) (Kasymov, 1972).
General distribution: Afghanistan, Armenia, China (Tibet), Georgia, Iran, Kazakhstan, Kyrgyzstan, Mongolia, Nepal, Tajikistan, Turkmenistan, Uzbekistan (Darilmaz, Ostovan, Ghahari, 2017).

***Ochthebius (Asiobates) lenkoranus* Reitter, 1885**
Ochthebius (Asiobates) lenkoranus Reitter, 1885: Darilmaz, Ostovan, Ghahari, 2017: 244
General distribution: Azerbaijan, Iran (Darilmaz, Ostovan, Ghahari, 2017).

***Ochthebius (Asiobates) limbicollis* Reitter, 1885**
Ochthebius (Asiobates) limbicollis Reitter, 1885: Darilmaz, Ostovan, Ghahari, 2017: 244
General distribution: Azerbaijan, Iran (Darilmaz, Ostovan, Ghahari, 2017).

***Ochthebius (Ochthebius) lividipennis* Peyron, 1858**
Ochthebius (Ochthebius) lividipennis Peyron, 1858: Darilmaz, Ostovan, Ghahari, 2017: 246
General distribution: Azerbaijan, Armenia, Austria, Bulgaria, Croatia, Cyprus, Czechia, Egypt, Greece, Hungary, Iran, Israel, Italy, Lebanon, Poland, Romania, Serbia, Slovakia, Syria, Turkey. (Darilmaz, Ostovan, Ghahari, 2017).

***Ochthebius (Ochthebius) meridionalis* Rey, 1885**
Ochthebius marinus meridionalis Rey.: Kasymov, 1972: 121
Ochthebius (Ochthebius) meridionalis Rey, 1885: Darilmaz, Ostovan, Ghahari, 2017: 247
Distribution in Azerbaijan: Agstafa, Garayazi (Jandargol (Candargöl) (Kasymov, 1972).
General distribution: Armenia, Austria, Azerbaijan, Bulgaria, Croatia, Czechia, Egypt, France, Greece, Hungary, Iran, Iraq, Israel, Italy, Montenegro, Morocco, Poland, Roma nia, Russia (South European Territory), Saudi Arabia, Serbia, Slovakia, Spain, Switzerland, Tunisia, Turkey, Turkmenistan, Ukraine (Darilmaz, Ostovan, Ghahari, 2017).

***Ochthebius (Ochthebius) puberulus* Reitter, 1885**
Ochthebius puberulus Rttr.: Kasymov, 1972: 121
Distribution in Azerbaijan: Baku (*Bakı*) (Kasymov, 1972).
General distribution: Georgia, Iran (Darilmaz, Ostovan, Ghahari, 2017).

***Ochthebius (Ochthebius) ragusae* Kuwert, 1887**
Ochthebius (Ochthebius) ragusae Kuwert, 1887: Darilmaz, Ostovan, Ghahari, 2017: 247
General distribution: Afghanistan, Albania, Armenia, Azerbaijan, Cyprus, Egypt (Sinai), France, Georgia, Greece, Iran, Israel, Italy, Lebanon, Macedonia, Saudi Arabia, Syria, Tajikistan, Turkey, Turkmenistan, Uzbekistan (Darilmaz, Ostovan, Ghahari, 2017).

***Ochthebius (Ochthebius) schneideri schneideri* Kuwert, 1887**
Ochthebius schneideri Kuw.: Kasymov, 1972: 121
Ochthebius (Ochthebius) schneideri schneideri Kuwert, 1887: Darilmaz, Ostovan, Ghahari, 2017: 247
Distribution in Azerbaijan: Baku (Kasymov, 1972).
General distribution: Azerbaijan, Iran, Iraq, Syria, Turkey, Turkmenistan (Darilmaz, Ostovan, Ghahari, 2017).

***Ochthebius (Ochthebius) cf. evanescens* Sahlberg, 1875**
Ochthebius (Ochthebius) cf. evanescens Sahlberg, 1875: Darilmaz, Ostovan, Ghahari, 2017: 247
General distribution: Azerbaijan, Bosnia-Herzegovina, Croatia, Italy, Mongolia, Montenegro, Romania, Russia (East Siberia, West Siberia), Serbia, Slovenia, Turkey, Ukraine (Darilmaz, Ostovan, Ghahari, 2017).

LITERATURE CITED

Aubé, C. 1836-1838. Iconographie et histoire naturelle des coléoptères d'Europe. Tome Cinquième. Hydrocanthares. Paris: Méquignon-Marvis, xi + 416 pp. + 46 pls.

Bogachev, A.B. 1951. Zhivotnyy mir Azerbaydzhana. Baku, 2, 322-324.

d'Orchymont, A. 1926. A sujet de qtrelques *Helophorus* (Col. Hydrophylidae), récoltes faites en Perse et au Caucase par le Marquis Doria. Annali. Mus. Civ. Stor. nat. Genova 50: 384–392.

Darilmaz, M.C., Ostovan, H., Ghahari H. 2017. Annotated checklist of the Hydraenidae (Coleoptera: Staphylinoidea) recorded from Iran. Aquatic Insects. International Journal of Freshwater Entomology. 38(4), 239–253. https://doi.org/10.1080/01650424.2017.1392022.

Fabricius, J.C. 1775. Systema entomologiae, sistens Insectorum classes, ordines, genera, species adiectis synonymis, locis, descriptionibus, observationibus. Flensburgi et Lipsiae: Libraria Korte, xxxii + 832 pp.

Faldermann, F. 1838. Fauna Entomologica Transcaucasica. Pars 3. Nouveaux Mémoires de la Société Impériale des Naturalistes de Moscou, 6: 338 pp.

Fischer von Waldheim, G. 1829. Museum historiae naturalis Universitatis Caesareae Mosquensis. Pars II, Insecta. Mosquae: Typis Universitatis Caesareae, 147 pp.

Ganglbauer, L. 1901. Beiträge zur Kenntniss der paläarktischen Hydrophiliden. Verhandlungen der Kaiserlich-Königlichen Zoologisch-Bolanischen Gesellschaft in Wien, 51: 312–332.

Gentili, E., Shaverdo, H. 2016. Review of the genus *Laccobius* Erichson, 1837 from Armenia, Azerbaijan, and Georgia, with description of a new species (Coleoptera: Hydrophilidae). Koleopterologishe Rundschau, 86: 171–198.

Hájek, J., Fery, H. 2019. Catalogue of Palearctic Gyrinidae (Coleoptera). Internet version 2019-01-01.

Jacobson, G.G. 1909. Zhuki Rossii i zapadnoy Evropi [Beetles of Russia and Western Europe]. Devrien, St.-Petersburg, 1024 pp. + 83 pl. (in Russian).

Kasymov, A.G. 1965. Gidrofauna Nizhney Kury i Mingechaurskogo vodokhranilishcha. *Baku*, 1-372 [in Russian].

Kasymov, A.G. 1972. Presnovodnaya fauna Kavkaza. Baku: "ELM", 1-286. [in Russian]

Kuwert, A. 1888. Uebersicht der Berosus-Arten Europas, der Mittelmeer-Fauna und der angrenzenden Lander. Deutsche Entomologische Zeitschrift, 32: 129–144.

Lacordaire, J. T. 1835. In: Boisduval, J. B. A. D. de & J. T. Lacordaire. Faune entomologique des environs de Paris; ou species général des insectes qui se trouvent dans un rayon de quinze a vingt lieues aux alentours de Paris. Vol. 1.: Méquignon-Marvis, Père et Fils, Paris. 17 + 696 pp., 3 pls.

Linnaeus, C. 1758. Systema naturae per regna tria naturae, secundum classes, ordines, genera species. cum characteribus, differentiis, synonymis, locis. Editio decima, reformata. Tomus I. Holmiae: Laurentii Salvii, [4] + 824 + [1] pp.

Löbl, I., Smetana, A. (Eds.) 2003. Catalogue of Palaearctic Coleoptera. Volume 1. Archostemata – Myxophaga – Adephaga. Stenstrup: Apollo Books, 819 pp.

Löbl, Smetana, 2004. Catalogue of Palaearctic Coleoptera. Volume 2. Hydrophiloidea – Histeroidea – Staphylinoidea. Apollo Books, Stenstrup, 942 pp.

Marsham, T. 1802. Entomologia Britannica, sistens insecta Britanniae indigena, secundum methodum Linnaeanam disposita. Tomus I. Coleoptera. Londini: Wilks & Taylor, xxxi + 547 + [1] pp.

Ménétriés, E. 1832. Catalogue raisonné des objets de zoologie recueillis dans un voyage au Caucase et jusqu'aux frontières actuelles de la Perse. St. Pétersbourg: Imprimerie de l'Académie Impériale des Sciences, 1 + 272 + 6 pp. + 33 pls.

Müller, O.F. 1776. Zoologia Danicae prodromus, seu animalium Daniae et Norvegiae indigenarum characteres, nomina, et synonyma imprimis popularium. Hafniae: Hallager, xxxii + 282 pp.

Nilsson, A.N. 2014. A World catalogue of the family Dytiscidae, or the diving beetles (Coleoptera, Adephaga). Version 1.I.2014. http://www2.emg.umu.se/projects/biginst/andersn/

Nilsson, A.N., Hájek, J. 2019. Catalogue of Palearctic Dytiscidae (Coleoptera). Internet version 2019-01-01.

Nilsson, A.N., and Hájek, J. 2021a. 'Catalogue of Palearctic Dytiscidae (Coleoptera)', Internet version, http://www.waterbeetles.eu

Nilsson, A.N., and Hájek, J. 2021b., 'A World Catalogue of the Family Dytiscidae, or the Diving Beetles (Coleoptera, Adephaga)', Internet version, http://www.waterbeetles.eu

Przewoźny, M. 2019. Catalogue of Palearctic Hydrophiloidea (Coleoptera). Internet version 2019-01-01.

Shaverdo, H., Wewalka, G., Šťastný J., Hendrich, L., Fery, H., Hájek, J. 2021. New records of diving beetles and corrections updating the catalogue of Palearctic Dytiscidae (Coleoptera), Aquatic Insects, 42:2, 179-196, DOI: 10.1080/01650424.2021.1903509

Sharp, D.S. 1870. On the species of the genus *Philhydrus* found in the Atlantic Islands. The Annals and Magazine of Natural History (4) **5**: 13–16.

Schaller J.G. 1783: Neue Insekten. Abhandlungen der Hallisehen Naturforsehenden Gesellsehaft **1**: 217–332.

Stephens, J.F. 1828. Pp. 1–-112, pls. 10–12. In: Illustrations of British entomology; or, a synopsis of indigeneous insects: containing their generic and specific distinctions; with an account of their metamorphoses, times of appearance, localities, food, and economy, as far as practicable. Mandibulata. Vol. II. London: Baldwin and Cradock, 200 pp., pls. 10–15. [pp. 113–200, pls. 13–15 issued in 1829].

Veysig, C.Ya. 1939. Materials to microscopic hydrofauna of Caucasus and its zoogeographical analysis. Thesisof Sci. D., Azerb. Ped. Inst., Baku. (in Russian).

Vondel, B.J. van 1991. Revision oĺ the Palaearctic species ol Haliplus subgenusLiaphlus Guignot (Coleoptera: Haliplidae). Tijdschrift voor Entomologie 134 75-1 44, 312 figs.

Vondel, B.J. van 2005. Haliplidae. – In Nilsson, A.N. (ed.): World Catalogue of Insects 7. Amphizoidae, Aspidytidae, Haliplidae, Noteridae and Paelobiidae (Coleoptera, Adephaga). – Stenstrup: Apollo Books, 171 pp.

Zaitzev, F.A. 1913. Neue kaukasische Wasserkäfer. I. Mitteilungen des Kaukasischen Museum **7**: 195-199.

Zaitzev, F.A. 1927. Die Dytiscidenfauna von Kaukasusländern. Travaux de la Station Biologique du Caucase du Nord **2**(1): 1-42. [In Russian, German title.]

Zaitzev, F.A. 1928. Review of the Caucasus whirlwinds (Coleoptera, Gyrinidae). Works of the North Caucasus Hydrobiological Station at the Gorsky Agricultural Institute. - Vladikavkaz, 2(2-3):43-48.

Zaitzev, F.A. 1945. To the fauna of swimmers of Transcaucasia (Coleoptera, Dytiscidae). Reports of the Academy of Sciences of Arm. SSR. 4(3): 87-91.

Zaitzev, F.A. 1946. Representatives of Fam. Haliplidae in the fauna of Transcaucasia and neighboring countries (Coleoptera). Works of the Zoologist. Institute of the Academy of Sciences of the Georgian SSR. (6): 285-290.

Zaitzev, P.A. 1947. Vodyanya zhuki basseina reki Zangi i nekotorykh drugikh vodoemov ASSR. Trudy Sevanskoy Gidrobiologicheskoy Stantsii, 8: 87–95. [in Russian].

Zaitzev, P.A. 1953. Vodnye zhestkokrylye v faune Gruzii. Trudy Instituta Zoologii Akademii Nauk Gruzinskoy SSR 11: 87–126 [in Russian].

Iranian Journal of Animal Biosystematics (IJAB)
Vol.18, No.1, 65-76, 2022
DOI: 10.22067/ijab.2022.72561.1020

IJAB
ISSN: 1735-434X (print); 2423-4222 (online)

RESEARCH ARTICLE Open access

Karyological studies of four agamid lizards from Semnan province of Iran

Seyed Mahmood Ghaffari[1*], Mosa Mahmoudi[2], Hasan Salehi[3], Alireza Sari[2]
[1]*Institute of Biochemistry and Biophysics, University of Tehran, Iran.*
[2]*Department of Animal Biology, College of Science, University of Tehran, Iran*
[3]*Department of Biology, Faculty of Scince, Razi University, Kermanshah, Iran*

(Received: *17 September 2021*; Accepted: 18 *October 2022*)

Abstract
Iran possesses about 241 species of reptiles, which 55 species of them (22.8%) are endemic to Iran. Agamidae is the important family of reptile in Iran with 22 species, which is poor in terms of chromosomal studies. In this paper, karyological survey was made for four species of the family Agamidae by bone marrow cell preparations. Karyotype of male and female of *Laudakia caucasia* (2n=34) was consisted of 6 pairs macro and 11pairs of microchromosomrs. Karyotype of *Laudakia nupta nupta* (2n=36) was including of 6 pairs of macro and 12 pairs of microchromosomes. Karyotype of *Phrynocephalus scutellatus* (2n=46) was consisted of 22 macro and 24 microchromosomes, which is reported here for the first time. Also, new cytotype of *Traplus agilis agilis* (2n=49) is reported here for the first time. Karyotype of this species was consisted of 21 large acrocentric and 28 microchromosomes, which one of the acrocentric chromosomes may be a sex chromosome.

Key words: *Agamid, Chromosome, Iran, Karyotype, Lizards.*

INTRODUCTION

Agamidae is the fourth largest family among lacertilians and distributed from Africa thought Asia to Australia. According to Mozaffari *et al.* (2016) Iran possesses about 225 species of reptiles including 18 species of Agamidae family. In recent years, several new species have been described and new records published. As a result, the number of reptile species in Iran is increasing very rapidly, 31 new species have been added between 2000 to 2014 (Safaei-Mahroo *et al.*, 2015). According to Safari-Maroo *et al.* (2015) Iran has about 241 species of reptiles which is 55 species (22.8 %) of them are endemic and also including 22 species of Agamidae family. The first described reptile chromosomes were from the sand lizard (*Lacerta agilis*), which was reported by Tellyesniczky (1897). Existence of microchromosomes in iguanind and teiid lizards reported for the first time by Painter (1921). As the discipline of reptile cytogenetics grew over the last century, it became clear that reptiles are an exceptional group in which to study chromosome evolution, as they display a high level of diversity in chromosome number and morphology (Olmo, 2008), differ in the absence or presence of microchromosomes, and have diversity in sex determination systems and sex chromosomes (Ezaz *et al.* 2009; Pokorná *et al.*, 2011; Gamble *et al*, 2015). There are diploid chromosome numbers range from 2n = 20 in a lizard (Rampholeon *spectrum*) to 2n = 68 in a freshwater turtle (twist-neck turtle, *Platemys platycephala)*. In this paper karyological studies of four species of Agamidae are presented.

Corresponding Author: mghaffary@ut.ac.ir

MATERIAL AND METHODS

Karyological analyses were carried out on four species of agamids, which are collected from Semnan province of Iran (Table 1). They were intraperitoneally injected with 0.1 ml of phytohemaglutinin (PHA) per gram body weight for 24 h and with 0.1 ml colchicine solution (2mg/ml) per gram body weight for 5 h before sacrifice. The bone marrow cells were treated with 0.075M KCl for 20 min and fixed in acetic acid-methanol (1:3) solution. Mitotic chromosome preparations were made by an air dry method and stained by the Geimsa solution. The karyotype was determined for each specimen on the basis of comparing photographs of 10 metaphase cells. The photographs of chromosomes enlarged were measured and numbered. Calculation for centromeric index and arm ratio on each chromosome is used accordingly to Levan *et al.*, (1964).

TABLE 1. Summary of the information on sampling lizards for this study

Species	Geographic Coordinates	Altitude (m)	Locality
Paralaudakia caucasia	53°37′E, 35°42′N	1662	Semnan: neck of Ahovan
Laudakia nupta nupta	55°47′E, 36°46′ N	1180	Semnan: Kharturan National Park
Phrynocephalus scutellatus	54°25′E, 35°38′N	1134	Semnan: Moaleman 56 Km towards Damghan.
Traplus agilis agilis	54°20′E, 35°53′N	1107	Semnan: Damghan,35 Km towards Moaleman

RESULTS AND DISCUSSION

Family Agamidae

Laudakia caucasia (Eichwald 1831)

Laudakia of Iran has been studied by Anderson (1963, 1974); Clark *et al.*, (1966); Schleich (1979) and Natalia et al. (2020). Also, Iranian *Laudakia* was studied by Rastegar-Pouyani & Nilson (2002); Faizi & Rastegar-Pouyani (2007). *Laudakia* has recently been divided into three genera *Stellagama*, *Paralaudakia* and *Laudakia* (Baig *et al.*, 2012) which *Laudakia caucasia placed* in the genus *Paralaudakia*.

The Caucasian agama, *Paralaudakia caucasia*, is known from Turkey, Transcaucasia, Iran, Afghanistan, Pakistan, India, Turkmenistan, Tajikistan, and Uzbekistan (Ahmadzadeh *et al.*, 2008). In Iran, *P. caucasia* occurs from sea level to about 4000 m in the mountains of the northern and eastern Central Plateau (Anderson, 1999). *Paralaudakia caucasia* has been collected in the northern parts of Kermanshah province, along the Zagros Mountains (Rastegar- Pouyani, 2002).

Karyotypic studies on agamids have been carried out by Gorman and Shochat (1972), Gorman (1973), Sokolovski (1975) and Kupriyanova (1984). In addition, Moody and Hutterer (1978) and Witten (1978) described karyotypic formulas for several Agamids. These studies suggest that *Laudakia* possess 2n = 36, a pattern considered ancestral for all lizards on the basis of its occurrence in nearly all lizard families (William & Hall, 1976). The chromosome number of *P. caucasia* (male) was 2n=34. Karyotype consisted of 12 Macrochromosomes and 22 microchromosomes. Macrochromosomes have range in size from 5.36 to 2.06 µm (Table 2). Its metaphase plate of chromosomes and karyotype were shown in Figure (1A, B). Also, the chromosome complements and karyotype of female of this species was similar with male and karyotype consisted of six pairs of macrometacentric and 11 pairs of microchromosomes (Fig.2A, B). This chromosome number and karyotype of this species is in agreements with previous report by Arronet (1965) and differ by Hall (1970) in Moody & Hutterer (1978) which is reported 2n=36. The different is related in numbers of micochromosomes (2n=12 macrometacentric and 24 microchromosomes).

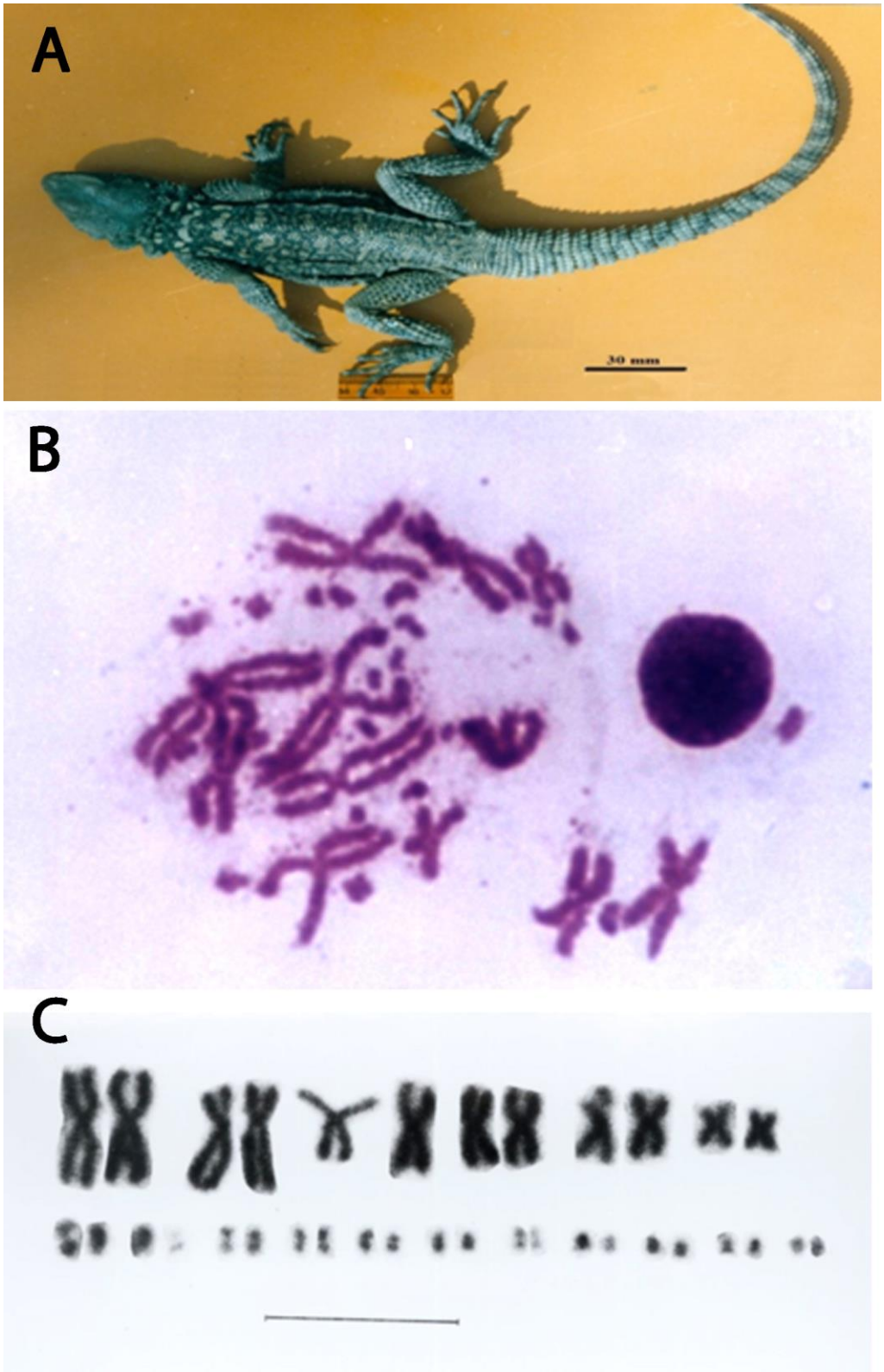

FIGURE 1. *Paralaudakia caucasia:* A, adult (male); B, plate metaphase (2n=34); C, karyotype (6 pairs of macro metacentric + 11pairs of micro chromosomes). Bar=10µm.

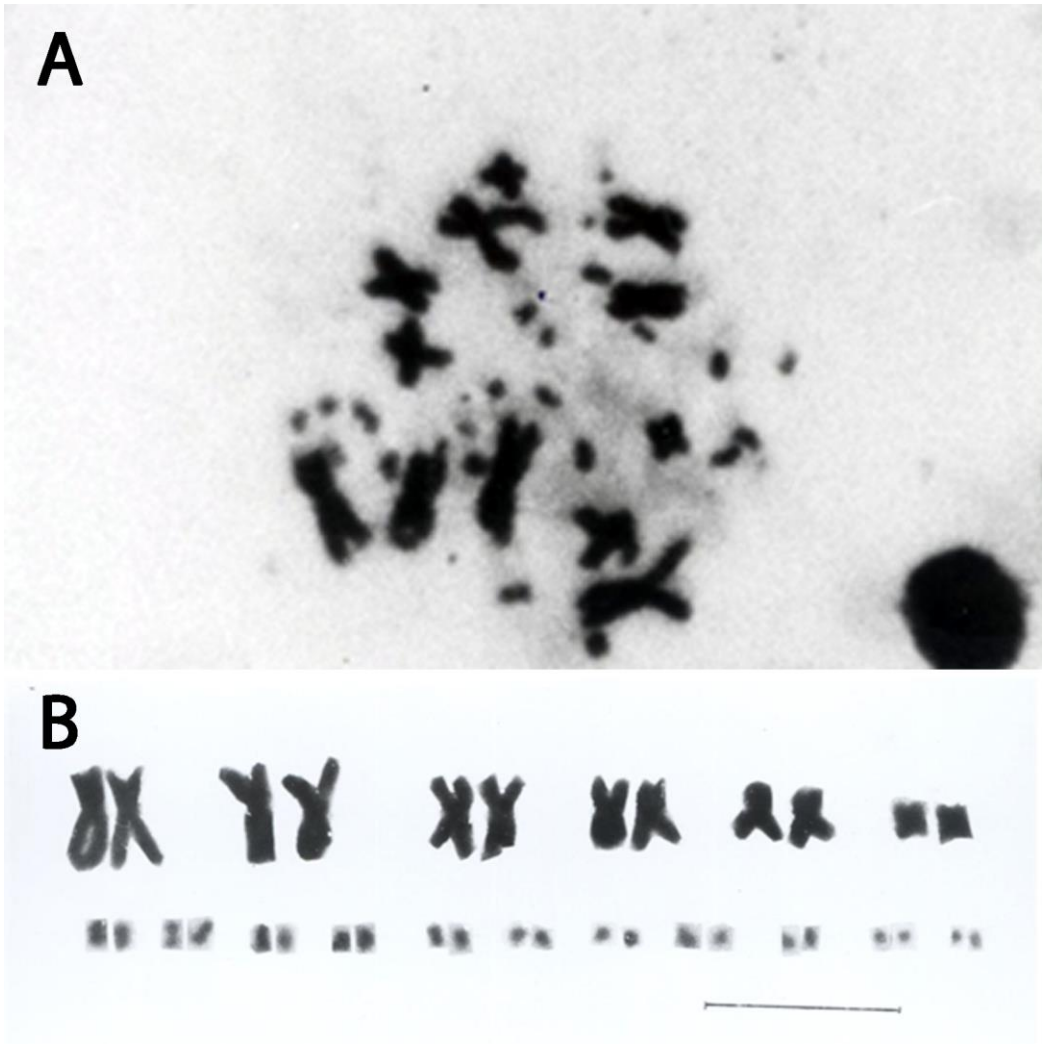

FIGURE 2. *Paralaudakia caucasia* (female): A, plate metaphase (2n=34); B, karyotype (6 pairs of macro metacentric + 11pairs of micro chromosomes). Bar=10µm.

***Laudakia nupta* nupta (De Filippi 1843)**

Khan and Mirza (1977) divided the populations of *L. nupta* in Pakistan into two subspecies*: L. n nupta* and *L.n. fusca*. *Laudakia n. nupta* is one of the largest rock-dwelling aramids occurring in northeastern and eastern Iraq eastwards through Iran, into Afghanistan and Pakistan. According to Anderson (1999), *L. n. nupta* is primarily a species of the southern and southwestern mountains of the Iranian plateau, distributed mainly on the outer slopes of the Zagros Mountains. Rastegar-Pouyani (2002) collected specimens of *L. n. nupta* in the central and east-central regions of Iran. *Laudakia n. nupta* together with *L. caucasia* and *L. stellio* represents the western radiation of the genus. In 1996 an Iranian expedition collected *L. n. nupta* from NE of Semnan province (Rastegar-Pouyani & Nilson, 2002). Previous chromosome information, indicated that *Laudakia n. nupta* has chromosome complement of 2n=36 (Hall, 1970) in Mooy & Hutterer (1975). Our female sample was diploid with 2n= 36 chromosomes. The metaphase plate of chromosomes and karyotype are shown in figure 3. The diploid karyotype consisted of six pairs of macro-chromosomes and twelve pairs of microchromosomes (Fig.3B). Macrochromosomes have range in size from 8.25to 2.62µm (Table 3).

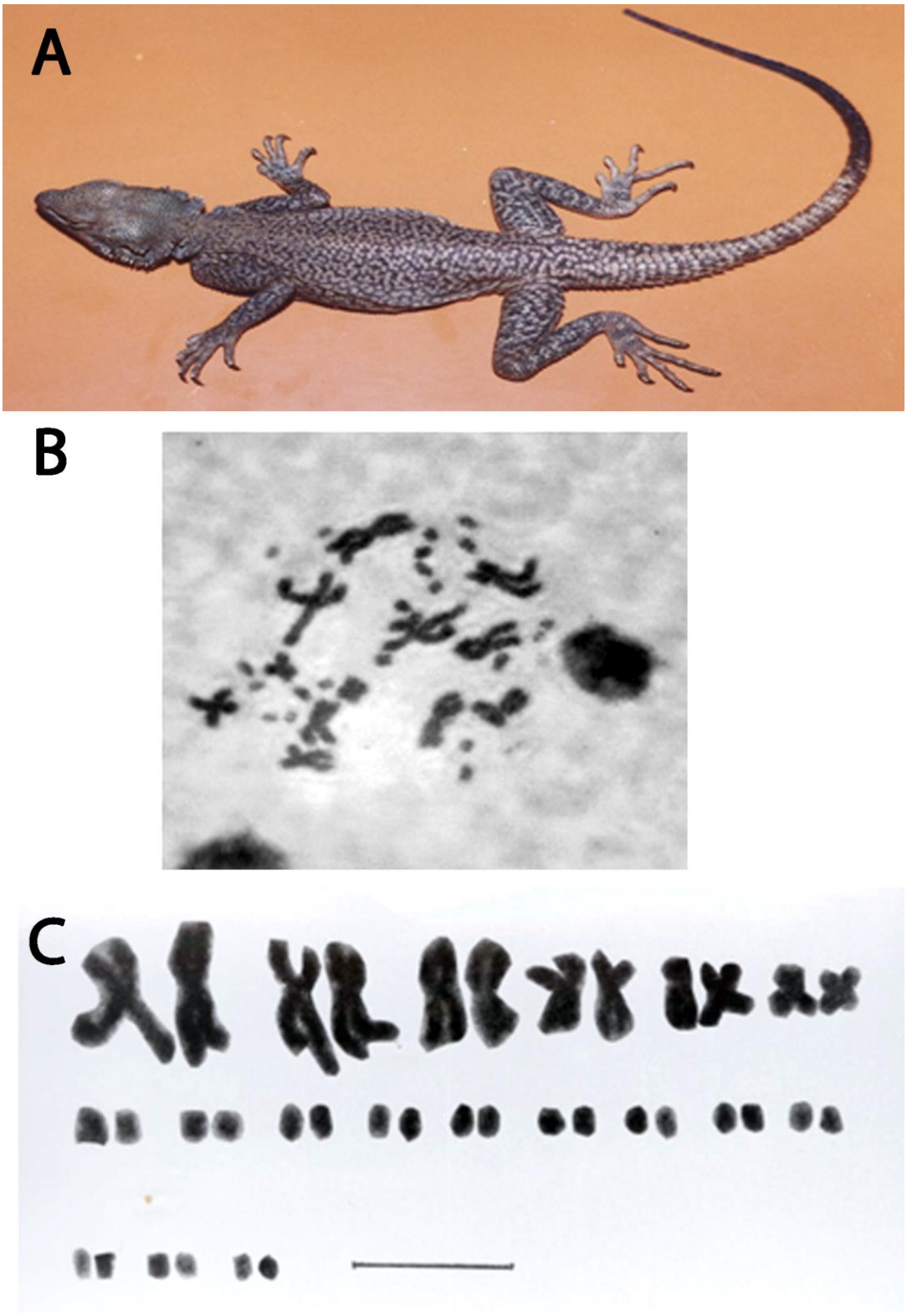

FIGURE 3. *Laudakia nupta nupta*. A: adult female; B: metaphase plate (2n=36); C: Karyotype (6 pairs of macrochromosomes + 12 microchromosomes). Bar=10µm.

TABLE 2. Measurements of macrochromosomes of *Paralaudakia caucasia*.

No. of chromosome	long arm (µ)	short arm (µ)	Arm ratio L/S= r	L+S
1	2.73	2.63	1.03	5.36
2	2.46	2.05	1.2	4.51
3	1.81	1.79	1.01	3.6
4	1.57	1.57	1	3.14
5	1.28	1.16	1.1	2.44
6	1.03	1.03	1	2.06

TABLE 3. Measurements of macrochromosomes of *Laudakia nupta nupta*.

No. of chromosome	Long arm (µm)	Short arm (µm)	Arm ratio	L+S
1	4.7	3.55	1.32	8.25
2	3.88	2.73	1.42	6.61
3	2.85	2.85	1	3.7
4	2.5	2.37	1.05	4.87
5	2.47	1.4	1.76	3.87
6	1.33	1.29	1.03	2.62

***Phrynocephalus scutellatus* (Olivier, 1807)**

The genus *phrynocephalus* Kaup, 1825 encompasses from 28 to 42 species distributed from China to the western side of the Caspian Sea and Southward to the Arabian Peninsula (Anderson, 1999; Guo & Wang, 2007). There are about 10-12 species of this monophyletic genus in desert regions of Iran (Ebrahimpour et al. 2022). The Gray Toad-headed Agama *Phrynocephalus scutellatus* occurs in Iran, Pakistan and Afghanistan. In Iran, the species is mainly found in desert, semi desert and plain areas covered with dispersed vegetation cover (Anderson, 1999). According to Solovyeva *et al.,* (2018) *Phrynocephalus* contained three main clades: (I) oviparous species from south-western and Middle Asia; (II) viviparous species of Qinghai–Tibetan Plateau (QTP); and (III) oviparous species of the Caspian Basin, Middle and Central Asia. The reconstruction of ancestral areas indicated that *Phrynocephalus* originated in Middle East–southern Middle Asia (Solovyeva *et al.,* 2018). The genus *Phrynocephalus* has a three range of chromosome numbers: 2n=44, 46 and 48, which more of them have 2n=48 (Sokolovsky, 1974; Manilo *et al.*, 1991; Zeng *et al.,* 1997; Malino, 2000). An analysis of 50 well-spread metaphase plates from different somatic tissue of two male specimens revealed a diploid chromosome count of 2n=46 comprising 22 macrochromosomes and 24 microchromosomes (Fig.4B, C). Macro chromosomes have range in size from 5.27 to 1.08µm (Table 4). Karyotype formula of our specimens was similar with karyotype formula of three species (P. *przewalskii*; *P. fontalis*; *P. guttatus*) which is reported by Zeng *et al.* (1997) from China. According to the literatures this is the first chromosome number report for this species.

***Traplus agilis agilis* (Olivieri 1807)**

Trapelus agilis is a species of agama found in Central, West and South Asia, in Iran, Pakistan, India, Russia, Turkmenistan, Tajikistan, Uzbekistan, Kazakhstan, China, possibly Iraq, and Afghanistan. The genus *Trapelus* consists of 13 species (Uetz, 2019), which are distributed from northwestern Africa, along the Saharan border, through the near East to southwest and central Asia (Rastegar-Pouyani, 1999; Rastegar-Pouyani, 2005; Wagner, 2006; Wagner & Crochet, 2009). *Trapelus agilis* is distributed on the Iranian Plateau and in adjacent regions of southwestern Asia (Šmíd *et al.*, 2014). Rastegar-Pouyani (1999) reported four subspecies within this complex group: the nominal subspecies *T. agilis agilis*, occurring on the central and southern Iranian Plateau; *T. a. pakistanensis*, restricted to the lowland and semi desert regions of southeastern Pakistan and to adjoining Indian territory; *T. a. sanguinolentus*, occupying the northern Iranian Plateau, vast areas of central Asia and westward into southeastern Europe, and *T. a. khuzestanensis* occurring in the southwestern area of the Iranian Plateau and possibly in neighboring regions of Iraq (Rastegar-Pouyani, 1999). According to literatures (Gorman & Schochat, 1972; Moody &

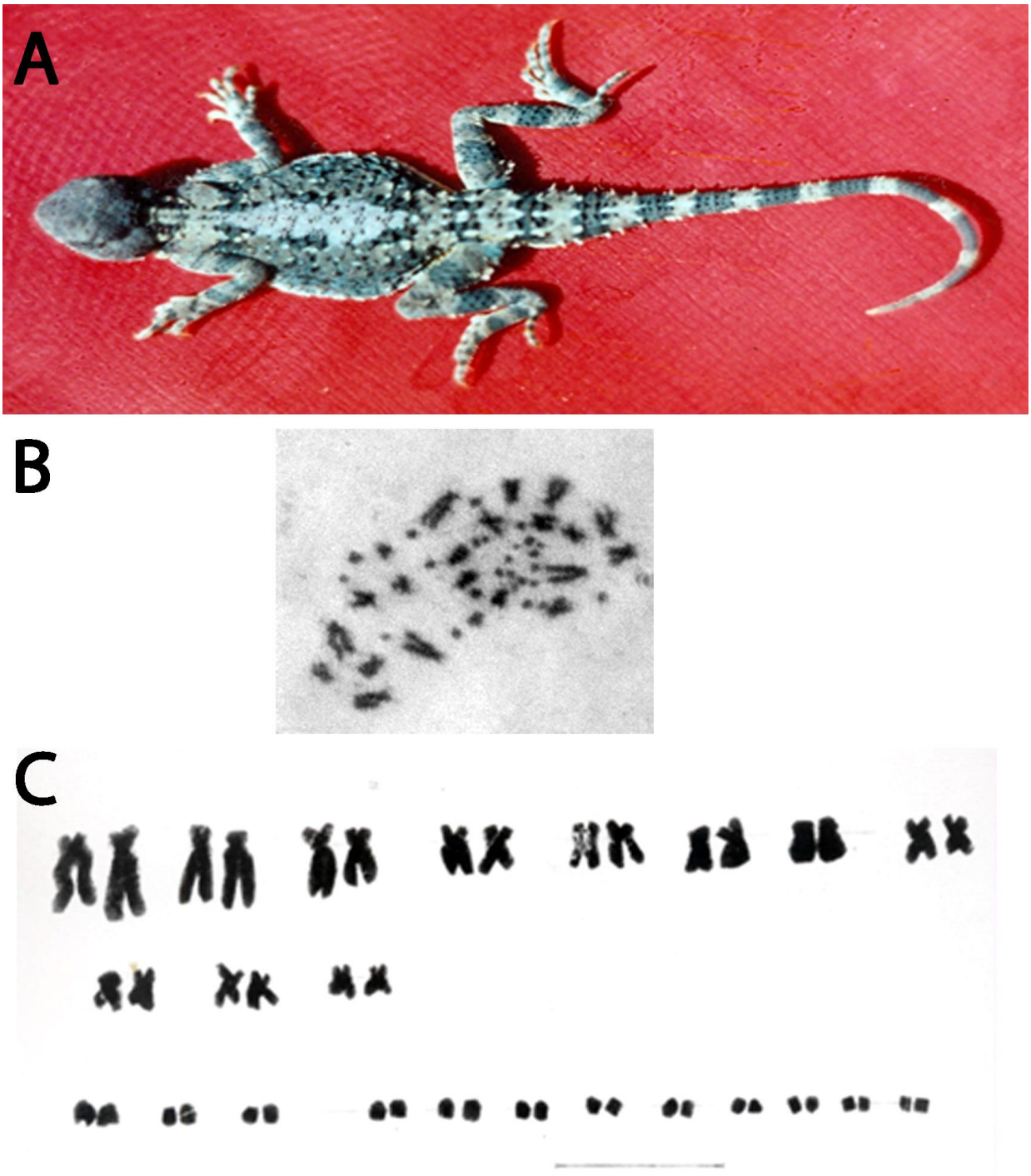

FIGURE 4. *Phrynocephalus scutellatus*. A: adult male. B: Metaphase plate (2n=46).C: karyotype (12 pairs of macro chromosomes+ 11 microchromosomes). Bar=10μm.

TABLE 4. Measurements of macrochromosomes of *Phrynocephalus scutellatus*.

No. of chromosome	long arm (µ)	short arm (µ)	Arm ratio = r	L+S
1	4.08	1.19	3.42	5.27
2	3.12	1.19	2.62	4.31
3	3	1.28	2.34	4.28
4	2.12	1.07	1.98	3.19
5	1.56	1.26	1.23	2.82
6	1.45	1.18	1.22	2.63
7	1.64	0.76	2.15	2.4
8	1.49	0.87	1.71	2.36
9	1.4	1.36	1.02	2.76
10	1.34	1.14	1.17	2.48
11	1.02	1.02	1	2.04
12	1.08	-	-	1.08

TABLE 5. Measurments of macro- acrocentric chromosomes in *Traoelus agilis agilis.*

No. of chromosome	Chromosome type	Long arm (µ)
1	Acrocentric	3.94
2	Acrocentric	3.72
3	Acrocentric	2.94
4	Acrocentric	2.61
5	Acrocentric	2.52
6	Acrocentric	2.34
7	Acrocentric	2.26
8	Acrocentric	2.21
9	Acrocentric	1.87
10	Acrocentric	1.3
11	Acrocentric	1.11
12	Acrocentric	0.91
13	Acrocentric	0.89
14	Acrocentric	0.77
15	Acrocentric	0.76
16	Acrocentric	0.71

Hutterer, 1975; Sokolovsky, 1975; Solleder & Schmid, 1988) from a total of 13 species of the genus *Trapelus*, eight of them were counted in chromosome number which seven of them have 2n=46 and one has 2n=44 chromosomes. Previous chromosome count for *Trapelus agilis* by Hall (1970) in Moody & Hutterer (1978) indicated that this species has karyotype that consisted of 24 acrocentric and 22 microchromosomes. Our male specimen was a new cytotype with karyotype including 21 acrocentric and 28 microchromosomes, which one of the acrocentric chromosomes may be sex chromosome (Fig. 5C) Macro acrocentric chromosomes have range in size from 3.94 to 0.71µm (Table 5).

ACKNOWLEDGMENTS

This work was supported by research council, University of Tehran.

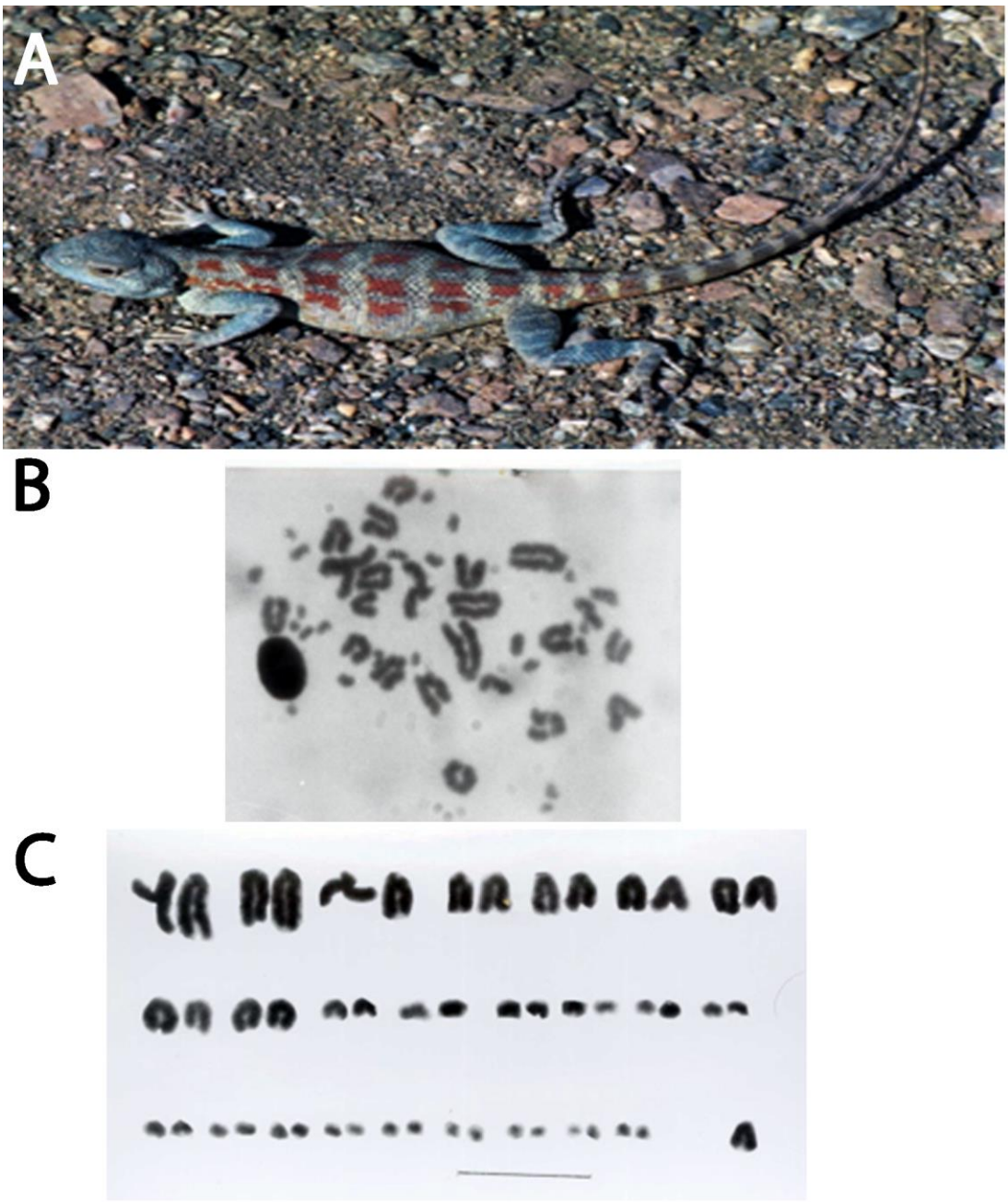

FIGURE 5. *Traplus agilis agilis*. A: adult female. B: Metaphase plate (2n=49).C: karyotype (21 macro acentric chromosomes + 28 microchromosomes). Bar=10µm.

LITERATURE CITED

Ahmadzadeh, F., Kiabi, B.H., Kami, H.G., Hojjati, V., 2008. A preliminary study of lizard's faunaand their habitats in the northwest of Iran. Asiatic Herpetological Research 11,1–9.

Anderson, S.C., 1963. Amphibians and Reptiles from Iran. Procceedings of the California Academy of Science 31 (16), 417 – 498.

Anderson, S.C., 1974. Preliminary key to the turtles, lizards and amphibianains of Iran Fieldiana Zoology 65(4), 27 – 44.

Anderson, S. C., 1999. *The Lizards of Iran.* Society for the Study of Amphibians and Reptiles, Saint Louis, Missouri, 442 p.

Arronet (Kulikova), V. N., 1965. Description of the karyotypes of Agama caucasica and Phrynocephalus helioscopus (Agamidae, Reptilia). Tsitologiya 7, 237-239.

Baig, K. J., Wagner, P., Ananjeva, N., Böhme, W., 2012. A morphology-based taxonomic revision of *Laudakia* Gray, 1845 (Squamata: Agamidae). Vertebrate Zoology 62 (2), 213–260.

Clark, R., 1991. Contribution to the reptiles fauna of northern Iran. British Herpetological Society Bulletin 35, 36 – 46.

Clark, J., Clark, D., Anderson, S.C., 1966. Reports on two small collections of reptiles from Iran. Occasional Papers of the Callifornia Academy of Science 55, 1 – 9.

Deakin, J. E., Ezaz, T., 2019. Understanding the evolution of reptile chromosomes though applications of combined cytogenetics and genomics approaches. Cytogenetic and Genome Research 157, 7-20.

Ebrahimipour, F., Rastegar-Pouyani, N., Rastegar-Pouyani, E., 2022. Systematics and distribution of the genus Phrynocephalus Kaup, 1825 (Sauria: Agamidae) in the Iranian Plateau: A Review. Journal of Wild Life Biodiversity 6(x), x-x. DOI: https://doi.org/ 10.5281/zenodo.6502821

Ezaz, T., Sarre, SD., Meally, D., Marshall Graves, JA., Georges, A., 2009. Sex chromosome evolution in lizards: independent origins and rapid transitions. Cytogenetic and Genome Research 127, 249–260.

Faizi, N., Rastegar-Pouyani, N., 2007. Further studies on the lizards cranial osteology based on a comparative study of the skull in *Trachylepis aurata transcaucasica* and *Laudakia nupta* (Squamata: Sauria). Russian Journal of Herpetology 14(2), 107 – 116.

Gamble, T, Coryell, J., Ezaz, T., Lynch, J., Scantlebury, DP., Zarkower, D., 2015. Restriction site-associated DNA sequencing (RAD-seq) reveals an extraordinary number of transitions among gecko sex-determining systems. Molecular Biology and Evolution 32, 1296–1309.

Gorman, G.C., 1973. The chromosomes of the reptilia, a cytotaxonomic interpretation. In: Chiarelli, A.B., Capanna, E. eds. Cytotaxonomy and vertebrate evolution. Academic Press, London, pp. 349 424.

Gorman, G.C., Shochat, D., 1972. A taxonomic interpretation of chromosomal and eletrophoretic data on the agamid lizards of Israel with notes on some East African species. Herpetologica 28, 106 – 112

Guo, x. g., Wang, y. z., 2007. Partitioned Bayesian analyses, dispersal-vicariance analysis, and the biogeography of Chinese toad-headed lizards (Agamidae: *Phrynocephalus*): A revaluation. Molecular Phylogenetics and Evolution 45 (2), 643–662

Khan, M. S., Mirza, M.R., 1977. An Annotated Checklist and Key to the Reptiles of Pakistan, Part II: Sauria (Lacertilia*).* Biologia 23(1), 41-64.

Kupriyanova, L.A., 1984. Karyotypes of 3 species of agamid lizards – Ecology and faunistic of amphibians and reptiles of USSR and adjacent countries. Procceedings of the Zoological Institute of the Academy of Sciences USSR, 124, 115 – 118.

Levan, A., Fredga, K., Sandberg, A.A., 1964. Nomenclature for centromeric position on chromosomes. Hereditas 52, 201-220.

Moody, S.M., Hutterer, R., 1978. Karyotype of the agamid lizard Lyriocephalus scutatus (L. 1758), with a brief review of the chromosomes of the lizard family Agamidae. Bonner Zoologische Beiträge 29,165-170.

Manilo, V.V., Golubev, M.L., Sattorov, T., 1991. Karyotype of *Phrynocephalus helioscopus saidalievi* (Sauria, Agamidae) from Fergana Valley. Vestnik Zoologii 2, 79–81.

Manilo, VV., 2000 Description of karyotypes of some species and subspecies of the genus Phrynocephalus (Sauria, Agamidae) from Central Asia. *Vestnik Zoologii,* 34(6),113–118.

Mozaffari, O., Kamali, K., Fahimi, H., 2016. The Atlas of Reptiles of Iran. Department of the Environment, Tehran, pp.361.

Natalbia, B., Ananjeva, Konstantin, D., Milto, Andrei, V., Barabanov, Angeny, A., Golynsky, 2020. An annotated type catalogue of amphibians and reptiles collected by Nikolay A. Zarudny in Iran and Middle Asia. Zootaxa DOI: 10.11646/ZOOTAXA.4722.2.1

Sokolovsky, V. V. (.1974) Comparative caryological study of the lizards Agamidae. I. Chromotype of eight species of Phrynocephalus. Cytology 16(7), 920 – 925.

Olmo, E., 2008. Trends in the evolution of reptilian chromosomes. Integratve and Comparative Biology 48, 486–493.

Painter T. S., 1921. Studies in Reptilian spermatogenesis. I. The spermatogenesis of lizards. Journal Experimental Zoology 34, 281-327.

Pokorná, M., Giovannotti, M., Kratochvíl, L., Kasai, F., Trifonov, VA., 2011. Strong conservation of the bird Z chromosome in reptilian genomes is revealed by comparative painting despite 275 million years divergence. Chromosoma 120,455–68.

Rastegar-Pouynai, N., Nilson, G., 2002. Taxonomy and biogeography of the Iranian species of *Laudakia*. Zoology of the Middle East 26, 93 – 122.

Rastegar-Pouyani, N., 1999. Analysis of geographic variation in the Trapelus agilis complex (Sauria: Agamidae). Zoology in the Middle East 19,75 –99.

Rastegar-Pouyani, N., 2005. A multivariate analysis of geographic variation in the Trapelus agilis complex (Sauria: Agamidae). Amphibia-Reptilia 26,159–173

Safaei-Mahroo, B., Ghaffari, H., Fahimi, H., Broomand, S., Yazdanian, M., Najafi Majd, E., Hosseinian Yousefkhani, S. S., Rezazadeh E., Sadat Hosseinzadeh, M., Nasrabadi, R., Eajabizadeh, M., Mashayekhi,

M., Motesharei, A., Naderi, A. & Kazemi, S., 2015. The Herpetofauna of Iran: Checklist of Taxonomy, Distribution and Conservation Status. Asian Herpetological Research 6(4), 257–290

Schleich, H.H., 1979. Feldherpetologische Beobachtungen in Persien, nebst morphologischen Daten zu den Agamen, *Agama agilis*, *Agama caucasica* and *Agama erythrogaster*. Salamandra 15(4), 237 – 253.

Šmíd, J., Moravec, J., Kodym, P., Kratochvíl, L., Hosseinian Yousefkhani, SS., Frynta, D., 2014. Annotated checklist and distribution of the lizards of Iran. Zootaxa 3855,1–97

Sokolovsky, V. V. (.1974) Comparative caryological study of the lizards Agamidae. I. Chromotype of eight species of Phrynocephalus. Cytology 16(7), 920 – 925.

Sokolovskii, V.V., 1975. A comparative karyological study of the lizards of the family Agamidae. Part II. Karyotypes of the five species of the genus *Agama*. Tsitologiya 17, 91 – 93.

Solleder, E., Schmidt, M., 1988. Cytogenetic studies on Sauria (Reptilia). I. Mitotic chromosomes of the Agamidae. Amphibia-Reptilia 9, 301-310.

Tellyesniczky, K., 1897. Über den Bau des Eidechsenhodens. Mathematische Naturwissenschaftliche Berichte Ungarn 13,303–342

Uetz, P., Freed, P., Hosek, J., 2019. The Reptile Database, http://www.reptile-database.org

Wagner, P., 2006. A new species of the genus Trapelus Cuvier, 1816 (Squamata: Agamidae). Bonner Zoologische Beitraege 55,81–87.

Wagner, P., Crochet, PA., 2009. The status of the nomina Trapelus savignyi Audouin, 1827 and Agama savignii Duméril & Bibron, 1837 and the valid nomen of the Savigny s Agama (Sauria: Agamidae). Zootaxa 2209,57–64.

William, E.E., Hall, W.P., 1976. Lizard karyotypes from the Galapagos Island: Chromosomes in phylogeny and evolution Part II. Primitive karyotypes. Breviora 441,6 – 18.

Witten, G.J., 1978. A triploid male individual *Amphibolurus nobbi nobbi* Witten (Lacertilia: Agamidae). Australian Zoology 19, 305 – 308.

Zeng, XM., Wang, YZ., Liu, ZJ., Fang, ZL., Wu, GF., Papenfuss, TJ., Macey, JR., 1997. Karyotypes of nine species in the genus *Phrynocephalus*, with discussion of karyotypic evolution of Chinese Phrynocephalus. Acta Zoologica Sinica 43,399–410.

Zug, G R., Vitt, LJ., Caldwell, JP., 2001. Herpetology: an introductory biology of amphibians and reptiles, 2nd edition, Academic press, New York.

Iranian Journal of Animal Biosystematics (IJAB)
Vol.18, No.1, 77-91, 2022
DOI: 10.22067/ijab.2022.77160.1033

IJAB
ISSN: 1735-434X (print); 2423-4222 (online)

RESEARCH ARTICLE Open access

Ticks (Metastigmata: Ixodidae) parasitizing songbirds in Iran with new host records

Behnoosh Moodi[1], Mansour Aliabadian[1,2], Alireza Saboori,[3] Ali Moshaverinia[4], Omid Mirshamsi[1,2]*
[1]*Department of Biology, Faculty of Science, Ferdowsi University of Mashhad, Iran*
[2]*Institute of Applied Zoology, Faculty of Science, Ferdowsi University of Mashhad, Iran*
[3]*Department of Plant Protection, Faculty of Agriculture, University of Tehran, Karaj, Iran*
[4]*Department of Pathobiology, Faculty of Veterinary Medicine, Ferdowsi University of Mashhad, Mashhad, Iran*

(Received: *13 June 2022*; Accepted: *10 November 2022*)

Abstract
The present study investigates the occurrence and the identification of tick species infesting wild songbirds in northern Iran. Totally, 342 songbirds belonging to 15 families and 37 species were captured and examined for tick infestation during 2015-2016. Of which, 70 specimens were infested by ticks (infestation rate = 20.46%). Three tick species detached from examined birds and identified as follow: *Ixodes ricinus* (Linnaeus, 1758), *Hyalomma* sp., and *Rhipicephalus* sp. The most common one was *I. ricinus*. In all infected birds, collected ticks were in immature stages and the number of specimens of the larval stage was more than in the nymphal stage, and no adult tick was found. Following songbirds were introduced as new hosts: *Petronia petronia* (Linnaeus, 1766), *Gymnoris xanthocollis* (Burton, E, 1838), *Hippolais pallida* (Hemprich & Ehrenberg, 1833), *Emberiza calandra* Linnaeus, 1758, *Acridotheres tristis* (Linnaeus, 1766), *Oenanthe picata* (Blyth, 1847), *O. pleschanka* (Lepechin, 1770), *Rhodospiza obsoleta* (Lichtenstein, MHC, 1823), *Serinus pusillus* (Pallas, 1811), and *Ficedula parva* (Bechstein, 1792) for *I. ricinus*. The overall mean intensity and mean abundance were 4.6 and 0.95, respectively. The highest mean intensity, 12.18 ticks per bird, was recorded from Common Starling. The highest prevalence of infestation was recorded on Common Blackbird (53%). The most prevalence of tick infestation occurred in the Turdidae family (37.83%) followed by Passeridae (33.33%) and Sturnidae (28.57%).

Key words: *passerine birds, ixodid, Ixodes ricinus, tick infestation.*

INTRODUCTION

Hard ticks (Metastigmata: Ixodidae) are medically important ectoparasites and known as vectors of important diseases such as lyme borreliosis, tick-borne encephalitis (TBE) and babesiosis to animals and humans. These hematophagous ectoparasites transmit a wide variety of pathogens including: viruses (such as tick borne encephalitis and Crimean-Congo hearnorrhagic fever virus), rickettsia (such as tickborne spotted fever rickettsioses, typhus fever rickettsioses, Scrub Typhus, and Ehrlichioses), bacteria (such as relapsing fever borrelioses, tularemia and Q fever) and protozoa (such as *Babesia* species and *Hepatozoon* species) (Cupp, 1991; Parola & Raoult, 2001; Labuda & Nuttall, 2008; Nicholson et al., 2019; Ceylan et al., 2021). The family Ixodidae comprises of 14 genera and approximately 707 species known throughout the world (Guglielmone et al., 2014). Ticks require vertebrate hosts at each stage of their life to complete life cycles. Birds, mainly songbirds, are often hosts of ticks (Smith et al., 1996). The significance of birds as hosts for ticks and tick-borne diseases is more than the other vertebrate hosts because of their worldwide distribution and wide range of habitat (Smith et al., 1996). The long migration paths of birds enable these parasites to occupy new areas (Loss et al., 2016; Ogden et al., 2008; Smith et al., 1996). Additionally, many of the songbirds, especially those are ground foraging species show a

Corresponding Author: mirshams@um.ac.ir

reasonable high tick infestation rate. Ticks parasitize songbirds, especially in subadult stages (Humair et al., 1993; Smith et al., 1996). Songbirds are known as hosts of ticks belong to Ixodidae family especially in following genera: *Ixodes*, *Haemaphysalis* and *Amblyomma* (Guglielmone et al., 2014). About 154 species of ixodid ticks at different stages (larva, nymph or adult) are parasite of birds, of which 40 species are exclusively parasites of birds for all stages (Guglielmone et al., 2014; Hoogstraal & Aeschlimann, 1982).

Of the 729 currently recognized Ixodidae species more than 41 species of ticks belonging to Ixodidae has reported in Iran. Almost all these reported species include ixodid ticks on domestic animals and wild mammals (Deply, 1936; Janbakhsh, 1956; Abbassian-Lintzen, 1960; Mazlum, 1968; Mazlum, 1971; Hoogstraal & Wassef, 1979; Piazak, 1991; Tavakoli, 1997; Nekoui et al., 1999; Kamali et al., 2001; Telmadarraiy et al., 2004; Aghighi et al., 2007; Rahbari et al., 2007; Razmi et al., 2007; Guglielmone & Robbins, 2018; Hosseini-Chegeni, 2019).

The avifauna of Iran includes 548 birds, of which approximately 235 species belong to the songbirds (Dickinson and Christidis, 2014). Despite the importance of wild birds as a transmitter of tick and tick-borne diseases (Hasle, 2011), no study has been conducted on their tick fauna in Iran.

Due to the rich songbird diversity in the north of Iran and the importance of ticks as a vector of pathogens, the main objective of this study is evaluating tick infestation rate on songbirds in the north of Iran.

MATERIAL AND METHODS

Samplings were conducted at 23 different localities of Iran's northern regions (36°32'49.2" N, 61°09'07.2" E to 37°03'56.9" N, 48°29'10.6" E) during 2015-2016 (Table 1). The songbirds were captured from different ecosystems to cover all species of songbirds as many as possible using mist-nets (Fig. 1).

The trapped birds were identified by field guides (Porter & Aspinall, 2016), examined carefully for ticks by naked eyes and immediately released. Collected ticks were preserved in vials containing 75% ethanol. Ticks were examined under a stereomicroscope and identified to species level and categorized according to their developmental stages (Nosek & Sixl, 1972; Filippova, 1977a; Filippova, 1997b; Aeschlimann et al., 1979; Perry, 2001; Pérez-Eid, 2007; Kleinjan & Lane, 2008; Estrada-Peña et al., 2018). In order to reduce bias for small size samples, bird species fewer than ten individuals were excluded from the study. Parasitological indices, including prevalence, mean intensity, mean abundance of infestation, were calculated for each infested bird (Lafferty et al., 1997).

To evaluate the association between nutrition and migration with tick infestation, the hosts were classified based on their trophic guild (granivorous, omnivorous and insectivorous), their feeding habitats (non-ground feeders and ground feeders) and their migrant guild (sedentary, short-distance migration, long-distance migration) (Hoyo et al., 1992). Statistical analyses were performed only for *Ixodes ricinus* (Linnaeus, 1758) because it was the most common tick species among hosts that were examined in this study. Data were statistically analyzed by SPSS version 16 using the chi-square and Fisher exact test. For bird's taxon names and taxonomy, we follow Dickinson and Christidis (2014).

RESULTS

From 342 birds, 326 ticks were collected, 263 (80.67%) were in larval stage and, 63 (19.32%) in the nymphal stage. These immature ticks were included three genera (*Ixodes* Latreille, 1795, *Rhipicephalus* Koch, 1844 and, *Hyalomma* Koch, 1844) and three species. The most frequent tick species detected was *I. ricinus* (323 individuals, 99%, 260 larvae, 63 nymphs) followed by *Hyalomma* sp. (1 individual, 0.30%, 1 Larva) and *Rhipicephalus* sp. (2 individuals, 0.61%, 2 Larva) (Fig. 2).

In this study, *I. ricinus* were collected from 24 bird species belonging to 32 genere and 13 families, consisting: House Sparrow (*Passer domesticus* (Linnaeus, 1758)), Tree Sparrow (*P. montanus* (Linnaeus, 1758)), Rock Sparrow (*Petronia petronia* (Linnaeus, 1766)), Chestnut-shouldered Petronia (*Gymnoris xanthocollis* (Burton, E, 1838)) from the family Passeridae; Eastern Olivaceous Warbler (*Hippolais pallida* (Hemprich & Ehrenberg, 1833)) from the family Sylviidae; Common Chiffchaff

TABLE 1. Sampling localities, birds and the number of ticks per bird. Examined birds/ Infested birds/ Number of separated ticks.

Localities Host / Species	Mashhad	Kardeh	Ortokand	Dam Zavin	Qarah su	Kalat	Lof abad	Dargaz	Tandoreh	Kashmar	Sarakhs	Shirvan	Bojnord	Azad shahr	Alangdareh	Gorgan	Bandar Gaz	Vaz-e-olys	Chamestan	Nur	Eshkavarat	Masal	Asalem	Total
Passer domesticus	7/1/2	3/0/0	4/0/0	2/0/0	3/0/0	1/0/0	2/0/0	1/0/0	1/0/0	1/0/0	1/0/0	3/0/0	1/0/0	1/0/0	-	6/2/6	3/1/5	2/2/4	4/2/3	3/2/7	4/2/4	3/2/3	3/2/5	59/16/39
Passer montanus	2/0/0	1/0/0	-	-	-	1/0/0	3/2/3	1/0/0	3/1/1	-	-	3/1/2	6/2/3	-	-	1/1/1	-	2/1/1	-	1/1/2	1/0/0	1/1/1	2/1/1	33/10/15
Petronia petronia	-	-	-	-	-	2/0/0	-	-	2/1/1	-	-	2/1/2	-	-	-	-	-	-	-	-	-	-	-	6/2/3
Gymnoris xanthocollis	-	-	-	-	-	-	-	-	1/0/0	-	-	2/1/2	-	-	-	-	-	-	-	-	-	-	-	3/1/2
Carpospiza brachydactyla	-	-	-	-	-	-	-	-	-	1/0/0	-	-	-	-	-	-	-	-	-	-	-	-	-	1/0/0
Hippolais pallida	3/0/0	1/0/0	-	-	-	-	-	-	1/0/0	2/0/0	1/0/0	1/1/2	-	-	-	-	-	-	-	-	-	-	-	9/1/2
Iduna caligata	1/0/0	2/0/0	1/0/0	-	-	2/0/0	1/0/0	-	2/0/0	-	1/0/0	-	1/0/0	-	-	-	-	-	-	-	-	-	-	11/0/0
Acrocephalus stentoreus	1/0/0	2/0/0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3/0/0
Sylvia communis	2/0/0	-	-	-	-	2/0/0	2/0/0	-	1/0/0	2/0/0	-	1/0/0	-	-	-	1/0/0	-	-	-	-	-	-	-	11/0/0
Phylloscopus collybita	2/0/0	-	-	-	-	1/0/0	2/0/0	-	3/2/2	-	2/0/0	3/0/0	-	-	-	-	-	-	-	-	-	-	-	13/2/2
Scotocerca inquieta	-	-	-	-	-	-	-	-	1/0/0	-	-	1/0/0	-	-	-	-	-	-	-	-	-	-	-	2/0/0
Emberiza calandra	-	-	-	2/0/0	-	-	2/0/0	2/2/4	1/1/2	4/0/0	-	2/1/1	-	-	-	-	-	-	-	-	-	-	-	13/4/7
Emberiza bruniceps	-	-	-	-	-	-	-	-	4/0/0	-	-	3/0/0	-	-	-	-	-	-	-	-	-	-	-	7/0/0
Sitta europaea	-	-	-	-	-	-	-	2/0/0	2/0/0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	4/0/0
Sturnus vulgaris	1/0/0	-	-	-	-	3/1/19	-	-	2/0/0	1/0/0	-	1/0/0	-	2/1/9	-	1/1/106	-	-	-	-	-	-	-	11/3/134
Acridotheres tristis	-	-	-	-	-	-	1/0/0	-	1/0/0	-	-	1/1/2	-	-	-	-	-	-	-	-	-	-	-	3/1/2
Turdus merula	7/4/14	2/1/1	-	-	-	-	-	2/2/3	-	-	-	2/0/0	-	-	-	-	-	-	-	-	-	-	-	13/7/18
Erithacus rubecula	-	-	-	-	-	-	-	-	-	-	1/0/0	2/1/5	-	-	-	-	-	-	-	-	-	-	-	3/1/5

Oenanthe lugens	-	-	-	-	-	-	-	-	-	-	1/0/0	2/0/0	-	-	-	-	-	-	-	-	-	-	-	3/0/0
Oenanthe picata	-	-	-	-	-	-	-	1/0/0	-	1/0/0	1/0/0	1/0/0	1/1/5	-	-	-	-	-	-	-	-	-	-	5/1/5
Oenanthe albonigra	-	-	-	-	-	-	-	-	1/0/0	-	1/0/0	-	-	-	-	-	-	-	-	-	-	-	-	2/0/0
Oenanthe pleschanka	-	-	-	-	-	1/0/0	1/0/0	-	1/0/0	-	1/0/0	2/1/5	-	-	-	-	-	-	-	-	-	-	-	6/1/5
Phoenicurus ochruros	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2/1/4	2/0/0	4/1/4
Rhodospiza obsoleta	-	-	-	-	-	1/0/0	-	2/2/2	1/0/0	1/0/0	-	1/0/0	-	-	-	-	-	-	-	-	-	-	-	6/2/2
Serinus pusillus	2/1/3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2/1/3
Fringilla coelebs	-	-	-	-	-	-	-	1/0/0	-	-	-	-	-	-	-	3/0/0	-	2/0/0	-	-	3/0/0	3/1/15	2/1/9	14/2/24
Carduelis chloris	-	-	-	-	-	-	-	-	-	-	-	2/0/0	3/0/0	-	-	1/0/0	-	2/0/0	-	2/0/0	-	2/0/0	-	12/0/0
Parus major	10/0/0	4/0/0	-	-	-	-	3/0/0	10/0/0	3/0/0	-	1/0/0	2/0/0	-	-	-	7/0/0	-	5/2/4	-	2/1/5	1/1/5	1/1/3	2/1/3	51/6/20
Cyanistes caeruleus	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3/0/0	-	2/2/6	-	1/0/0	1/0/0	-	-	7/2/6
Galerida cristata	-	-	-	-	-	-	-	-	-	-	3/1/5	-	-	-	-	-	-	-	-	-	-	-	-	3/1/5
Calandrella rufescens	-	-	-	-	-	-	-	-	2/0/0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2/0/0
Hirundo rustica	-	-	-	-	-	-	-	-	-	-	1/0/0	-	-	-	-	-	-	-	-	-	-	-	-	1/0/0
Ficedula parva	2/0/0	-	-	-	-	-	1/0/0	-	2/0/0	-	1/0/0	-	-	-	-	3/1/1	1/1/2	-	-	-	-	-	-	10/2/3
Pica pica	-	-	-	-	-	-	-	-	-	-	1/0/0	-	-	-	-	-	-	1/1/4	-	-	-	-	-	2/1/4
Corvus corone	1/0/0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1/0/0
Motacilla alba	3/1/9	-	-	-	-	1/0/0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	4/1/9
Oriolus oriolus	-	-	-	-	-	-	2/1/4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2/1/4
																								342/70/32

TABLE 2. *Ixodes ricinus* collected from passerine birds in the north of Iran. Exa. b, Examined birds; Inf. b, Infested birds; P., Prevalence; M.I., Mean intensity; M.A., Mean abundance, G., Granivorous; O., Omnivorous and I., insectivorous. * Record on new host.

Host family	Common name	Host species	No. of Exa. b	No. of Inf. b	P	No of ticks found			Mean I.	Mean A.	Trophic guild	Migrating behavior	Feeding behavior
						Larvae	Nymphs	Total					
Passeridae	House Sparrow	*Passer domesticus*	59	16	27.11	35	4	39	2.43	0.66	O	Sedentary bird	Ground feeder
	Tree Sparrow	*Passer montanus*	33	10	0.30	14	1	15	1.5	0.45	O	Sedentary bird	Ground feeder
	Rock Sparrow	*Petronia petronia**	6	2	0.33	3	0	3	1.5	0.5	Gr	Sedentary bird	Ground feeder
	Chestnut-shouldered Petronia	*Gymnoris xanthocollis* *	3	1	0.33	2	0	2	2	0.66	Gr	Short-distance migratory bird	Ground feeder
	Pale Rock Sparrow	*Carpospiza brachydactyla*	1	0	0	0	0	0	0	0	Gr	Short-distance migratory bird	Ground feeder
Sylviidae	Eastern Olivaceous Warbler	*Hippolais pallida**	9	1	0.11	2	0	2	0	0.22	I	Short-distance migratory bird	Non-ground feeder
Acrocephalidae	Booted Warbler	*Iduna caligata*	11	0	0	0	0	0	0	0	I	Long-distance migratory bird	ground feeder
	Clamorous Reed Warbler	*Acrocephalus stentoreus*	3	0	0	0	0	0	0	0	I	Short-distance migration	Non-ground feeder
	Greater Whitethroat	*Sylvia communis*	11	0	0	0	0	0	0	0	I	Long-distance migratory bird	Non-ground feeder
Phylloscopidae	Common chiffchaff	*Phylloscopus collybita*	13	2	0.15	2	0	2	1	0.15	I	Long-distance migratory bird	Ground feeder
Scotocercidae	Streaked scrub warbler	*Scotocerca inquieta*	2	0	0	0	0	0	0	0	I	Sedentary bird	Ground feeder
Emberizidae	Corn Bunting	*Emberiza calandra**	13	4	0.30	7	0	7	1.75	0.53	Gr	Sedentary bird	Ground feeder
	Red-headed Bunting	*Emberiza bruniceps*	7	0	0	0	0	0	0	0	Gr	Long-distance migratory bird	Ground feeder
Sittidae	Eurasian Nuthatch	*Sitta europaea*	4	0	0	0	0	0	0	0	I	Sedentary bird	Ground feeder
Sturnidae	Common Starling	*Sturnus vulgaris*	11	3	0.27	95	39	13 4	44.6 6	12.1 8	O	Short-distance migratory bird	Ground feeder
	Common mynah	*Acridotheres tristis**	3	1	0.33	2	0	2	2	0.66	O	Sedentary bird	Ground feeder
Turdidae	Common Blackbird	*Turdus merula*	13	7	0.53	16	2	18	2.57	1.38	I	Short-distance migratory bird	Ground feeder
Muscicapidae	European Robin	*Erithacus rubecula*	3	1	0.33	5	0	5	5	1.66	I	Short-distance migratory bird	Ground feeder
	Mourning Wheatear	*Oenanthe lugens*	3	0	0	0	0	0	0	0	I	Short-distance migratory bird	Ground feeder
	Eastern Pied Wheatear	*Oenanthe picata*	5	1	0.2	2	3	5	5	1	I	Short-distance migratory bird	Ground feeder

	Hume's Wheatear	*Oenanthe albonigra*	2	0	0	0	0	0	0	0	I	Sedentary bird	Ground feeder
	Pied Wheatear	*Oenanthe pleschanka*	6	1	0.16	4	1	5	5	0.83	I	Long-distance migratory bird	Non- Ground feeder
	Black Redstart	*Phoenicurus ochruros*	4	1	0.25	4	0	4	4	1	I	Long-distance migratory bird	Ground feeder
	Red-breasted Flycatcher	*Ficedula parva**	10	2	0.2	3	0	3	1.5	0.3	I	Long-distance migratory bird	Ground feeder
Fringillidae	Desert Finch	*Rhodospiza obsoleta**	6	2	0.33	2	0	2	0	0.33	Gr	Sedentary bird	Ground feeder
	Fire-fronted Serin	*Serinus pusillus*	2	1	0.5	3	0	3	3	1.5	Gr	Sedentary bird	Ground feeder
	Common chaffinch	*Fringilla coelebs*	14	2	0.14	20	4	24	12	1.71	O	Short-distance migratory bird	Ground feeder
	European Greenfinch	*Carduelis chloris*	12	0	0	0	0	0	0	0	Gr	Short-distance migratory bird	Ground feeder
Paridae	Great Tit	*Parus major*	51	6	0.11	19	1	20	3.33	0.39	O	Sedentary bird	Non-ground feeder
	Blue Tit	*Cyanistes caeruleus*	7	2	0.28	4	2	6	3	0.85	O	Sedentary bird	Ground feeder
Alaudidae	Crested Lark	*Galerida cristata*	3	1	0.33	4	1	5	5	1.66	Gr	Sedentary bird	Ground feeder
	Lesser Short-toed Lark	*Calandrella rufescens*	2	0	0	0	0	0	0	0	O	Sedentary bird	Ground feeder
Hirundinidae	Barn Swallow	*Hirundo rustica*	1	0	0	0	0	0	0	0	I	Long distance migration	Non-ground feeder
Corvidae	Common Magpie	*Pica pica*	2	1	0.5	3	1	4	4	2	O	Sedentary bird	Ground feeder
	Carrion Crow	*Corvus corone*	1	0	0	0	0	0	0	0	O	Sedentary bird	Ground feeder
Motacillidae	White Wagtail	*Motacilla alba*	4	1	0.25	6	3	9	9	2.25	I	Short-distance migration	Ground feeder
Oriolidae	Golden Oriol	*Oriolus oriolus*	2	1	0.5	3	1	4	4	2	O	Long-distance migratory bird	Ground feeder
Total			342	70		260	63	323					

TABLE 3. Other tick species collected on songbirds in the north of Iran. *Record on new host.

Host family	**Common name**	**Host species**	**Number examined birds**	**No of infested birds**	**Prevalence**	***Rhipicephalus* sp. *L/N/A***	***Hyalomma* sp. *L/N/A***
Paridae	Great Tit	*Parus major*	51	1	1.96	0/2/0	-
Emberizidae	Corn Bunting	*Emberiza calandra*	13	1	7.6	-	0/1/0
Total						0/2/0	0/1/0

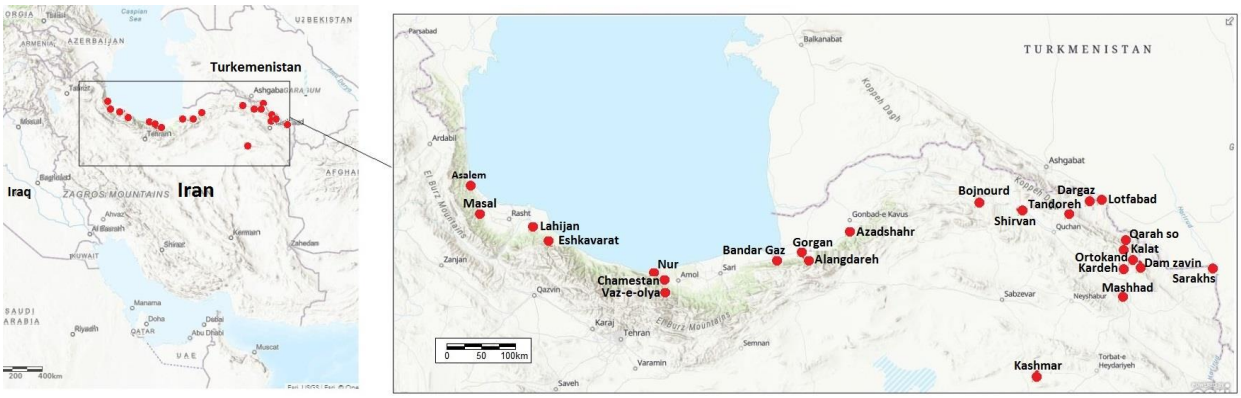

FIGURE 1. Bird sampling localities in the north of Iran. The 23 sampling stations are showed by red dots.

(*Phylloscopus collybita* (Vieillot, 1817)) from the family Phylloscopidae; Corn Bunting (*Emberiza calandra* Linnaeus, 1758)) from the family Emberizidae; Common Starling (*Sturnus vulgaris* Linnaeus, 1758), Common Mynah (*Acridotheres tristis* (Linnaeus, 1766)) from the family Sturnidae, (Common Blackbird *Turdus merula* Linnaeus, 1758) from the family Turdidae; Desert Finch (*Rhodospiza obsoleta* (Lichtenstein, MHC, 1823)), Fire-fronted Serin (*Serinus pusillus* (Pallas, 1811)), Common chaffinch (*Fringilla coelebs* Linnaeus, 1758) from the family Fringillidae; Great Tit (*Parus major* Linnaeus, 1758), Blue Tit (*Cyanistes caeruleus* Linnaeus, 1758) from the family Paridae; Crested Lark (*Galerida cristata* (Linnaeus, 1758)) from the family Alaudidae; (Red-breasted Flycatcher *Ficedula parva* (Bechstein, 1792), European Robin *Erithacus rubecula* (Linnaeus, 1758), Eastern Pied Wheatear *Oenanthe picata* (Blyth, 1847), Pied Wheatear *Oenanthe pleschanka* (Lepechin, 1770), Black Redstart *Phoenicurus ochruros* (Gmelin, SG, 1774) from the family Muscicapidae; Common Magpie (*Pica pica* (Linnaeus, 1758)) from the family Corvidae; White Wagtail (*Motacilla alba* Linnaeus, 1758) from the family Motacillidae, Golden Oriol (*Oriolus oriolus* (Linnaeus, 1758)) from the family Oriolidae (Table 2).

Rhipicephalus sp. specimens were separated from the Paridae (Great Tit) (Table 3). *Rhipicephalus* specimens were damaged and the specimen belonging to the genus *Hyalomma* was in premarginal stage, therefore they only identified at the genus level. Ticks were located on the anterior part of the body, around the eyes, crown, and forehead.

The overall mean intensity and mean abundance were 4.6 and 0.95, respectively. The highest mean intensity, 12.18 ticks per bird, was recorded from Common Starling, followed by Common Chaffinch and European Robin with 1.71 and 1.66 per bird, respectively. The highest prevalence of infestation was recorded on Common Blackbird (53%). The most prevalence of tick infestation occurred in the Turdidae family (37.83%) followed by Passeridae (33.33%) and Sturnidae (28.57%).

In order to evaluate the association between trophic guild, feeding habitats and their migrant guild with tick infestation, Fisher's exact and Chi-square tests were performed. Feeding habitats and their migrant guild represented significant association with tick infestation (P= 0.02 and P= 0.03 respectively, P< 0.05) but no association was observed between trophic guild and tick infestation (P= 0.217, P> 0.05).

DISSCUSSION

In the past few decades, there has been a surge of interest in research on ticks. This increasing interest is because of their economic and medically importance as vectors of dangerous diseases to animals and humans (Aeschlimann et al., 1979; Estrada-Peña et al., 2018). In these studies, birds with their flying capability and their essential roles in transportation and spreading ticks and tick-borne diseases to new areas have drawn more attention compared to other vertebrate hosts (Loss et al., 2016; Ogden et al., 2008; Smith et al., 1996). However, the study of ticks associated with wild birds has been neglected in Iran.

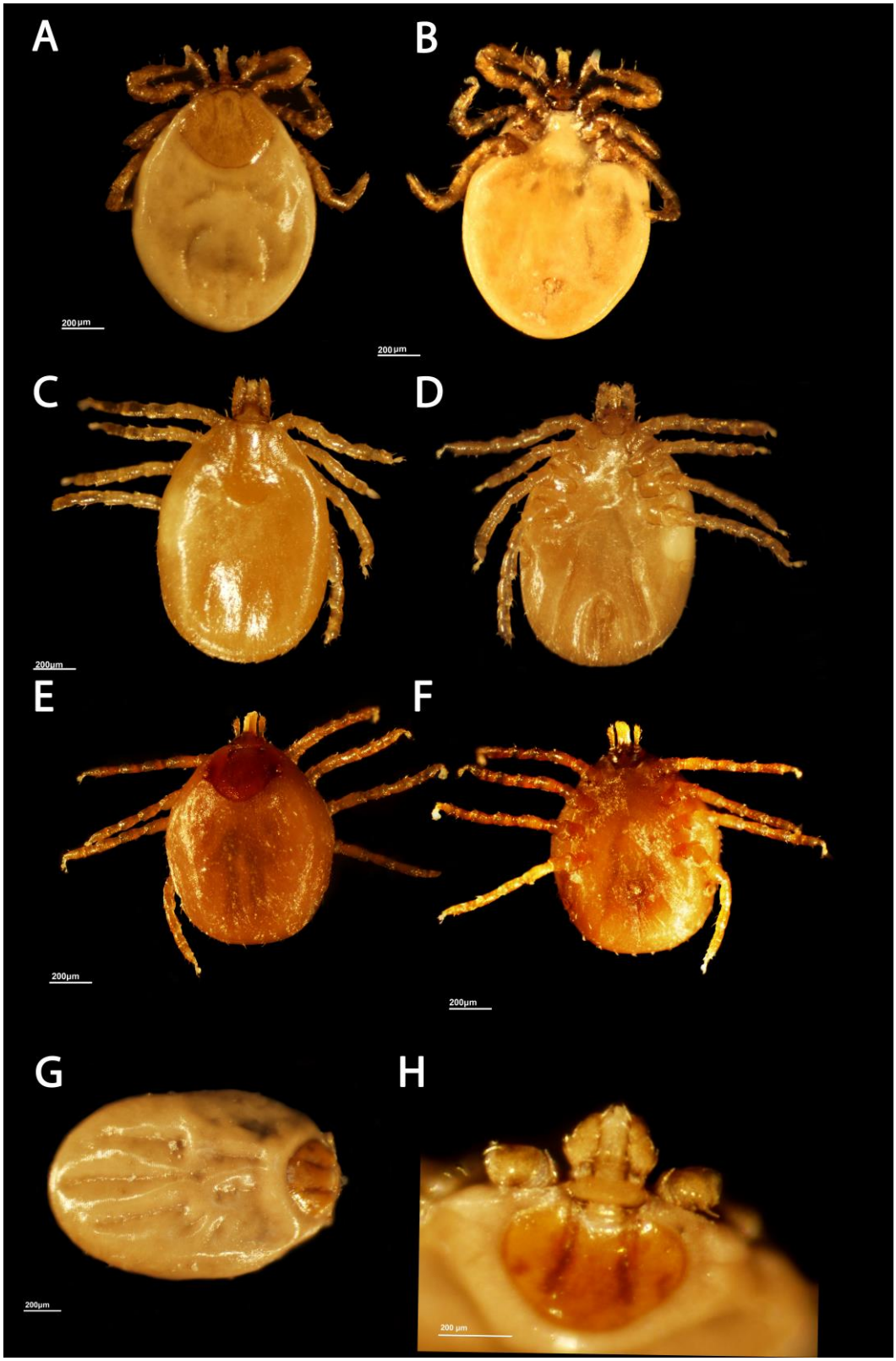

FIGURE 2. *Ixodes ricinus* larva: A. dorsal view, B. ventral view; *Ixodes ricinus* nymph: C. dorsal view, D. ventral view; *Hyalomma* sp. nymph: E. dorsal view, F. ventral view; *Rhipicephalus* sp. larva: G. dorsal view, H. Basis capituli and scutum (200 µm).

In the current study, ticks infesting songbirds were investigated in the north of Iran, which is a contact zone hotspot of songbirds (Aliabadian et al., 2005). This study reports three ixodid ticks, including *I. ricinus*, *Hyalomma* sp. and *Rhipicephalus* sp. from 70 out of 342 examined songbirds. Birds, especially songbirds are known as the host of ticks in subadult stages (Humair et al., 1993; Fourie et al., 2006; Ogrzewalska et al., 2010; da Cunha Amaral et al., 2013; Maturano et al., 2015).

In this study, only larval and nymphal stages were found on examined birds, and no adult ticks were found. The genus *Ixodes* are known as commonly or even exclusively parasitizing birds especially immature stages, which this study corroborates (Klaus et al., 2016; Papadopoulos et al., 2001). The most common tick species collected in this study was *I. ricinus*, constituted 94% (323 of 342) of all collected ticks. The previous studies have been reported it on domestic ruminant in northern mountain slopes and humid and lower hills of Caspian Sea from spring to autumn (Abbassian-Lintzen, 1960; Hoogstraal & Valdez, 1980; Hosseini-Vasoukolaei et al., 2014; Hosseini-Chegeni et al., 2019; Nabian et al., 2007; Razmi et al., 2007; Vahedi-Noori et al.,2012). *I. ricinus* has also been collected from foxes in the north and northwest of Iran (Meshgi et al. 2009). This species is known as one of the most critical vectors of many of Europe's tick-borne diseases and as telotropic parasite, in immature stages feed on small mammals, birds and, lizards and in adult stage prefer large mammals (Estrada-Peña et al., 2018). Our study showed that *I. ricinus* infestation rate was 20.46% (parasitize 70 examined birds), which is considerable in comparison with other tick infestation rates (*Hyalomma* sp. *and Rhipicephalus* sp. 1.71%). Birds, especially songbirds, have been frequently introduced in various studies as an obvious host for immature *I. ricinus* (Ciebiera et al., 2019; Humair et al., 1993). In this study, both nymphal and larval stages of *I. ricinus* have been reported, but the larval stage was more frequent on songbirds (nymphal/larval ratios 0.24, 63 nymphs and 260 larvae).

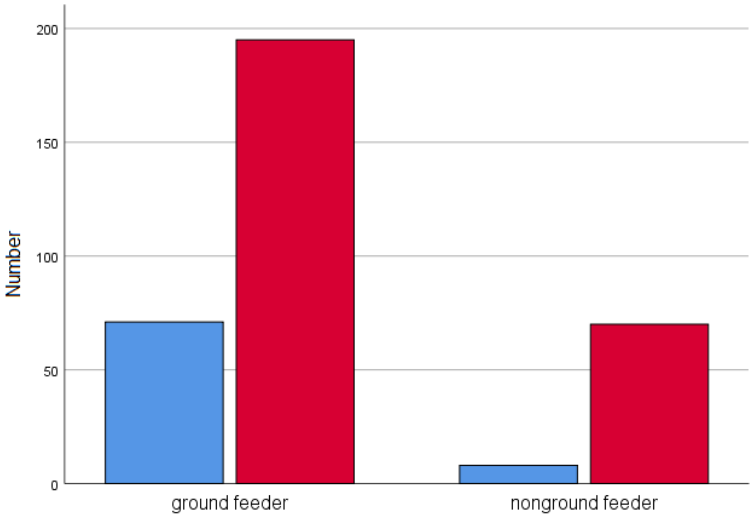

FIGURE 3. Number of infested and non-infested birds in relation to their feeding behaviour, Red: Positive tick infestation, Blue: Negative tick infestation (P = +0.002, P < 0.05).

Common Blackbird (*Turdus merula*) has shown the highest prevalence of tick infestation (53%), followed by House Sparrow (*Passer domesticus*) (35.5%), which is consistent with the results of James et al. (2011). The highest prevalence of tick infiestaion in these hosts depends mainly on their high degree of feeding on the ground (Klaus et al., 2016). In Europe, Japan, Russia, Common Blackbird also have been reported as the most important hosts for harbouring ticks (Hasle, 2013). The highest mean intensity of infestation for *I. ricinus* was recorded on Common Starling (*Sturnus vulgaris*) (12.18 ticks per bird). The cause of the high amount of mean intensity in Common Starling was infestation of one individual by 106 tick specimens.

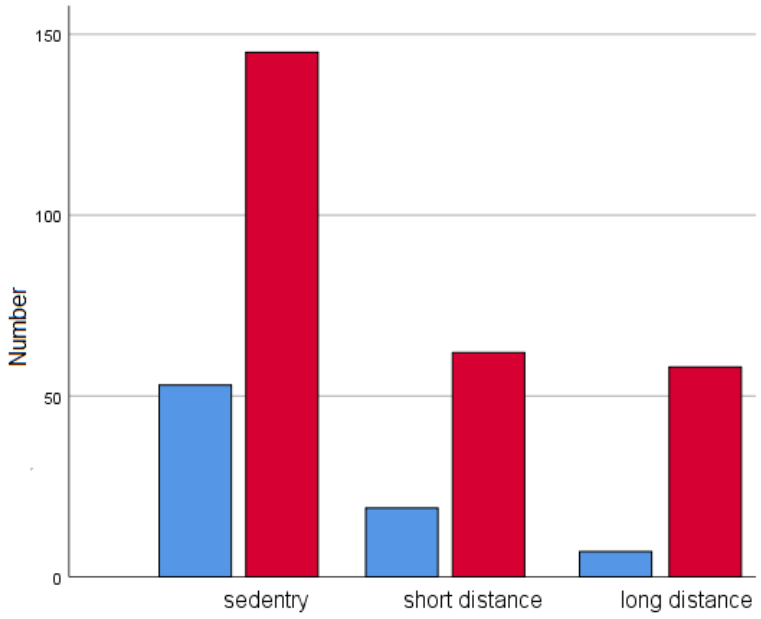

FIGURE 4. Number of infested and non-infested birds to *Ixodes ricinus* in relation to their migrating behaviour, Red: Positive tick infestation, Blue: Negative tick infestation (P = +0.029, P < 0.05).

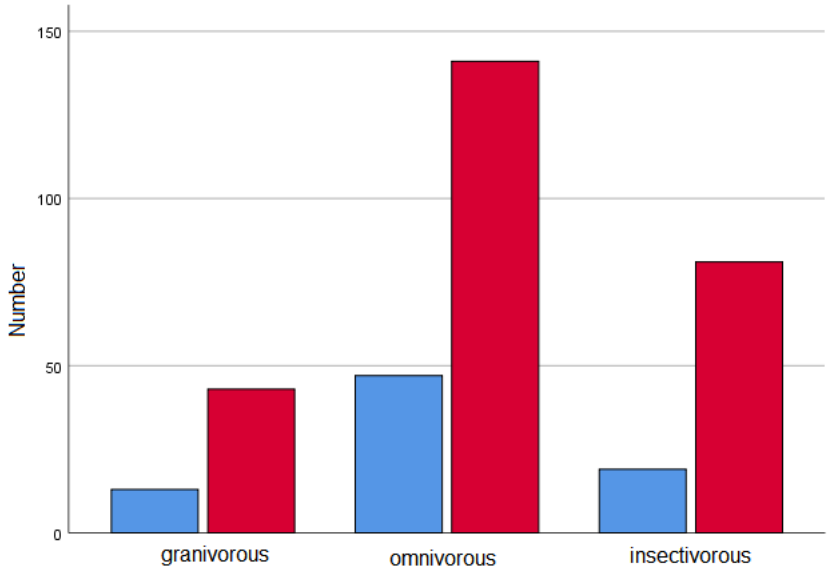

FIGURE 5. Number of infested and non-infested birds in relation to their trophic guild, Red: Positive tick infestation, Blue: Negative tick infestation (P = +0.514, P > 0.05)

The most prevalent tick infesting songbirds was reported in the Turdidae family that is in line with previous studies (Aeschlimann et al.,1974; Humair et al.,1993). In this study, the occurrence of *I. ricinus* on Rock Sparrow, Chestnut-shouldered Petronia, Eastern Olivaceous Warbler, Corn Bunting, Common Mynah, Desert Finch, Red-breasted Flycatcher is documented for the first time.

According to previous studies, ground feeder birds and the birds which nest on the ground are more exposed to tick infestations than nonground feeder birds or the bird's nest on the top of the trees [7, 9, 56] (Brinck et al., 1965; Cohen et al., 2015; Wang & Moore, 2005). Our study confirmed that differences between tick infestation rates for ground feeder birds (25.75%) and non-ground feeder (10.25%) were more than twice as much. Differences between these two groups of birds were statistically significant ($P< 0.05$) (Fig. 3).

The data presented here showed that the total *I. ricinus* infestation rate for sedentary birds (26.39%) was more than migratory birds (16.55%) (Fig. 4). It was predictable because sedentary birds are more likely to be exposed to ticks. It is in agreement with the results of Klaus et al. (Klaus et al., 2016) in Germany.

The statistical analysis showed that no association was observed between the probability of infestation by ticks and trophic guild, (Fig. 5). In previous studies, diet alone was presented as a weak component for the probability of tick infestation rate (Kolonin, 2008; Marini et al., 1996).

The species of the genus *Hyalomma* are predominantly infesting mammals. Only some species of this genus in immature stages parasitize ground feeding birds (Apanaskevich, 2004). A larva identified as *Hyalomma* sp. was recorded on Corn Bunting in the current study.

Of 37 studied species here, 11 species carried no ticks, including: Pale Rock Sparrow, Booted Warbler *Iduna caligata* (Lichtenstein, MHC, 1823), Clamorous Reed Warbler *Acrocephalus stentoreus* (Hemprich & Ehrenberg, 1833), Greater Whitethroat *Sylvia communis* Latham, 1787, Red-headed Bunting *Emberiza bruniceps* von Brandt, 1841, Eurasian Nuthatch *Sitta europaea* Linnaeus, 1758, Mourning Wheatear *Oenanthe lugens* , Hume's Wheatear, European Greenfinch *Carduelis chloris* (Linnaeus, 1758), Lesser Short-toed Lark *Calandrella rufescens* (Vieillot, 1819), Barn Swallow *Hirundo rustica* Linnaeus, 1758, Carrion Crow *Corvus corone* Linnaeus, 1758 carried no ticks maybe because of being in environment that they were not exposed to ticks.

Our study improved our knowledge about songbirds as transmitter of ticks and effects of their migrating and feeding behaviours on tick infestation rates. According to data presented here, some songbird species introduced as new hosts of some tick species in the world. It seems that Iran, with a relatively high amount of diversity in different wild bird species, especially songbirds might provide good cases for reporting new records of tick fauna for Iran and the Middle East.

ACKNOWLEDGMENTS

This study was supported by the Office of Research Affairs, Ferdowsi University of Mashhad, Iran (Project 3/40050), which is gratefully acknowledged. We thank Dr. Asadollah Hosseini Chegeni for their collaborations in this project. We also wish to thank Dr. Sahar Javaheri Tehrani and Somayeh Pourebrahimi.

LITERATURE CITED

Abbassian-Lintzen, R., 1960. A preliminary list of ticks (Acariña: Ixodoidea) occurring in Iran and their distributional data. Acarologia 2(1), pp. 43-61

Aeschlimann, A., Vaucher, C. and Mermod, C., 1974. The role of birds in the life cycle of *Ixodes Ricinus* (L.) in a low marsch forest of Switzerland. In ICOPA III Proceedings pp. 949-950

Aeschlimann, A., Burgdorfer, W., Matile, H., Péter, O. and Wyler, R., 1979. Aspects nouveaux du rôle de vecteur joué *par Ixodes ricinus* L. en Suisse. Note préliminaire. Acta Tropica 36, pp. 181-191.

Aghighi, Z., Assmar, M., Piazak, N., Javadian, E., Seyedi, R.M., Kia, E.B., Rassi and Y., Vatandoost, H., 2007. Distribution of soft ticks and their natural infection with *Borrelia* in a focus of relapsing fever in Iran. Arthropod-Borne Diseases 1, 14-18.

Aliabadian, M., Roselaar, C.S., Nijman, V., Sluys, R. and Vences, M., 2005. Identifying contact zone hotspots of passerine birds in the Palaearctic region. Biology Letters 1(1), pp. 21-23.

Apanaskevich, D.A., 2004. Host-parasite relationships of the genus *Hyalomma* Koch, 1844 (Acari, Ixodidae) and their connection with microevolutionary process. Parazitologiia 38(6), pp. 515-523.

Brinck, P., Svedmyr, A. and von Zeipel, G., 1965. Migrating birds at Ottenby Sweden as carriers of ticks and possible transmitters of tick-borne encephalitis virus. Oikos 16, 88-99.

Ceylan, O., Xuan, X. and Sevinc, F., 2021. Primary tick-borne protozoan and rickettsial infections of animals in Turkey. Pathogens, 10(2), p.231.

Ciebiera, O., Jerzak, L., Nowak-Chmura, M. and Bocheński, M., 2019. Ticks (Acari: Ixodida) on birds (Aves) migrating through the Polish Baltic coast. Experimental and Applied Acarology 77(2), pp. 241-251.

Cohen, E.B., Auckland, L.D., Marra, P.P. and Hamer, S.A., 2015. Avian migrants facilitate invasions of Neotropical ticks and tick-borne pathogens into the United States. Applied and Environmental Microbiology 81(34), pp. 8366-8378.

Cupp, E.W., 1991. Biology of ticks. The veterinary clinics of North America small animal practice 21(1), pp. 1-26.

da Cunha Amaral, H.L., Bergmann, F.B., dos Santos, P.R.S., Krüger, R.F. and Graciolli, G., 2013. Community of arthropod ectoparasites of two species of *Turdus* Linnaeus, 1758 (Passeriformes: Turdidae) in southern Rio Grande do Sul, Brazil. Parasitology Research 112(2), pp. 621-628.

Hasle, G., 2011. Dispersal of ticks and tick-borne pathogensby birds: Dynamics of birds' transport of ticks to Norway.

Hoyo, J.D., Elliott, A., Sargatal, J. and Cabot, J., 1992. Handbook of the birds of the world, Lynx edicions, Barcelona, Spain, p. 812.

Deply, L., 1936. Notes sur les Ixodidés du ge-nere *Hyalomma* (Koch). Annales de Parasitologie Humaine et Comparee 14(3), pp.206-245.

Dickinson, E.C. and Christidis, L., 2014. The Howard & Moore complete checklist of the birds of the world: Passerines, vol. 2. 4th ed. Aves Press, London.

Estrada-Peña, A., Mihalca, A.D. and Petney, T.N., 2018. Ticks of Europe and North Africa: a guide to species identification, Springer, P. 348.

Filippova, N.A, 1977a. Arachnida class: ixodid ticks of the subfamily Ixodinae. Fauna SSSR Paukoobraznye, p. 316.

Filippova, N.A., 1997b. Ixodid ticks of subfamily Amblyomminae. Fauna of Russia and neighbouring countries, Nauka Publishing House, St. Petersburg.

Fourie, L., Horak, I. and Van Niekerk, D., 2006. Birds as hosts of immature ixodid ticks in Free State Province, South Africa. Onderstepoort Journal of Veterinary Research 73(2), pp. 123-130.

Guglielmone, A.A., Robbins, R.G., Apanaskevich, D.A., Petney, T.N., Estrada-Peña, A. and Horak, I.G., 2014. The hard ticks of the world, Springer, Dordrecht 10, pp. 978-994.

Guglielmone, A.A. and Robbins, R.G., 2018. Hard Ticks (Acari: Ixodida: Ixodidae) Parasitizing Humans. Cham: Springer, p.230.

Janbakhsh, B., 1956. Studies on tick vectors of relapsing fever in Iran, report of institute parasitology and malariology. Tehran Iran, Report of the Institute Parasitology & Malarialogy p. 33 (In Persian)

Hasle, G., 2013. Transport of ixodid ticks and tick-borne pathogens by migratory birds. Frontiers in Cellular and Infection Microbiology 3, p. 48.

Hoogstraal, H. and Wassef, H.Y., 1979. *Haemaphysalis* (*Allophysalis*) *Kopetdaghica*: identity and discovery of each feeding stage on the wild goat in northern Iran (Ixodoidea: ixodidae). The Journal of Parasitology pp. 783-790.

Hoogstraal, H. and Aeschlimann, A., (1982) Tick-host specificity. Bulletin de la société entomologique suisse 55 pp. 5-32.

Hoogstraal, H., Valdez, R., 1980. Ticks (Ixodoidea) from wild sheep and goats in Iran and medical and veterinary implications. Fieldiana Zoology 6, pp. 1-16.

Hosseini-Vasoukolaei, N., Oshaghi, M.A., Shayan, P., Vatandoost, H., Babamahmoudi, F., Yaghoobi-Ershadi, M.R., Telmadarraiy, Z. and Mohtarami, F., 2014. Anaplasma infection in ticks, livestock and human in Ghaemshahr, Mazandaran Province, Iran. Journal of Arthropod-Borne Diseases 8(2), p. 204.

Hosseini-Chegeni, A., Tavakoli, M. and Telmadarraiy, Z., 2019. The updated list of ticks (Acari: Ixodidae & Argasidae) occurring in Iran with a key to the identification of species. Systematic and Applied Acarology 24(11), pp. 2133-2166.

Humair, P.F., Turrian, N., Aeschlimann, A. and Gern, L., 1993. *Ixodes ricinus* immatures on birds in a focus of Lyme borreliosis. Folia Parasitologica 40, 237-242.

James, M.C., Furness, R.W., Bowman, A.S., Forbes, K.J. and Gilbert, L., 2011. The importance of passerine birds as tick hosts and in the transmission of *Borrelia burgdorferi*, the agent of Lyme disease: a case study from Scotland. Ibis 153(2), pp. 293-302.

Kamali, K., Ostovan, H. and Atamehr, A., 2001. A catalog of mites and ticks (Acari) of Iran, Islamic Azad University Scientific Publication Center, pp. 192.

Klaus, C., Gethmann, J., Hoffmann, B., Ziegler, U., Heller, M. and Beer, M., 2016. Tick infestation in birds and prevalence of pathogens in ticks collected from different places in Germany, Parasitology Research 115(7):2729-2740.

Kleinjan, J.E. and Lane, R.S., 2008. Larval keys to the genera of Ixodidae (Acari) and species of *Ixodes* (Latreille) ticks established in California. The Pan-Pacific Entomologist 84(2), p. 121.

Kolonin, G., 2008. Birds as hosts of ixodid ticks (Acarina, Ixodidae). Entomological Review 88(8), pp. 1012-1015.

Lafferty, K., Shostak, A., Bush, A. and Lotz. J., 1997. Parasitology meets ecology on its own terms: Margolis et al. Journal of Parasitology 83, 575-583.

Loss, S.R., Noden, B.H., Hamer, G.L. and Hamer, S.A., 2016. A quantitative synthesis of the role of birds in carrying ticks and tick-borne pathogens in North America. Oecologia 182(4), pp. 947-959.

Labuda, M. and Nuttall, P.A., 2008. Viruses transmitted by ticks. Ticks: biology, disease and control, pp.253-280.

Marini, M.Â., Reinert, B.L., Bornschein, M.R., Pinto, J.C. and Pichorim, M.A., 1996. Ecological correlates of ectoparasitism on Atlantic Forest birds, Brazil. Ararajuba 4(2), pp. 93-102.

Maturano, R., Faccini, J.L., Daemon, E., Fazza, P.O. and Bastos, R.R., 2015. Additional information about tick parasitism in Passeriformes birds in an Atlantic Forest in southeastern Brazil. Parasitology Research 114(11), pp. 4181-4193.

Mazlum, Z., 1968. *Hyalomma asiaticum asiaticum* Schülze and Schlottke, 1929. Its distribution, hosts, seasonal activity, life cycle, and role in transmission of bovine theileriosis in Iran. Acarologia 10(3), pp. 437-442.

Mazlum, Z., 1971. Different ticks occurring in Iran (geographical distribution, seasonal activities, hosts). Faculty Veterinary Medicine of Tehran, Iran, 27, pp. 1–32.

Meshgi, B., Eslami, A., Bahonar, A., Kharrazian-Moghadam, M. and Gerami-Sadeghian, A., 2009. Prevalence of parasitic infections in the Red Fox (*Vulpes vulpes*) and Golden Jackal (*Canis aureus*) in Iran. Iranian Journal of Veterinary Research 10(4), pp. 387-391.

Nabian, S., Rahbari, S., Shayan, P. and Haddadzadeh, H., 2007. Current status of tick fauna in north of Iran. Iranian Journal of Parasitology pp. 12-17.

Nekoui, H., Assmar, M., Amirkhani, A. and Pyazak N., 1999. Distribution of ticks and their association with *Borrelia* in Semnan province. Iranian Journal of Public Health 28(1-4), pp. 103-109.

Nosek, J. and Sixl, W., 1972. Central-European ticks (Ixodoidea). Mitteilungen der Abteilung fu¨r Zoologie an Landesmus Joanneum 2, pp. 61–92.

Nicholson, W.L., Paddock, C.D., Brunette, G.W. and Nemhauser, J.B., 2019. Rickettsial diseases (including spotted fever & typhus fever rickettsioses, scrub typhus, anaplasmosis, and ehrlichioses). CDC yellow book. Centers for Disease Control and Prevention, Atlanta, GA.

Ogden, N.H., Lindsay, L.R., Hanincová, K., Barker, I.K., Bigras-Poulin, M., Charron, D.F., Heagy, A., Francis, C.M., O'Callaghan, C.J. and Schwartz, I., 2008. Role of migratory birds in introduction and range expansion of *Ixodes scapularis* ticks and of *Borrelia burgdorferi* and *Anaplasma phagocytophilum* in Canada. Applied and Environmental Microbiology 74(6), pp. 1780-1790.

Ogrzewalska, M., Uezu, A. and Labruna, M.B., 2010. Ticks (Acari: Ixodidae) infesting wild birds in the eastern Amazon, northern Brazil, with notes on rickettsial infection in ticks. Parasitology Research 106(4), pp. 809-816.

Papadopoulos, B., Humair, P., Aeschlimann, A., Vaucher, C. and Büttiker, W., 2001. Ticks on birds in Switzerland. Acarologia 42(1), pp. 3-19.

Parola, P. and Raoult, D., 2001. Ticks and tickborne bacterial diseases in humans: an emerging infectious threat. Clinical infectious diseases, 32(6), pp.897-928.

Pérez-Eid, C., 2007. Les Tiques: Identification, Biologie, Importance Médicale Et Vétérinaire. Tec & Doc, Lavoisier, Paris.

Perry, B., 2001. The Genus *Rhipicephalus* (Acari: Ixodidae)-A Guide to the Brown Ticks of the World-Jane B. Walker, James E. Keirans, Ivan G. Horak; Cambridge University Press, Cambridge. Preventive Veterinary Medicine, 3(49), pp. 281-283.

Piazak, N., 1991. Preliminary studies on the presence of Lyme disease in Iran through the study of *Ixodes ricinus* population. [master's thesis]. School of Public Health & Institute of Health Research, Tehran University of Medical Sciences p. 158

Porter, R. and Aspinall, S., 2016. Birds of the Middle East. Bloomsbury Publishing.

Rahbari, S., Nabian, S. and Shayan, P., 2007. Primary report on distribution of tick fauna in Iran. Parasitology Research 101(2) pp. 175-177.

Razmi, G.R., Glinsharifodini, M. and Sarvi, S., 2007. Prevalence of ixodid ticks on cattle in Mazandaran province, Iran. The Korean Journal of Parasitology 45(4), p. 307.

Smith Jr, R.P., Rand, P.W., Lacombe, E.H., Morris, S.R., Holmes, D.W. and Caporale, D.A., 1996. Role of bird migration in the long-distance dispersal of *Ixodes dammini*, the vector of Lyme disease. The Journal of Infectious Diseases.174(1), pp. 221-224.

Tavakoli, M., 1997. Survey on geographical distribution of ticks in Lorestan province (western Iran) [master's thesis]. Department of Parasitology and Entomology, Tarbiat Modares University, Tehran, Iran.

Telmadarraiy, Z., Bahrami, A. and Vatandoost, H., 2004. A survey on fauna of ticks in West Azerbaijan Province, Iran. Iranian Journal of Public Health 33(4), pp. 65-69.

Vahedi-Noori, N., Rahbari, S. and Bokaei, S., 2012. The seasonal activity of *Ixodes ricinus* tick in Amol, Mazandaran Province, Northern Iran. Journal of Arthropod-Borne Diseases 6(2), p. 129.

Wang, Y. and Moore, R., 2005. Long-distance bird migrants adjust their foraging behavior in relation to energy stores. Acta zoologica Sinica 51(1), pp. 12-23.

Iranian Journal of Animal Biosystematics (IJAB)
Vol.18, No.1, 93-100, 2022
DOI: 10.22067/ijab.2022.74136.1022

IJAB
ISSN: 1735-434X (print); 2423-4222 (online)

RESEARCH ARTICLE Open access

A rare species, *Rhiza stenoptera* (Boursin, 1970) new record from Iran with a catalogue of Pseudohadenina Ronkay & Fibiger, 2007 of Iran

Asghar Shirvani
Department of Plant Protection, Faculty of Agriculture, Shahid Bahonar University of Kerman, Kerman, Iran

(Received: *12 December 2021*; Accepted: *8 October 2022*)

Abstract
Based on the examination of the materials collected by LED light trap in 2021, from south of Iran (Kerman province), a rare moth species belonging to Xyleninae subfamily (Lepidoptera, Noctuidae), *Rhiza stenoptera* (Boursin), is newly recorded for the country. The external and the genital characters of this species are presented and compared with its close relatives, *R. schlumbergeri* (Püngeler), collected from Sistan-va-Balouchestan province, Iran and *R. commoda*, a widely distributed species in the Palearctic region. Notes on the bionomic and distribution of *R. stenoptera* are given. The taxonomic position of *Pseudohadena* Alphéraky, s. l. has been changed through the time with the increase of the materials described mainly collected from Central Asia which was resulted in erecting the Pseudohadenina Ronkay & Fibiger, 2007. An inclusive catalogue of Pseudohadenina of Iran is presented. Beside the citation of first description, the distribution range of the members of this subtribe is given worldwide.

Key words: *catalogue, Iran, new record, Pseudohadenina, Rhiza.*

INTRODUCTION

The subtribe Pseudohadenina Ronkay & Fibiger, 2007 belongs to tribe Xylenini Guenée, 1837 and subfamily Xyleninae Guenée, 1837. This subtribe comprises eight genera including *Pseudohadena* Alphéraky, 1889; *Rezahiria* G. Ronkay, Ronkay & Gyulai, 2014; *Rhiza* Staudinger, 1889; *Eremohadena* Ronkay, Varga & Fábián, 1995; *Orohadena* Ronkay, Varga & Gyulai, 2002; *Scotocampa* Staudinger, 1888; *Lanatopyga* Gyulai & Ronkay, 2002 and *Palaeagrotis*, Hampson, 1907.

Since 1989, the taxonomic position and rank of different lineages of the genus *Pseudohadena* s. l. has been undergone massive and rapid changes with finding and describing new species mainly by Hungarian lepidopterists (e.g.: Ronkay & Varga, 1989; Yela & Ronkay, 1992; Ronkay & Varga, 1993; Ronkay *et al.*, 1995; Ronkay *et al.*, 2002). The first revised checklist of *Pseudohadena* and its species groups was published, based upon on the external and genital features, as a result of a revisional study by Ronkay and Varga, 1993 introducing 11 species-group for this genus. Having studied the materials from Central Asia, Ronkay *et al.* (1995) re-revised the genus *Pseudohadena* s. str. and introduced three subgenera: *Pseudohadena* Alphéraky, 1889; *Pseudopseustis* Hampson, 1910 and *Jaxartia* Püngeler, 1914. Splitting the formerly genus *Pseudohadena*, they also erected two new genera, *Eremohadena* for the *siri*-group and *Graphantha* Ronkay, Varga & Fábián, 1995 for the *laciniosa*- and the *commoda*-groups.

In a phylogenetically attempt to evaluate the supra-specific characters of *Pseudohadena* and its related genera, Ronkay *et al.* (2002) revised the groups of this generic group and re-evaluated the taxonomical ranking of the supra-specific taxa. They established *Orohadena* as a new genus and

Corresponding Author: shirvani@uk.ac.ir

Megahadena Ronkay, Varga & Gyulai, 2002 and *Bryohadena* Ronkay, Varga & Gyulai, 2002 as two new subgenera for *Eremohadena* and *Orohadena* respectively.

In order to remain the genus *Pseudohadena* as a monophyletic group, *Eremohadena* and *Graphantha* were downgraded to the subgenera of *Pseudohadena* by Fibiger and Hacker (2005). The next and so far stable phylogenetic study on this generic group was presented by Fibiger and Hacker (2007) establishing Pseudohadenina as a new subtribe that together with Antitypina Forbes & Franclemont, 1954 and Xylenina Guenée, 1837 form a large monophyletic group within tribe Xylenini Guenée, 1837. They presented a correction on Ronkay *et al.* (1995) and replaced the genus *Rhiza* for *Rhiza commoda* Staudinger, 1889. They upgraded *Eremohadena* to the genus level and erected *Iberihadena* Fibiger & Ronkay, 2007 as its new subgenus. The Central Asian genus, *Palaeagrotis* Hampson, 1907 was later added to Pseudohadenina by Volynkin (2012) and the eighth Pseudohadenina genus *Rezahiria* from Iran was established by Ronkay *et al*. (2014).

The Eurasiatic genus *Rhiza* comprises three subgenera *Rhiza*, *Gryphadena* and *Graphantha* with eremic, univoltine species. This genus is represented in Iran by five species; *Rhiza commoda* Staudinger, 1889, *Rhiza schlumbergeri* (Püngeler, 1905), *Rhiza stenoptera* (Boursin, 1970), *Gryphadena minuta sengana* (Brandt, 1941) and *Graphantha laciniosa* (Christoph, 1887). The present paper contains the report of a rare species of the genus *Rhiza*, *R. stenoptera*, from south of Iran, Kerman province. In addition, the catalogue of Pseudohadenina of Iran is presented.

MATERIAL AND METHODS

This study is based on the examination of the materials collected by LED light trap (with 24 UV, one blue, one green and one white LEDs arranged on a three-dimension structure, powered by 12-V batteries) in May, 2021 from Sirch Mountains, southeastern of Kerman (Iran) and the materials deposited in the collection of Noctuidae, Shahid Bahonar University of Kerman (Kerman) as well. The genitalia slide of the specimens were prepared following Fibiger (1990). The specimens were photographed by a Canon digital camera (Power Shot A710) and the photographs of the genitalia were taken by an Olympus SZH stereo-microscope with an Omax (18Mp) A35180U3 digital camera.

RESULTS

Subtribus Pseudohadenina Ronkay & Fibiger, 2007
Type genus: *Pseudohadena* Alphéraky, 1889

Genus *Pseudohadena* Alphéraky, 1889

Type species: *Hadena armata* Alphéraky, 1887
Subgenus *Jaxartia* Püngeler, 1914
Type species: *Hadena armata* Alphéraky, 1887

evanida species-group

***Pseudohadena zahedana* Shirvani & Ronkay, 2008**
Pseudohadena zahedana Shirvani & Ronkay, 2008, *Esperiana* 14: 578. L. t.: Iran, Sistan-va-Balouchestan.
Distribution: Iran (Sistan-va-Balouchestan).

***Pseudohadena magnitudinis* Hacker & Ebert, 2002**
Pseudohadena magnitudinis Hacker & Ebert, 2002, *Esperiana* 9: 256. L. t.: Iran, Esfahan.
Distribution: Iran (Esfahan).

***Pseudohadena pseudamoena* Boursin, 1943**
Pseudopseustis pseudamoena Boursin, 1943, *Revue France de Ent.*10: 81. L. t.: Armenia, Julfa.

Distribution: Armenia, Iran (Golestan, Khorasan-e-Shomali (Wieser & Stangelmaier, 2005)).

Genus *Rezahiria* G. Ronkay, Ronkay & Gyulai, 2014
Type species: *Rezahiria marmota* G. Ronkay, Ronkay & Gyulai, 2014
Rezahiria marmota G. Ronkay, Ronkay & Gyulai, 2014
Distribution: Iran (Esfahan (Ronkay et al., 2014)).

Genus *Rhiza* Staudinger, 1889
Type species: *Rhiza commoda* Staudinger, 1889
syn.: *Dysgraphhadena* L. Ronkay, Varga & Fábián, 1995

Subgenus *Rhiza* Staudinger, 1889
Type species: *Rhiza commoda* Staudinger, 1889

***Rhiza commoda* Staudinger, 1889**
Rhiza commoda Staudinger, 1889, *Stettiner Entomologische Zeitung* 50: 44. L. t.: Kyrgyzstan, Issyk-Kul.
syn.: *manifesta* Christoph, 1893
Distribution: Armenia, Turkey, Kyrgyzstan, Tajikistan, Kazakhstan, Turkmenistan, Afghanistan, Pakistan, southern Siberia, Mongolia (Fibiger & Hacker, 2007), Iran (Khorasan-e-Shomali (Gulteb & Wieser, 2002)).

***Rhiza schlumbergeri* (Püngeler, 1905)**
Pseudohadena schlumbergeri Püngeler, 1905, *Deutsche Entomologische Zeitschrift Iris* 17 (2): 265. L. t.: Kazakhstan, Zharkent.
Distribution: Kazakhstan, Turkmenistan, Tadjikistan, western China (Fibiger & Hacker, 2007), Iran (Sistan-va-Balouchestan).

***Rhiza stenoptera* (Boursin, 1970)**
Pseudohadena stenoptera Boursin, 1970, *Entomops* 18: 65, L. t.: Russia: Uralsk, Emba.
Distribution: Kazakhstan, Russia (Fibiger & Hacker, 2007), Iran (first record).

Subgenus *Gryphadena* Kusnezov, 1908
Type species: *Pseudohadena minuta* Püngeler, 1899

***Rhiza minuta sengana* (Brandt, 1941)**
Pseudohadena sengana Brandt, 1941, *Mitteilungen der Munchner Entomologischen Gesellschal* 31: 843. L.t.: Iran, Sistan-va-Balouchestan.
Distribution: Iran (Sistan-va-Balouchestan (type locality), Kerman).

Subgenus *Graphantha* Ronkay, Varga & Fábián, 1995
Type species: *Chloantha laciniosa* Christoph, 1887.

laciniosa species-group

***Rhiza laciniosa* (Christoph, 1887)**
Chloantha laciniosa Christoph, 1887, In: *Romanoff Mémoires sur les Lépidoptères* 3: 77. L.t.: Turkmenistan, Aschabad, Germob.
Distribution: Turkmenistan, Afghanistan (Shirvani *et al*., 2008), Iran (Kerman (Shirvani *et al*., 2008), Khorasan (Koçak & Kemal, 2014), Khorasan-e-Jonobi (Shahreyari-Nejad, *et al.*, 2018), Khorasan-e-Shomali (Gulteb & Wieser, 2002).

Genus *Eremohadena* Ronkay, Varga & Fábián, 1995
Type species: *Mamestra siri* Ershov, 1874

Subgenus *Eremohadena* Ronkay, Varga & Fábián, 1995
Type species: *Mamestra siri* Ershov, 1874

coluteae species-group

***Eremohadena coluteae coluteae* (Bienert, 1869)**
Luperina coluteae Bienert, 1869, *Lep. Ergebnisse Reise in Persien in den Jahren* 1858 und 1859, 35, L.t.: Iran.
syn.: *arvicola* (Christoph, 1887)
Distribution: Pakistan, Kyrgyzstan (Ronkay & Varga, 1993), Iran (Mazandaran (Ebert & Hacker, 2002), Khorasan-e-Shomali, Golestan (Gulteb & Wieser, 2002), Sistan-va-Balouchestan).

***Eremohadena coluteae banghaasi* (Bytinsky-Salz & Brandt, 1937)**
Pseudohadena banghaasi Bytinsky-Salz & Brandt, 1937, *The Entomologist's Record and Journal of Variation.*:49: 9, L.t.: Iran.
Distribution: Iran (Tehran (Bytinsky-Salz & Brandt, 1937)).

siri species-group

***Eremohadena siri* (Ershov, 1874)**
Mamestra siri Ershov, 1874, *In Fedtschenko, Reise in Turkestan*: 41. L. t.: Turkestan, Kisilkum.
Distribution: Uzbekistan, Iran (Khorasan, Mazandaran (Gulteb & Wieser, 2002)).

***Eremohadena roseotinctoides* (Poole, 1989)**
Pseudohadena roseotinctoides Poole, 1989, *Lepidopterorum Catalogus* 118 (2): 849. L. t.: Iran, Sistan-va-Balouchestan.
syn.: *roseotincta* (Brandt, 1941) (preoccupied)
Distribution: Iran (Tehran, Mazandaran, Sistan-va-Balouchestan, Kerman (Ebert & Hacker 2002)).

chenopodiphaga species-group

***Eremohadena chenopodiphaga chenopodiphaga* (Rambur, 1832)**
Mamestra chenopodiphaga Rambur, 1832, *Annales de Société Entomologique de France* 1832: 283, L. t.: France, Corsica.
syn.: *erubescens* Staudinger, 1901; *roseotincta* Turati, 1929
Distribution: This species is widespread from the Maghreb countries to Mongolia (Fibiger & Hacker, 2007), Iran (Tehran, Fars (Brandt, 1938)).

***Eremohadena afzalipouri* Shirvani, 2012**
Eremohadena afzalipouri Shirvani, 2012, *Journal of Insect Science* 12: 137. L. t.: Iran, Kerman.
Distribution: Iran (Kerman (Shirvani *et al.*, 2012)).

pexa species-group

***Eremohadena toerpexa* Ronkay & Gyulai, 2006**
Eremohadena toerpexa Ronkay & Gyulai, 2006, *Esperiana* 12: 218, L. t.: Iran, Khorasan.
Distribution: Iran (Khorasan-e-Shomali (Ronkay & Gyulai 2006)).

Subgenus *Iberihadena* Fibiger and Ronkay, 2007

Type species: *Pseudohadena mariana* E. de Lajonquiére, 1964

***Eremohadena immunis* (Staudinger, 1889)**
Luperina immunis Staudinger, 1889, *Stettiner Entomologische Zeitung* 50: 40, L. t.: Kirghizstan.
Distribution: Kirghizstan, Iran (Khorasan-e-Shomali, Golestan (Gulteb & Wieser, 2002)).

Subgenus *Megahadena* Ronkay, Varga and Gyulai, 2002
Type species: *Pseudohadena megaptera* Boursin, 1970

***Eremohadena rjabovi* (Boursin, 1970)**
Pseudohadena rjabovi Boursin, 1970, *Entomops Nice* 18: 66, L. t.: Iran. Armenia.
Distribution: Armenia (Boursin, 1970), Iran (Tehran, Alborz, Fars (Boursin, 1970), Qom (Ebert & Hacker 2002)).

***Eremohadena megaptera* (Boursin, 1970)**
Pseudohadena megaptera Boursin, 1970, *Entomops Nice* 18: 69, L. t.: Iran
Distribution: Afghanistan (Boursin, 1970), Iran (Mazandaran (Boursin, 1970)).

***Rhiza stenoptera* (Boursin, 1970)**
Pseudohadena stenoptera Boursin, 1970, *Entomops* 18: 65, L. t.: Russia: Uralsk, Emba.

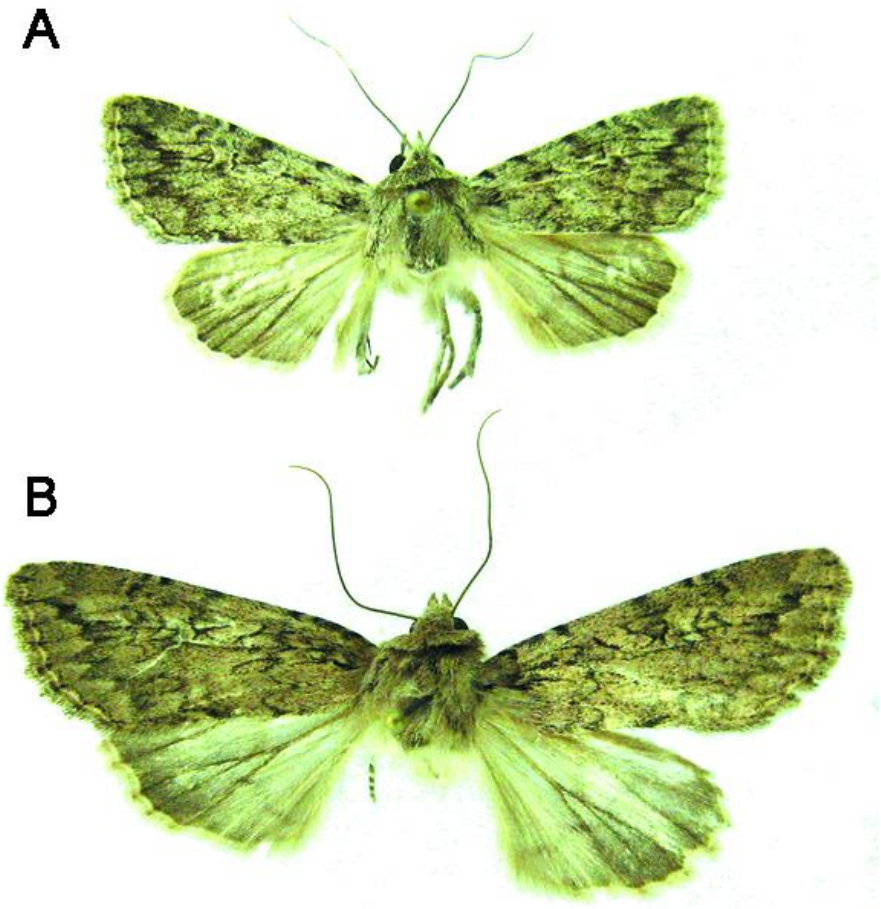

FIGURE 1. *Rhiza* spp., adults. A. *R. schlumbergeri* female, Iran, Sistan & Balouchestan, Taftan; B. *R. stenoptera* female, Iran, Kerman, Sirch., Elburz Mountains. Afghanistan, Iran.

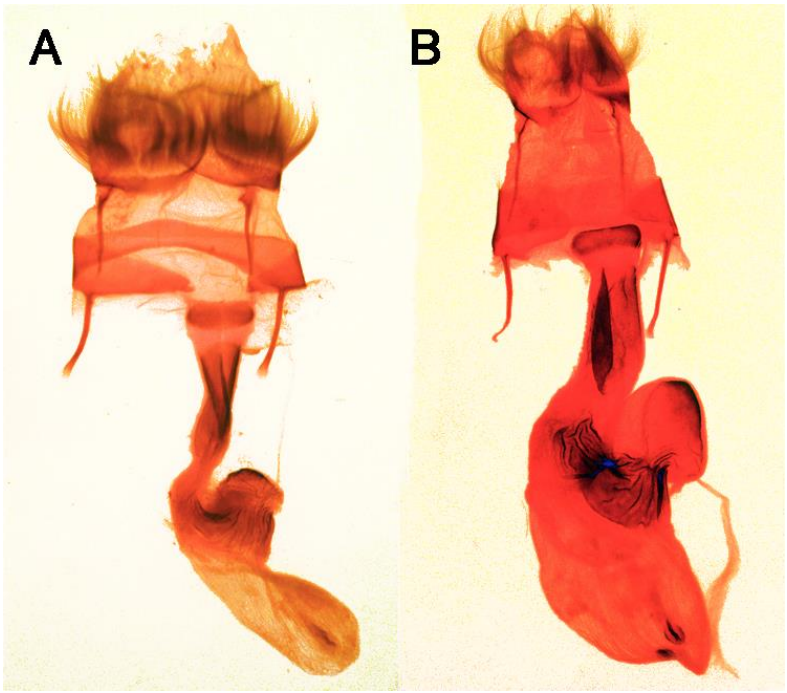

FIGURE 2. *Rhiza* spp., female genitalia. A. *R. schlumbergeri* Iran, Sistan & Balouchestan, Taftan; B. *R. stenoptera* Iran, Kerman, Sirch

FIGURE 3. Habitat of *R. stenoptera* Iran, Kerman, Sirch, S. Tunnel, 2681 m., 30°8′30″N 57°23′57″E, 25. May.2021.

Diagnosis: *R. stenoptera* differs from its close relative, *R. schlumbergeri* (figs. 1 A and 2 A), by its larger size, longer and less triangular forewing and in the female genitalia by the longer ovipositor, thinner and more sclerotized ostium bursae and shorter and thicker ductus bursae. The forewing ground color of *R. stenoptera* is pinkish light brown while that of *R. schlumbergeri* is olive light brown. The main difference, in the male genitalia, between these two species is the fully coiled vesica of *R. stenoptera* compared to the recurved vesica of *R. schlumbergeri*. Compared to *R. commoda*, *R. stenoptera* has larger

and narrower forewings, narrower ampulla, heavily sclerotized ostium bursae and fully coiled vesica. The differences among *R. stenoptera*, *R. schlumbergeri* and *R. commoda* are fully discussed by Fibiger and Hacker (2007).

Identification (fig. 1 B): female, wingspan 40 mm, forewing narrow. Antennae filiform, head small, eyes large, globular, palpi porrect, ventrally with long tufts. Head, collar, tegulae and forewing ground color light brown, that of wings softly pinkish. Forewing crosslines narrow, black basal dash present, noctuid maculation present, all outlined by dark brown, orbicular stigma doubled, fringes light brown. Hindwing light brown, basal two-third whitish, subterminal line fine, fringes white. Underside of forewing grey, that of hindwing whitish, subterminal line of both wings distinct.

Female genitalia (fig. 2 B). Ovipositor longer than wide, long apical setae present, gonapophyses slender, posterior apophyses longer than anterior ones. Ostium bursa narrow, rectangular, heavily sclerotized, ductus bursa short, posterior two-third heavily sclerotized, anteriorly rugulose, smoothly sclerotized. Corpus bursae ovoid, membranous, two short signum-bands present, appendix bursae short, ovoid-globular, heavily sclerotized, strongly rugulose basally.

Bionomics and distribution: This species was collected by a light trap in the foothills of a mountainous region. The plant coverage of its habitat (fig. 3) is constituted mainly by the bushes of *Artemisia* and scarcely by *Astragalus* species. The early stages and the larval food plants are unknown as yet. This species was previously reported from Kazakhstan, Russia (Boursin, 1970; Fibiger & Hacker, 2007).

Material examined: 1♀, Iran, Prov. Kerman, Sirch, S. Tunnel, 2681 m., 30°8′30″N 57°23′57″E, 25. May.2021, leg. Asghar Shirvani.

DISCUSSION

About 80 species and subspecies of Pseudohadenina are listed from Palearctic region. This subtribe is represented in Iran by 19 taxa (25% of all described taxa), of those, one genus (*Rezahiria*) and 10 species and subspecies have Iranian type locality. These eremic species have evolved in the desert, semi-desert and xeromontane biomes of Anatolia, Asia Minor, Central Asia and part of Himalaya (Fibiger and Hacker 2007).

Five members out of 18 *Rhiza* Palearctic taxa belonging to three subgenera (*Rhiza, Gryphadena* and *Graphantha*) are present in Iran, of those, *R. minuta sengana* has Iranian type locality. These species inhabit desert, semi-deserts and dry montane slopes. The distribution range of nominate *R. commoda* (Transcaucasia, Anatolia, Central Asia, and Himalaya) is the largest among the subgenus *Rhiza*, while *R. schlumbergeri* is distributed locally from Kazakhstan to west China eastward and to Iran southward. In contrast to the wide distribution range of *R. commoda*, *R. stenoptera* is restricted to the type locality (Uralsk), Kazakhstan and xerothermic rocky slopes of mountains in south of Iran. *R. laciniosa* populates arid biotopes of Turkmenistan, Afghanistan and Iran. The range of species is from northeast to southeast of Iran stretching from Khorasan-e-Jonobi to Kerman and Sistan-va-Balouchestan. Another Iranian species with local distribution range is *R. minuta sengana* reported from semi-desert habitats.

The biology of these univoltine species is poorly known. The early stages and the larval food-plants are unknown as yet. The information on their bionomics is restricted to the flight behavior that is, long summer diapause for the species inhabiting lower altitudes and active adults throughout the summer (Fibiger & Hacker, 2007) for those in high altitudes. The deficiency of information on the biology of this taxa, as well as most other noctuid moths, must be compensated by regulating expansive faunistic investigations in their habitats.

ACKNOWLEDGMENTS

This study is dedicated to the late Alireza Afzalipour (1909-1993) and his respected wife, Fakhereh Saba (1920-2007), the founders of Shahid Bahonar University of Kerman.

LITERATURE CITED

Boursin, C., 1970. Description de 40 espèces nouvelles de Noctuidae Trifinae palèarctiques et de deux genres nouveaux des sous-familles Noctuinae et Amphipyrinae. Entomops Nice 18, 45–79.

Bytinsky-Salz, H., Brandt, W., 1937. New Lepidoptera from Iran. Entomologist's Record 49 (Suppl.), 1–9.

Ebert, G., Hacker, H.H., 2002. Beitrag zur fauna der Noctuidae des Iran: Verzeichnis der bestandeim staatlichen Museum fur Naturkunde Karlsruhe, taxonomische bemerkungen und beschreibung neuer taxa. Esperiana 9, 237–409.

Fibiger, M., 1990. Noctuinae I. - Noctuidae Europaeae. Volume 1. - Entomological Press, Sorø, Denmark.

Fibiger, M., Hacker, H., 2005. Systematic list of the Noctuoidea of Europe (Notodontidae, Nolidae, Arctiidae, Lymantriidae, Erebidae, Micronoctuidae and Noctuidae). Esperiana 11, 93–205.

Fibiger, M., Hacker, H., 2007. Amphipyrinae, Condicinae, Eriopinae, Xyleninae. Noctuidae Europaeae, Vol. 9, Entomological Press, Soro, Denmark.

Gulteb, B., Wieser, CH., 2002. Ergebnisse einer zoologischen Exkursion in den Nordiran, 2001. *Carinthia* 2(192/112), 33–140.

Koçak, A.Ö., Kemal, M., 2014. Lepidoptera of Iran based upon the Info-system of the Cesa. Centre for Entomological Studies Ankara 31, 1015–8243.

Ronkay, L., Varga, Z., 1993. Taxonomic studies on the genera *Pseudohadena* Alphéraky, 1889 and *Auchmis* Hübner, (1821) (Lepidoptera: Noctuidae), part IV. Acta Zoologica Hungarica 39 (1-4), 211–248.

Ronkay, L., Varga, Z., Fábián, G., 1995. Taxonomic studies on the genus *Pseudohadena* Alpheraky, 1889, Part V. The revision of the genus *Pseudohadena* s. str. Acta Zoologica Hungarica 41, 251–282.

Ronkay, G., Ronkay, L., Gyulai, P., 2014. New Xyleninae and Psaphidinae species from Asia, with special reference to the Central and Inner Asiatic *Dasypolia* Guenée, 1852 (Lepidoptera, Noctuidae). Fibigeriana Supplement 2, 141–169.

Shahreyari-Nejad, S., Esfandiari, M., Rasekh, A., Mossadegh, M.S., Shirvani, A., 2018. New records of Noctuinae for Iran with additional distribution data (Lepidoptera: Noctuidae. SHILAP Revista de lepidopterología 46 (181), 145–155.

Shirvani, A., Kamali., K., Ronkay, L., Talebi, A.A., 2008. Taxonomic and Faunistic notes of certain Noctuidae species (Lepidoptera) for Iran. Esperiana 14, 565–571.

Shirvani, A., Sheykhnejad, H., Shoghali, M.A., 2012. *Eremohadena afzalipouri* sp. nov. from Iran. Journal of Insect Science 12, 137.

Volynkin, AV., 2012. Noctuidae of the Russian Altai (Lepidoptera). Proceedings of the Tigirek State Natural Reserve, 5 (Barnaul), 1–339.

Wieser, C., Stangelmaier, G., 2005. Zwischenergebnisse einer lepidopterologischen Forschungsreise in den Nordiran, Oktober 2003 (Insecta: Lepidoptera). Carinthia 2(195/115), 659–674.