Pakistan J. Zool., vol. 46(6), pp. 1663-1671, 2014.

Faunistical and Ecological Investigations on Water Scavenger Beetles (Coleoptera: Hydrophilidae) of Isparta Province, Turkey

Ayçin Yılmaz and Ebru Gül Aslan*
Department of Biology, Faculty of Arts and Science, Süleyman Demirel University, 32260 Isparta, Turkey

Abstract.- Species composition and habitat preferences of Hydrophilidae (Coleoptera) occurring in Isparta province of Turkey were determined in this study. Field surveys were performed between April-November during 2009 and 2010. Totally, 33 species and 2 subspecies belonging to 14 genera were recorded from the study area. According to the obtained data, 28 of the species were not reported from Isparta province previously. Specimens were collected from various kinds of stagnant and shallow freshwaters, brackish water ponds and wet habitats close to the water. Information regarding to relative abundance and habitat preferences of each beetle were given. General comments on habitat choices of the genera were provided, as well as some distributional notes on some species. Additionally, male genitalia photos of 29 species were presented.

Key words: Hydrophilidae, habitat preference, water scavenger beetles.

INTRODUCTION

Hydrophilidae (water scavenger beetles) represents the largest group of the superfamily Hydrophiloidea comprising 172 genera (Mart, 2009) and about 2900 species all over the world (Short and Fikáček, 2013). Hydrophilids zoogeographically have a wide range of distribution and are classified into six subfamilies including Hydrophilinae, Chaetarthriinae, Enochrinae, Acidocerinae, Rygmodinae and Sphaeridiinae (Hansen, 1999; Komarek, 2003; Short and Hebauer, 2006; Jäch and Balke, 2008; Short and Fikáček, 2013). Only two subfamilies, Hydrophilinae and Sphaeridiinae, inhabit the Palaearctic region. Hydrophilinae has 57 genera and 1784 described species which are mostly aquatic while Sphaeridiinae includes more than 929 species, mostly terrestrial (Komarek, 2003; Jäch and Balke, 2008; Fikáček *et al*., 2010). Hitherto; 19 genera, 95 species and 4 subspecies of hydrophilids within two subfamilies have been recorded from Turkey (Darılmaz and İncekara, 2011; Mart *et al*., 2014).

Adult water scavenger beetles can be classified as aquatic or terrestrial in terms of habitat preferences. Terrestrial species are included in the subfamily Sphaeridiinae of which members inhabit under the decomposing organic matter such as compost piles, decayed fungi or algae. Aquatic species prefer various kinds of habitats, preferably lentic systems including permanent or temporary water bodies and shallow water parts of ponds and lakes (Mart *et al.*, 2006). Polluted waters and salt water marshes can also be favorable habitats for some other species. However, most of the hydrophilid larvae are aquatic, living directly in the water rather than moist areas near it (Hansen, 1987). Adult beetles are mostly saprophagous, feeding on different kinds of decaying organic matter, whereas larvae are absolutely predaceous, preying on various invertebrates (Fikáček *et al.*, 2010).

The western and southern parts of Turkey incorporate numerous water resources, thus possibly contain a rich aquatic beetle fauna. Up to now, the majority of the studies about Hydrophilidae were conducted in eastern, central and northern parts of Turkey. Therefore, the purpose of the present study was to carry out the first step of a comprehensive study in southern regions of Turkey where the group is poorly studied. This study and forthcoming surveys are intended to contribute Hydrophiloidea fauna of Turkey and their ecology.

MATERIALS AND METHODS

Study site

The present study is based on Hydrophilidae material gathered throughout April - November in

* Corresponding author: ebruaslan@sdu.edu.tr, egaslan@gmail.com
0030-9923/2014/0006-1663 $ 8.00/0

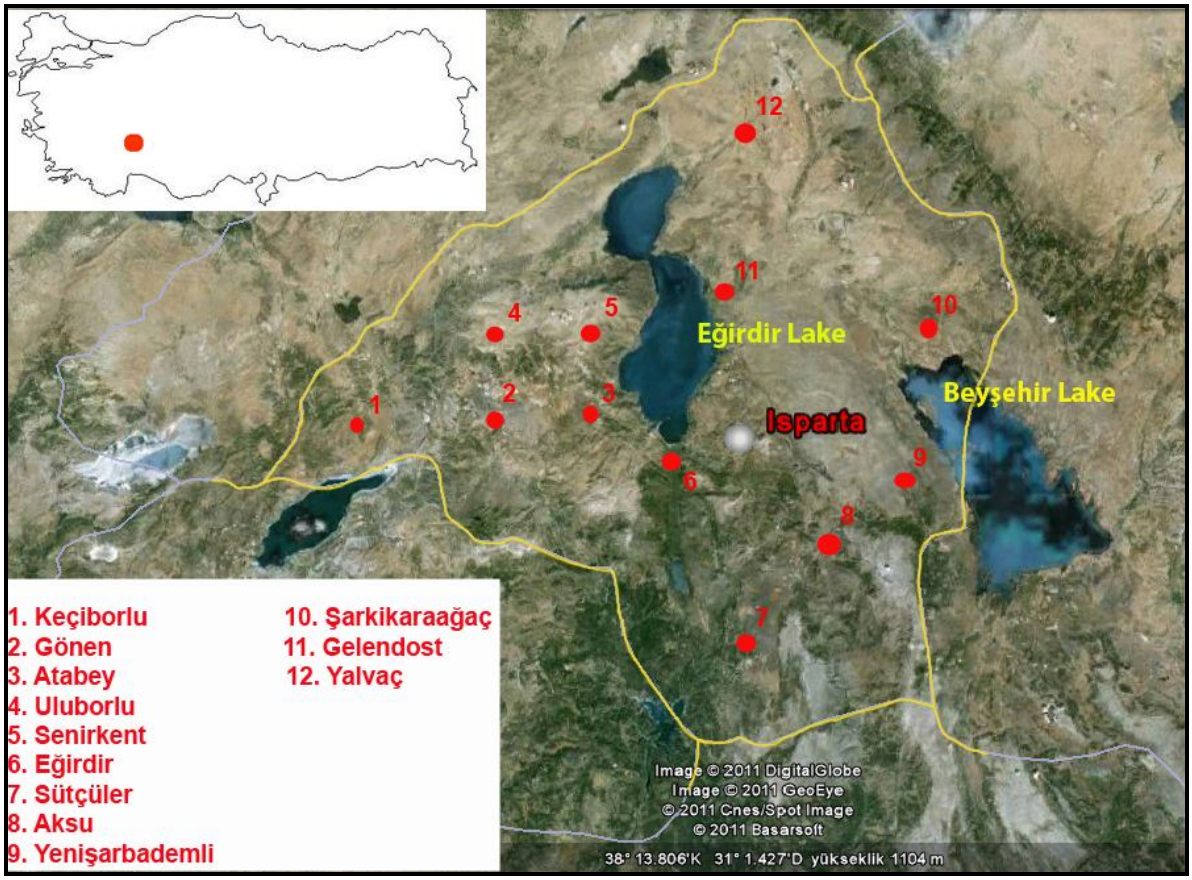

Fig. 1. General view of the study area showing the sampled districts.

2009 and 2010 from Isparta and its adjacent areas. Isparta has an average altitude of 1050 m situated in the western Mediterranean region of Turkey, and in the central part of the "Lakes Region" (Fig. 1). The Lakes Region constitutes one of the most important wetland areas of Turkey including a series of lakes of different sizes and ecological conditions, as well as many other water bodies, shallow and stagnant waters, slow running waters, and moist habitats near water sources.

Sampling method

Specimens were collected by using a sieve, ladle, or net having a diameter of 1-2 mm pores from the appropriate habitats. Collected samples were killed by using ethyl acetate or 70% ethyl alcohol solution. Beetles were taken to the laboratory for further analysis and dissection. The aedeagophores of the beetles were cleaned with a brush, dissected out under a stereo microscope and exposed in 10% KOH or NaOH solution for 1-2 hours. Diagnosis of beetles was carried out using aedeagophores and some other important morphological characters. All the specimens were identified to species using keys and figures given by: Hansen (1987, 1991, 1999), Shatrovskiy (1984), Gentili (1975, 1979, 2000), Gentili and Chiesa (1975), Schödl (1991, 1993), Hebauer (1994, 1998), Darılmaz and Kıyak (2009, 2010) and Mart (1999, 2005). Determination of some problematic taxa were completed after corresponding with the foreign colleagues mentioned in the acknowledgements. The figures of the aedeagophores and morphological characters were taken with a Camedia C-5060 digital camera attached to an Olympus SZX12 stereomicroscope. Voucher specimens are deposited at the Biology Department of Süleyman Demirel University, Isparta, Turkey.

RESULTS

As a result of collection surveys performed in the study area, 33 species and 2 subspecies of water scavenger beetles belonging to 14 genera were identified (Table I). *Laccobius* was determined as the most species rich genus with 13 species corresponding to a percentage of 37% in total. *Enochrus* was represented by five species, *Helochares* by three species, *Cercyon*, *Hydrobius*, *Berosus* each by two species, and *Anacaena*, *Chasmogenus*, *Cymbiodyta*, *Hydrochara*, *Hydrophilus*, *Brownephilus*, *Coleostoma* and *Sphaeridium* each by a single species (Fig. 2).

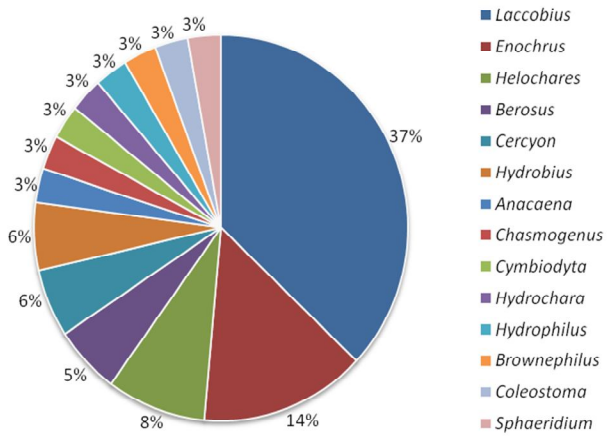

Fig. 2. Percentages of Hydrophilidae genera in terms of species number collected from the study area.

The habitat preferences of the determined hydrophilids were also presented in Table I, together with relative abundance ratios. Respectively, *Enochrus fuscipennis* Thomson, *Laccobius gracilis* Motschulsky and *Laccobius obscuratus aegaeus* Gentili appear to be the top three species in terms of their relative abundances.

Five species of the 35 taxa, namely *Hydrochara caraboides*, *Brownephilus major*, *Cercyon circumcinctus*, *Cercyon laminatus and Sphaeridium scarabaoides* were identified based on female samples. Additionally, *Hydrophilus piceus*, representing the largest hydrophilid samples among the other material, was determined based on its aberrant body size and charecteristic structure of pretarsi. Except these, the aedeagophore photos are provided for the rest 29 taxa below in Figure 3.

DISCUSSION

The hydrophilid species reported in the present study correspond to about 35% of the whole Turkish Hydrophilidae fauna based on the numeric data given in the recent checklist of Hydrophiloidea (Darılmaz and İncekara, 2011). It was also determined that 28 of the species were not reported from Isparta region previously.

The most common and dominant genus in the research area was *Laccobius* showing a wide range of habitat preference generally including shallow waters and their edges displaying different ecological features, as well as muddy and wet habitats. According to Gentili (1995), although many species prefer cold and clean waters as habitat some species such as *Laccobius decorus* Gyllenhal, 1827, *L. minutus* Linnaeus, 1758 and *L. biguttatus* Gerhardt, 1877 inhabit saltwater and brackish waters. Because of the broad range of habitats, *Laccobius* has a wider range of species diversity and a large number of individuals than most other Hydrophilidae genera. The number of *Laccobius* species recorded from Isparta in the present study account for 50% of the whole *Laccobius* fauna in Turkey. The most abundant species were *L. gracilis* and *Laccobius obscratus aegaeus* occurred nearly everywhere in Isparta Province.

Enochrus has been the second largest Hydrophilidae genus in Isparta. Densely vegetated water bodies accompanied by decomposing plant debris were determined as commonly preferred habitats. *Enochrus fuscipennis* and *E. quadripunctatus* were the predominant *Enochrus* species in the research area.

*Helochare*s is represented by three species in Isparta. Adult beetles mainly prefer well vegetated stagnant waters, edges of slow running waters and polluted waters contaminated with human waste. *Helochares punctatus* was sampled from western Turkey for the first time by this study, after Artvin and Çorum provinces (northern parts of Turkey).

Berosus, *Cercyon* and *Hydrobius* included two species each from Isparta region. *Berosus* species preferably occur in shallow and stagnant

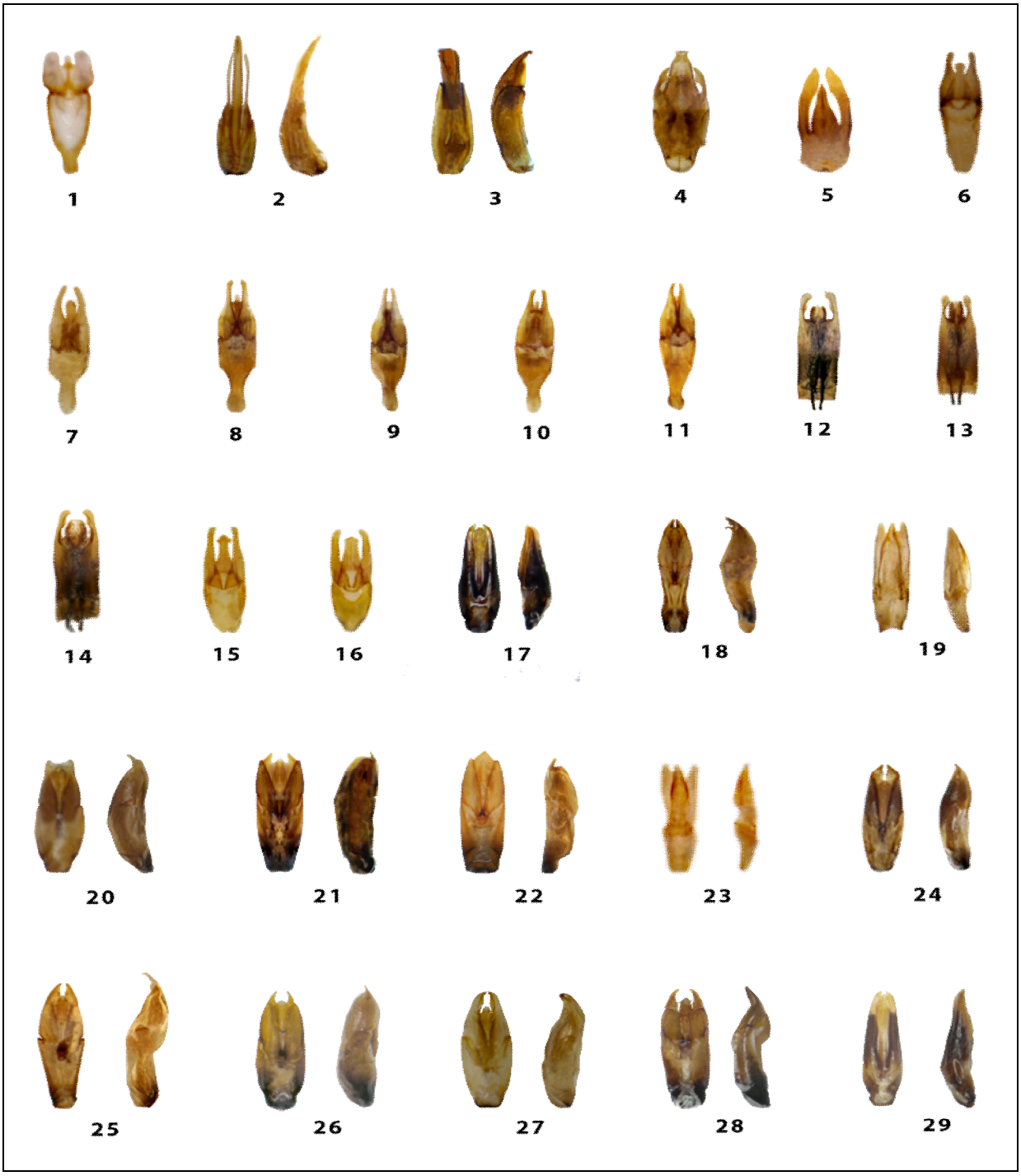

Fig. 3. Male genitalia of the determined hydrophilid species: 1, *Anacaena rufipes*; 2, *Berosus luridus*; 3, *B. signaticollis*; 4, *Chasmogenus livornicus*; 5, *Coelostoma orbiculare*; 6, *Cymbiodyta marginella*; 7, *Enochrus coarctatus*; 8, *E. fuscipennis*; 9, *E. halophilus*; 10, *E. testaceus*; 11, *E. quadripunctatus*; 12, *Helochares lividus*; 13, *H. obscurus*; 14, *H. punctatus*; 15, *Hydrobius arcticus*; 16, *H. fuscipes*; 17, *Laccobius bipunctatus*; 18, *L. chiesai*; 19, *L. gracilis*; 20, *L. hindukuschi*; 21, *L. obscratus aegaeus*; 22, *L. obscratus orchymonti*; 23, *L. persicus*; 24, *L. scutellaris*; 25; *L. simulatrix*; 26, *L. sipylus*; 27, *L. striatulus*; 28, *L. sulcatulus*; 29, *L. syriacus.*

Table I.- Species list, relative abundance and habitat preferences of water scavenger beetles sampled from Isparta province (N: Number of specimens, R: Relative abundance).

Water scavenger beetles	N	R (%)	Habitat preferences
Anacaena Thomson, 1859			
A. rufipes (Guillebeau, 1896)	42	6.3	Small water puddles rich in organic matter
Berosus Leach, 1817			
B. luridus (Linnaeus, 1761)	10	1.4	Slightly vegetated, small ponds and water bodies
B. signaticollis (Charpentier, 1825)	7	1.0	Shallow and stagnant waters
Chasmogenus Sharp, 1882			
Ch. livornicus (Kuwert, 1890)	10	1.4	Densely vegetated waters
Cymbiodyta Bedel, 1881			
C. marginella (Fabricius, 1792)	6	0.8	Clean and stagnant waters
Enochrus Thomson, 1859			
E. coarctatus (Gredler, 1863)	10	1.4	Between vegetation of shallow and clean waters
E. fuscipennis (Thomson, 1884)	82	12.2	Well vegetated fresh waters, shallow waters including high decomposing matter
E. halophilus (Bedel, 1878)	19	2.8	Shallow waters and edges of salt marshes containing much leaf residue
E. testaceus (Fabricius, 1801)	10	1.4	Well vegetated clean waters
E. quadripunctatus (Herbst, 1797)	36	5.3	Edges of the stagnant pools, waters rich in decomposing matter
Helochares Mulsant, 1844			
H. lividus (Forster, 1771)	14	2.1	Polluted waters including human waste
H. obscurus (Müller, 1776)	17	2.5	Fresh and rich vegetated waters
H. punctatus Sharp, 1869	13	1.9	Stagnant waters
Hydrobius Leach, 1815			
H. arcticus Kuwert, 1890	6	0.8	Poorly vegetated stagnant waters
H. fuscipes (Linnaeus, 1758)	43	6.4	Poorly vegetated waterbodies
Hydrochara Berthold, 1827			
H. caraboides (Linnaeus, 1758)	4	0.5	Poorly vegetated waters and accumulated rainwater
Hydrophilus Geoffroy, 1762			
H. piceus (Linnaeus, 1758)	2	0.2	Large waters with dense vegetation
Laccobius Erichson, 1837			
L. bipunctatus (Fabricius, 1775)	32	4.7	Muddy edges of stagnant waters
L. chiesai Gentili, 1974	5	0.7	Muddy habitats
L. gracilis Motschulsky, 1855	51	7.6	Shallow edges of lakes, small deposits of rainwater
L. hindukuschi Chiesa, 1966	7	1.0	Edges of the slow running waters
L. obscuratus aegaeus Gentili, 1974	48	7.1	Edges of water bodies in various sizes, muddy habitats, moss-covered waters with intensive eutrophication
L. obscuratus orchymonti Gentili, 1976	35	5.2	Muddy transition zones between water and land
L. persicus Gentili, 1974	6	0.9	Small water bodies
L. scutellaris Motschulsky, 1855	44	6.5	Inside in moss and mud in the slow running waters with intensive eutrophication
L. simulatrix d'Orchymont, 1932	28	4.1	Muddy habitats near the large water bodies, between mosses
L. sipylus d'Orchymont, 1939	10	1.4	Shallow and stagnant waters covered by mosses
L. striatulus (Fabricius, 1801)	14	2.1	Edges of the clean waters accompanied by rich vegetation

Continued

Water scavenger beetles	N	R (%)	Habitat preferences
L. sulcatulus Reitter, 1909	6	0.8	Edges of shallow waters, between vegetation or mud
L. syriacus Guillebeau, 1896	34	5.1	Muddy habitats
Brownephilus Mouchamps, 1959			
B. major (İncekara, Mart, Polat, Karaca, 2009)	2	0.2	Densely vegetated shallow waters
Coelostoma Brullé, 1835			
C. orbiculare (Fabricius, 1775)	23	3.4	Well vegetated shallow waters and their edges including decaying organic matter
Cercyon Leach, 1817			
C. circumcinctus Reitter, 1889	2	0.2	Edges of semi-dirty waters with rich vegetation and decaying organic matter
C. laminatus Sharp, 1873	3	0.4	Edges of well-vegetated big water bodies
Sphaeridium Fabricius, 1775			
S. scarabaeoides (Linnaeus, 1758)	3	0.4	Semi-moist habitats near the water

water bodies while members of *Cercyon* inhabit in semi-aquatic habitats including edges of well-vegetated stagnant waters. The genus *Hydrobius* is represented by three species in all over the Turkey (Darılmaz and İncekara, 2011), and two of them were recorded from Isparta. This study is the second report of *Hydrobius arcticus* from Turkey, after its first record from Bingöl province.

The genera *Anacaena*, *Brownephilus*, *Chasmogenus*, *Coleostoma*, *Cymbiodyta*, *Hydrochara*, *Hydrophilus*, and *Sphaeridium* are all represented by single species. The present study adds southern parts of Turkey to the distributional area of *Anacena rufipes* which was known only from northern parts till now. Very small water bodies with rich decaying organic matter or transition zones between water and land are the preferred habitats for this species.

Chasmogenus livornicus is the unique representitive of this genus in Turkey, recorded from Afyon and Denizli provinces previously (Darılmaz, 2010). In the study regarding its first record, it was indicated that the samples were collected during April-June, however our samples were collected in late November.

Cymbiodyta marginella, the unique representative of the genus throughout the Palaearctic region, was firstly recorded from Kayseri and Samsun provinces of Turkey by Mart *et al*. (2009). This study adds Isparta region to the Turkish distribution area of this species. *Hydrochara* and *Hydrophilus* were among the rarest genera of the study area both represented by single species and only a few individuals.

The genus *Brownephilus* is represented by *B. major* in the area. *B. major* was firstly described as a new species of *Hydrochara* by İncekara *et al*. (2009), and denominated as 'major' due to its large body size unusual for the *Hydrochara* taxa. Later, the re-examinations of the specimens revealed the erroneous identification, thus the newly described species was transferred to the genus *Brownephilus* Mouchamps which has been known from a single species from Israel (Darılmaz *et al.*, 2010). With the present report, Isparta has been added to the Turkish distributional records of *B. major*, after Samsun and Afyon provinces.

Coelostoma and *Sphaeridium*, including one species each from the study region, are terrestrial taxa generally found just away from the water unlike other hydrophilids. *Coelostoma orbiculare* and *Sphaeridium scarabaoides* were sampled in semi-aquatic habitats near the water source, under the decomposing plant debris or compost (Fig. 4).

Consequently, in the present study, a total of 35 taxa belonging to water scavenger beetles were listed from Isparta together with general habitat preferences, of which 28 were firstly reported from the region. The total number of Hydrophilidae

Fig. 4. Photos related to habitat preferences of some hydrophilid species inhabiting in Isparta province.

species recorded from Isparta is nearly 1/3 of the whole Turkish fauna. This is because the investigated area intrinsically provides numerous water sources all resulting with suitable conditions for aquatic beetles. On the other hand, there is still a certain need of collecting more specimens, especially in the whole 'Lakes Region', either to add new records for the Turkish fauna or to determine the habitat preferences of the water scavenger beetles.

ACKNOWLEDGEMENTS

The study was supported by Department of Scientific Research Project Management of Süleyman Demirel University with the project number SDUBAP (2050-YL-09). We would like to thank Dr. Albrecht Komarek (Austria), Dr. Elio Gentili (Italy), Dr. Franz Hebauer (Germany), and Dr. Martin Fikáček (Czech Republic) for their valuable helps in identification of some suspected species.

REFERENCES

DARILMAZ, M.C. AND KIYAK, S., 2009. The genus *Enochrus* Thomson (Coleoptera: Hydrophilidae) from Turkey, checklist and new records. *Arch. biol. Sci.*, **61** 767-772.

DARILMAZ, M.C., 2010. *Research on aquatic Coleoptera fauna of the inner western Anatolia*, Ph.D. Thesis., Gazi University, Graduate School of Natural and Applied Sciences, Ankara, Turkey, 451 pp.

DARILMAZ, M.C. AND KIYAK, S., 2010. The occurrence of the subgenus *Microlaccobius* Gentili in Turkey (Coleoptera: Hydrophilidae, *Laccobius*),with taxonomic notes. *Turk. J. Zool.*, **34**: 63-68.

DARILMAZ, M.C., KIYAK, S. AND SHORT, A.E.Z., 2010. Discovery of the water scavenger beetle genus *Brownephilus* Mouchamps in Turkey (Coleoptera, Hydrophilidae, Hydrophilini). *ZooKeys*, **53**: 13–16.

DARILMAZ, M.C. AND İNCEKARA, Ü., 2011. Checklist of Hydrophiloidea of Turkey (Coleoptera: Polyphaga). *J. Nat. Hist*., **45**: 685–735.

FIKÁČEK, M., GENTILI, E. AND SHORT, A.E.Z., 2010. Order Coleoptera, family Hydrophilidae. *Arthropod fauna of the UAE*, **3**: 135–165.

GENTILI, E. AND CHIESA, A., 1975. Revisione dei *Laccobius* Palearctici (Coleoptera: Hydrophilidae). *Mem. Soc. Ent. Ital*. Genova, pp. 187.

GENTILI, E., 1975. Alcuni nuovi *Laccobius* Paleartici (Coleoptera Hydrophilidae). *Estrat. Boll. Soc. Ent. Ital.*, **107**: N. 6-8-20, 127-134.

GENTILI, E., 1979. Aggiunte alla revisione dei *Laccobius* palearctici (Coleoptera: Hydrophilidae). *Estrat. Boll. Soc. Ent. Ital.*, **111**: N.1-3, 43-50.

GENTILI, E., 1995. Hydrophilidae: 3. The genus *Laccobius* Erichson in China and neighboring areas (Coleoptera). In: *Water beetles of China* (eds. M. A. Jäch and L. Ji), **1**: 245–286.

GENTILI, E., 2000. Distibuzione del genere *Laccobius* (Coleoptera: Hydrophilidae) in anatolia e problemi relativi. *Biogeographia*, **21**: 173-214.

HANSEN, M., 1987. *The Hydrophilidae (Coleoptera) of Fennoscandia and Denmark*, 18, Fauna Entomologica Scandinavica, E.J. Brill, Denmark, pp. 253.

HANSEN, M., 1991. *The Hydrophiloid Beetles. Phylogeny, Classification and A Revision of the Genera (Coleoptera, Hydrophiloidea)*. The Royal Danish Academy of Science and Letters, Biologiske Skrifter 40, Copenhagen, pp. 368.

HANSEN, M., 1999. *World cataloque of insects Hydrophiloidea (Coleoptera)*, Vol. 2, Apollo Books, Stenstrup, Denmark, 416 pp.

HEBAUER, F., 1994. The Hydrophilidae of Israel and Sinai (Coleoptera, Hydrophilidae). *Zool. Middle East*, **10**: 74-137.

HEBAUER, F., 1998. Teil A: Imagines. In: Insecta*:* Coleoptera*:* Hydrophilidae *(exkl. Helophorus)* (eds. F. Hebauer and B. Klausnitzer), pp. 1-90. Süsswasserfauna von Mitteleuropa, 20, part 7, 8, 9, 10-1. Gustav Fischer, Stuttgart, Jena, Lübeck, Ulm, xii + 134 pp.

İNCEKARA, Ü., MART, A., POLAT, A. AND KARACA, H., 2009. Turkish Hydrophilidae (Coleoptera) III. genus *Hydrochara* Berthold 1827 with the description of a new species, *Hydrochara major* sp. n. *Turk. J. Zool*., **33**: 315–319.

JÄCH, M.A. AND BALKE, M., 2008. Global diversity of water beetles (Coleoptera) in freshwater. *Hydrobiologia*, **595**: 419–442.

KOMAREK, A., 2003. Hydrophilidae: I. Checklist and key to Palaearctic and Oriental genera of aquatic Hydrophilidae (Coleoptera). *Water Beetles of China*, **3**: 383–395.

MART, A., 1999. *Systematic investigations on the species of Helophorinae and Hydrobiinae (Hydrophilidae, Coleoptera) in Erzurum and Erzincan plains*. M.Sc. thesis, Atatürk University, Graduate School of Natural and Applied Sciences, Erzurum, Turkey, pp. 55.

MART, A., 2005. *Systematic investigations on the species of Helophoridae, Hydrophilidae and Hydrochidae (Coleoptera) in Bingöl province*. Ph.D. thesis, Atatürk University, Graduate School of Natural and Applied Sciences, Erzurum, Turkey, pp. 136.

MART, A., İNCEKARA, Ü. AND HAYAT, R., 2006. Two new records of Hydrophilid (Coleoptera: Hydrophilidae) species of the Turkish fauna. *Turk. J. Zool.*, **30**: 267–269.

MART, A., 2009. Water scavenger beetles (Coleoptera: Hydrophilidae) provinces of Central Black Sea region of Turkey. *J. Ent. Res. Soc*., **11**: 47–70.

MART, A., İNCEKARA, Ü., POLAT, A. AND KARACA, H., 2009. New genera and species in the family Hydrophilidae (Coleoptera) to Turkey. *Turk. J. Zool*., **33**: 237–240.

MART, A., TOLAN, R., CAF, F. AND KOYUN, M., 2014. A faunistic study on aquatic coleoptera (Helophoridae: Hydrophilidae) species in Elazığ Province, Turkey. *Pakistan J. Zool.,* **46:** 681-696.

SCHODL, S., 1991. Revision der gattung *Berosus* Leach, 1. Teil: Die palaarktischen arten der untergattung *Enoplurus* (Coleoptera: Hydrophilidae). *Koleopterol. Rundsch.*, **61**: 111-135.

SCHODL, S., 1993. Revision der gattung *Berosus* Leach, 3. Teil: Die palaarktischen und orientalischen arten der untergattung *Berosus* s. str. (Coleoptera: Hydrophilidae). *Koleopterol. Rundsch.*, **63**: 189-233.

SHATROVSKIY, A., 1984. Revision of the genus *Laccobius* Er. of the Soviet Union (Coleoptera, Hydrophilidae). *Ent. Obzor*, **63**: 301-325.

SHORT, A.E.Z. AND HEBAUER, F., 2006. World catalogue of Hydrophiloidea –additions and corrections, 1 (1999–2005) (Coleoptera). *Koleopterol. Rundsch*., **76**: 315–359.

SHORT, A.E.Z. AND FIKÁČEK, M., 2013. Molecular phylogeny, evolution and classification of the Hydrophilidae (Coleoptera). *Syst. Ent*., **38**: 723–752.

(Received 5 May 2014, revised 26 August 2014)