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A Good Sample to Concurrent Fauna: Study on Aquatic Coleoptera Fauna (Adephaga and Polyphaga) of Lake Van Basin (Turkey), with some Zoogeographic Remarks

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ABSTRACT

A brief zoogeographic analysis of the aquatic and semi aquatic Coleoptera fauna of Lake Van Basin (East Anatolia) based on the distribution of 194 species/subspecies belong to ten families in basin shows the existence of three major faunas, one influenced European-Siberian region, the others by the Eremia and Mediterranean. Species from different zoogeographical units are determined and listed. Totally, in research area, it is found out that 111 species find in every three zoogeographic region. *Rhantus frontalis* (Dytiscidae), *Helophorus occidentalis* and *H. yammounensis* (Helophoridae) are newly recorded from Turkey. Turkey is southern limit of *Ochthebius costatellus*, and eastern limit of *Hygrobia hermanni* ranges.

Key words: Water beetles, zoogeography, distribution, Lake Van Basin, Turkey.

INTRODUCTION

Turkey shows a notable diversity of habitats, with significant variations in altitude, rainfall, temperature, topography and geological history, which is reflected in its richness of animal life. Its zoogeography is therefore of considerable interest.

The most comprehensive study and analysis on the Anatolian zoogeography was carried on by Kosswig (1955). Until this study, unique considerable study on the Anatolian zoogeography by the other researcher is Uvarov (1921). In this paper, he has tried to explain relations between Mediterranean and Eremian faunas based on the Orthopters.

The Lake Van Basin, has one fifth of total wetland existence in Turkey, is one of the most important areas that can protect its natural structure in Eastern Anatolia. Geographically, the basin associated with Ağrı, Bitlis, Muş and Van provinces. Lake Van is the largest lake in Turkey, located in Bitlis and Van districts. It is a saline and

soda lake, receiving water from numerous small streams that descend from the surrounding mountains. Lake Van, has an area of 3,755 km², is one of the world's largest endorheic lakes (having no outlet). The original outlet from the basin was blocked by an ancient volcanic eruption.

The lake's outlet was blocked at some time during the Pleistocene, when lava flows from Nemrut volcano blocked westward outflow towards the Muş Plain. Now dormant, Nemrut Mountain is close to the western shore of the lake, and another dormant stratovolcano, Süphan Mountain dominates the northern side of the lake (Anonymus, 2011). Besides the main lake, there are some smaller lakes in the basin as Erçek, Aygır and Arin also.

The modern East Anatolian aquatic Coleoptera fauna may be a remnant of movements at various times (Figs. 1-2). Theoretically, Euro-Siberian fauna must be concurrent with Eremian elements, entering from eastern and southern, in the research area. On the other hand, fauna of research area is associated with Mediterranean also.

In this study, aquatic beetles of the families Dytiscidae, Gyrinidae, Haliplidae, Helophoridae, Hydraenidae, Hydrochidae, Hydrophilidae, Hygrobiidae, Noteridae, Scirtidae and Spercheidae were sampled in Lake Van Basin (East Anatolia).

Aim of this study is to investigate the Lake Van Basin, having elements from different zoogeographical units, in light of aquatic Coleoptera distribution.

MATERIALS AND METHODS

Samples were collected from various water bodies: cool streams and a lake; with a sieve, a ladle and a net having mesh size of one millimeter. The specimens were killed with 70% alcohol, and in the laboratory they were cleaned off from clayey and muddy substances with a small paintbrush. At the end of the study families of Dytiscidae, Gyrinidae, Haliplidae, Helophoridae, Hydraenidae, Hydrochidae, Hydrophilidae, Hygrobiidae, Noteridae and Spercheidae were evaluated. Distribution in Turkey, besides collected material, is mainly based on Darılmaz and Kiyak (2009), Darılmaz and İncekara (2011), Ertorun *et al.*, (2011), Türken (2011) and Aydoğan (2011). Distribution in world is mainly based on Nillson (2003) and Hansen (2004).

This study is a part of 1st author's Ph. D.; 4th and 5thauthor's, MS. Thesis.

RESULTS

Totally, 194 species/subspecies were recorded. Of these, 118 species/subspecies belong to ten families (Dytiscidae: 35; Gyrinidae: 1; Haliplidae: 1; Helophoridae: 27; Hydraenidae: 7; Hydrochidae: 1; Hygrobiidae: 1; Hydrophilidae: 43; Noteridae: 1; Spercheidae: 1) were collected and identified by the authors in the Lake Van Basin. Others were added by using literatures.

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Distribution of the species in the East Anatolia, Lake Van Basin, Euro-Siberia, Eremia and Mediterranean are shown in Table 1. Of 194, 111 species/subspecies are common for Lake Van Basin, Euro-Siberia, Mediterranean and Eremia. No Dryopidae and Elmidae species were collected from the lake Van basin.

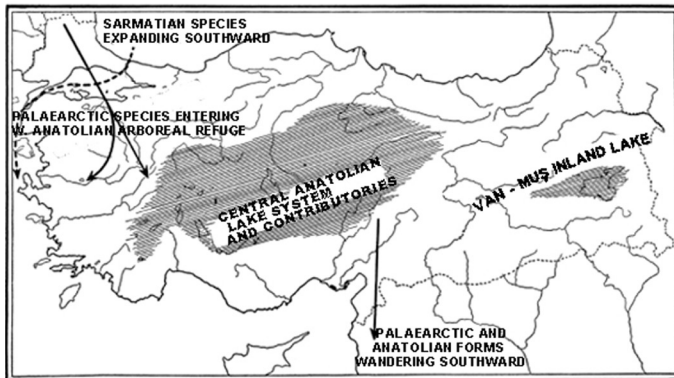


Fig. 1. Movements of the Anatolian fauna during the glaciations (Koswig, 1955).

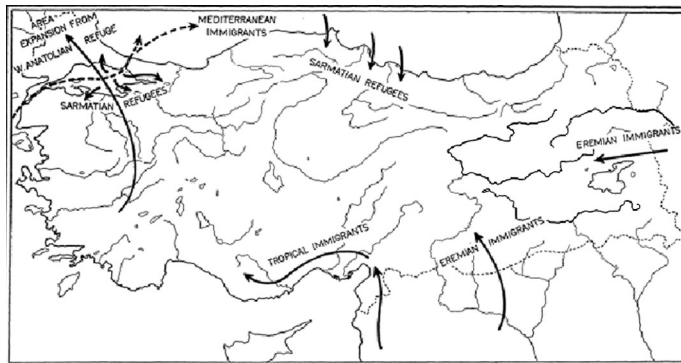


Fig. 2. Movements of the Anatolian fauna in the postglacial period (Koswig, 1955).

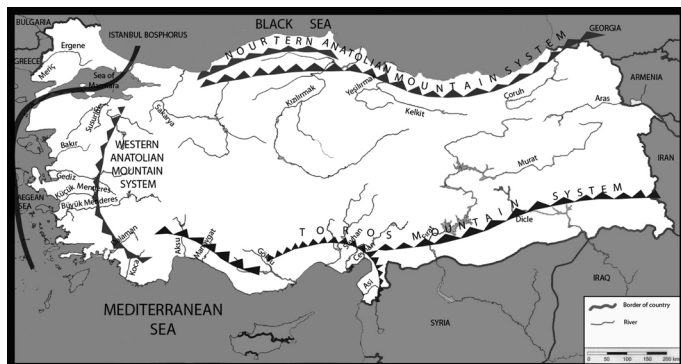


Fig. 3. Main modern barriers to the distribution of species in Turkey.

Table 1. Distribution of the species/subspecies in the East Anatolia, Lake Van Basin, Euro-Siberian, Mediterranean and Eremian.

Family/Species	EA	LVB	E-S	M	E	Remark
Dytiscidae						
<i>Agabus conspersus</i> (Marsham, 1802)	+	+	+	+	+	
<i>A. biguttatus</i> (Olivier, 1795)	+	+	+	+	+	
<i>A. bipustulatus</i> (Linnaeus, 1767)	+	+	+	+	+	
<i>A. dilatatus</i> (Brullé, 1832)	+	+	+	+	-	
<i>A. labiatus</i> (Brahm, 1790)	-	+	+	+	-	
<i>A. nebulosus</i> (Forster, 1771)	+	+	+	+	+	
<i>A. paludosus</i> (Fabricius, 1801)	+	+	+	+	-	
<i>Bidessus nasutus</i> Sharp, 1887	-	+	+	+	-	
<i>Colymbetes fuscus</i> (Linnaeus, 1758)	+	+	+	+	+	
<i>Cybister lateralmarginalis torquatus</i> (Fischer von Waldheim, 1829)	-	+	+	-	+	
<i>Dytiscus circumflexus</i> Fabricius, 1801	+	+	+	+	+	
<i>Graphoderus cinereus</i> (Linnaeus, 1758)	-	+	+	+	-	
<i>Graptodytes veterator behningi</i> Zaitsev, 1927	+	+	-	-	-	Endemic
<i>Hydroglyphus geminus</i> (Fabricius, 1792)	+	+	+	+	+	
<i>Hydroporus discretus</i> Fairmaire and Brisout, 1859	+	+	+	+	+	
<i>H. jonicus caucasicus</i> Miller, 1862	-	+	-	+	-	
<i>H. holzschuhi</i> Fery, 2009	+	+	-	-	-	
<i>H. kozlovskii</i> Zaitzev, 1927	+	+	-	+	-	
<i>H. marginatus</i> (Duftschmid, 1805)	+	+	+	+	+	
<i>H. planus</i> (Fabricius, 1781)	+	+	+	+	+	
<i>H. pubescens</i> (Gyllenhal, 1808)	-	+	+	+	+	
<i>H. transgrediens</i> Gschwendtner, 1923	+	+	+	+	+	
<i>Hygrotus armeniacus</i> (Zaitzev, 1927)	+	+	+	+	-	
<i>H. confluens</i> (Fabricius, 1787)	+	+	+	+	+	
<i>H. impressopunctatus</i> (Schaller, 1783)	+	+	+	+	+	
<i>H. inaequalis</i> (Fabricius, 1777)	+	+	+	+	+	
<i>H. lernaeus</i> (Schaum, 1857)	-	+	-	+	+	
<i>H. parallelogrammus</i> (Ahrens, 1812)	+	+	+	-	+	
<i>H. saginatus</i> Schaum, 185	-	+	-	+	+	

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Table 1. Continued.

Family/Species	EA	LVB	E-S	M	E	Remark
<i>Hydrovatus cuspidatus</i> (Kunze, 1818)	-	+	+	+	+	**
<i>Ilybius chalconatus</i> (Panzer, 1796)	+	+	+	+	+	
<i>I. fuliginosus</i> (Fabricius, 1792)	+	+	+	+	+	
<i>Laccophilus hyalinus</i> (De Geer, 1774)	+	+	+	+	+	
<i>L. minutus</i> (Linnaeus, 1758)	+	+	+	+	+	
<i>L. poecilus</i> Klug, 1834	+	+	+	+	+	***
<i>Liopterus haemorrhoidalis</i> (Fabricius, 1787)	+	+	+	-	+	
<i>Nebrioporus airumilus</i> (Kolenati, 1845)	+	+	+	+	+	
<i>Platambus lunulatus</i> (Fischer von Waldheim, 1829)	+	+	-	+	+	
<i>Rhantus frontalis</i> Marsham, 1802	-	+	+	+	-	*
<i>R. suturalis</i> (W.S. Macleay, 1825)	+	+	+	+	+	**
<i>Scarodytes halensis</i> (Fabricius, 1787)	+	+	+	+	+	
<i>Stictotarsus griseostriatus</i> (De Geer, 1774)	+	+	+	+	-	
Gyrinidae						
<i>Gyrinus urinator</i> Illiger, 1807	+	-	-	-	+	
Halplidae						
<i>Halplus laminatus</i> (Schaller, 1783)	+	-	+	+	-	
<i>H. lineatocollis</i> (Marsham, 1802)	+	+	+	+	+	
<i>H. variegatus</i> Sturm, 1834	-	+	+	+	+	
<i>Peltodytes caesus</i> (Duftschmid, 1805)	-	+	+	+	+	
Helophoridae						
<i>Helophorus abeillei</i> Guillebeau, 1896	+	+	+	+	+	
<i>H. aquaticus</i> Linnaeus, 1758	+	+	+	-	+	
<i>H. arvernicus</i> Mulsant, 1846	+	+	+	+	+	
<i>H. brevipalpis</i> Bedel, 1881	+	-	+	+	+	
<i>H. daedalus</i> D'orchymont, 1932	+	+	+	-	+	
<i>H. discrepans</i> Rey, 1885	+	+	+	+	+	
<i>H. dorsalis</i> Marsham, 1802	-	+	+	+	+	**

Table 1. Continued.

Family/Species	EA	LVB	E-S	M	E	Remark
<i>H. frater</i> D'orchymont, 1926	+	+	+	+	-	
<i>H. grandis</i> Illiger, 1798	+	+	+	-	+	***
<i>H. griseus</i> Herbst, 1793	+	+	+	+	+	
<i>H. hilaris</i> Sharp, 1916	+	+	+	+	+	
<i>H. kirgizicus</i> Kniz, 1914	+	+	+	-	+	
<i>H. lapponicus</i> Thomson, 1853	+	+	+	+	+	
<i>H. lewisi</i> Angus, 1985	+	+	+	-	+	***
<i>H. liguricus</i> Angus, 1970	+	+	+	+	+	***
<i>H. longitarsis</i> Wollaston, 1864	+	+	+	+	+	***
<i>H. micans</i> Faldermann, 1835	+	+	+	+	+	
<i>H. minutus</i> Fabricius, 1775	+	+	+	+	+	**
<i>H. nanus</i> Sturm, 1836	+	+	+	+	+	***
<i>H. nubilus</i> Fabricius, 1776	+	+	+	+	+	
<i>H. occidentalis</i> Angus, 1983	+	+	-	+	-	*
<i>H. oscillator</i> Sharp, 1915	+	+	+	+	-	**
<i>H. pallidipennis</i> Mulsant&Wachanru, 1852	+	+	-	+	+	***
<i>H. paramontanus</i> Angus, 1985	+	+	-	-	+	***
<i>H. subarcuatus</i> Rey, 1885	+	+	-	+	+	***
<i>H. syriacus</i> Kuwert, 1885	+	+	+	+	-	**
<i>H. yammounensis</i> Angus, 1988	+	+	+	+	+	*
Hydraenidae						
<i>Hydraena abbasigili</i> Jach, 1988	+	+	+	+	+	
<i>H. anatolica</i> Janssens, 1963	+	+	+	+	+	
<i>H. cappadocica</i> Jach, 1988	+	+	+	+	+	
<i>H. eichleri</i> Orchymont, 1937	-	+	-	-	+	
<i>H. eucnemis</i> Janssens, 1970	+	+	+	+	+	
<i>H. fontiscarsavii</i> (Jach, 1988)	+	+	-	+	+	
<i>H. gressa</i> Orchymont, 1944	+	+	-	+	-	Endemic
<i>H. helena</i> Orchymont, 1929	+	+	+	+	-	

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Table 1. Continued.

Family/Species	EA	LVB	E-S	M	E	Remark
<i>H. integra</i> Pretner, 1931	+	+	+	+	+	
<i>H. khnzoriani</i> Janssens, 1968	+	+	+	-	+	
<i>H. kurdistanica</i> Jäch, 1988	-	+	-	-	+	
<i>H. muezziginea</i> Jach, 1988	+	+	+	-	+	
<i>H. olidipastoris</i> Jach, 1988	-	+	-	-	+	
<i>H. schilffii</i> Jach, 1988	-	+	-	-	+	
<i>H. schoenmanni</i> Jach, 1988	+	+	-	-	+	
<i>H. virginalis</i> Janssens, 1963.	+	+	+	-	+	
<i>Limnebius corybus</i> Orchymont, 1945	+	+	+	+	+	
<i>L. distinguendus</i> Ferro, 1989	+	+	+	-	+	
<i>L. levantinus</i> Jäch, 1993	+	+		+	+	
<i>L. myrmidon</i> Rey, 1883	+	+	+	+	+	
<i>L. papposus</i> Mulsant, 1844	+	+	+	+	+	
<i>L. paranuristanus</i> Ferro, 1989	+	+	-	-	+	
<i>L. perparvulus</i> Rey, 1884	+	-	+	+	+	
<i>L. rubropiceus</i> Kuwert, 1890	+	-	+	+	+	
<i>L. stagnalis</i> Guillebeau, 1890	+	+	+	+	+	
<i>L. setifer</i> Khnzorian, 1962	+	-	-	-	+	
<i>Ochthebius akbuluti</i> Jäch & Kasapoğlu, 2003	+	-	-	-	-	
<i>O. anatolicus</i> Janssens, 1963	+	-	+	-	-	
<i>O. caucasicus</i> Kuwert, 1887	+	+	+	-	+	
<i>O. colveranus</i> Ferro, 1979	+	+	+	+	+	
<i>O. costatellus</i> Reitter, 1897	+	+	+	-	+	Turkey is Southern limit of its range
<i>O. decianus</i> Orchymont, 1942	+	-	+	+	+	
<i>O. difficilis</i> Mulsant, 1844	+	+	+	+	+	
<i>O. elburzi</i> Ferro, 1987	+	+	+	+	+	
<i>O. elisae</i> Sahlberg, 1900	+	-	+	+	+	

Table 1. Continued.

Family/Species	EA	LVB	E-S	M	E	Remark
<i>O. evanescens</i> Sahlberg, 1875	+	-	+	-	-	
<i>O. erzerumi</i> Kuwert, 1887	+	+	+	-	-	
<i>O. fausti</i> Sharp, 1887	+	-	+	+	+	
<i>O. foveolatus</i> Germar, 1824	+	+	+	+	+	
<i>O. hofratvukovitsi</i> Jäch, 1994	+	-	-	-	+	
<i>O. huberti</i> Jäch, 1989	+	-	+	+	+	
<i>O. inconspicuus</i> Jäch, 1991	+	-	+	+	+	
<i>O. inelegans</i> Jäch, 2002	+	-	-	-	+	
<i>O. kirschenhoferi</i> Jäch, 1994	+	+	-	-	+	
<i>O. lividipennis</i> Peyron, 1858	+	-	+	+	+	
<i>O. magnannulatus</i> Delgado & Jäch	+	-	+	+	+	
<i>O. metallescens</i> Rosenhauer, 1847	+	-	+	+	+	
<i>O. meridionalis</i> Rey, 1885	+	+	+	+	+	
<i>O. nonaginta</i> Jäch, 2004	+	-	-	-	+	
<i>O. oezkani</i> Jäch & Kasapoğlu, 2003	+	-	-	-	-	
<i>O. parvannulatus</i> Delgado & Jäch, 2009	+	-	+	+	+	
<i>O. peisonis</i> Ganglbauer, 1901	+	+	+	-	+	
<i>O. ragusae</i> Kuwert, 1887	+	+	+	+	+	
<i>O. remotus</i> Reitter, 1885	+	-	+	-	+	
<i>O. rivibelli</i> Jäch, 1990	+	+	-	-	+	
<i>O. schneideri</i> Kuwert, 1887	+	-	-	-	+	
<i>O. schuberti</i> Jäch, 1999	+	+	-	-	+	
<i>O. scitulus</i> Ferro, 1982	+	+	-	+	+	
<i>O. serpentinus</i> Jäch, 1989	+	+	-	+	+	
<i>O. speculator</i> Jäch, 1991	+	+	+	-	+	
<i>O. striatus</i> Laporte, 1840	+	+	+	+	+	
<i>O. stygalis</i> Orchymont, 1932	+	-	-	+	-	
<i>O. sulphuris</i> Jäch, 1989	+	-	-	-	+	
<i>O. turcicus</i> Jäch, 1989	+	-	-	+	+	

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Table 1. Continued.

Family/Species	EA	LVB	E-S	M	E	Remark
<i>O. uskubensis</i> Hebauer, 1986	+	-	+	-	+	
<i>O. ustaoglui</i> Topkara, Jäch & Kasapoğlu, 2011	+	-	-	+	+	
<i>O. virens</i> Jäch, 1992	+	+	-	-	+	
<i>O. viridis</i> Peyron, 1858	+	+	+	+	+	
Hydrochidae						
<i>Hydrochus flavipes</i> Küster, 1852	+	+	+	+	+	
Hygrobiidae						
<i>Hygrobia hermanni</i> (Fabricius, 1775)	+	+	+	+	+	second record for Turkey, Eastern limit of its range
Hydrophilidae						
<i>Anacaena limbata</i> (Fabricius, 1792)	+	+	+	+	+	***
<i>A. rufipes</i> (Guillebeau, 1896)	+	+	+	+	+	***
<i>Berosus</i> (s.str.) <i>byzantinus</i> (Ganglbauer, 1904)	+	+	+	+	+	**
<i>Berosus</i> (s. str.) <i>dispar</i> Reiche and Saulcy, 1856	+	+	-	+	+	**
<i>Berosus</i> (<i>Enoplurus</i>) <i>asiaticus</i> (Kuwert, 1888)	+	+	+	-	+	firstly recorded from Turkey by Aydoğan (2011)
<i>Berosus</i> (<i>E.</i>) <i>bispina</i> Reiche and Saulcy, 1856	+	+	+	+	+	
<i>Berosus</i> (<i>E.</i>) <i>fulvus</i> (Kuwert, 1888)	+	+	+	+	+	**
<i>Berosus</i> (<i>E.</i>) <i>guttalis</i> (Rey, 1883)	+	+	+	+	+	firstly recorded from Turkey by Aydoğan (2011)
<i>Berosus</i> (<i>E.</i>) <i>jeachi</i> (Schödl, 1991)	+	+	+	+	+	**
<i>Berosus</i> (<i>E.</i>) <i>spinus</i> (Steven, 1808)	+	+	+	+	+	
<i>Cercyon ustulatus</i> (Preysler, 1790)	+	+	+	+	+	***
<i>Coelostoma orbiculare</i> (Fabricius, 1775)	+	+	+	+	+	***
<i>Cymbiodyta marginella</i> (Fabricius, 1972)	+	+	+	+	+	**
<i>Enochrus</i> (<i>Lumetus</i>) <i>ater</i> (Kuwert, 1888)	+	+	+	+	-	**
<i>E. (L.) bicolor</i> (Fabricius, 1792)	+	+	+	+	+	***
<i>E. (L.) fuscipennis</i> (Thomson, 1884)	+	+	+	+	+	***

Table 1. Continued.

Family/Species	EA	LVB	E-S	M	E	Remark
<i>E. (L.) halophilus</i> (Bedel, 1878)	+	+	+	+	+	**
<i>E. (L.) ochropterus</i> (Marsham, 1802)	+	+	+	+	+	**
<i>E. (L.) politus</i> (Küster, 1849)	+	+	+	+	+	**/second record from Turkey
<i>E. (L.) quadripunctatus</i> (Herbst, 1797)	+	+	+	+	+	***
<i>E. (L.) segmentinotatus</i> (Kuwert 1888)	+	+	+	+	+	***

* First record for Turkish fauna; ** First record for East Anatolian region; *** First record for EA: East Anatolia; LVB: Lake Van Basin; E-S: Euro-Siberian; E: Eremian.

DISCUSSION

The most comprehensive study and analysis on the Anatolian zoogeography was carried on by Koswig (1955). The author had summarized his opinion on the Anatolian zoogeography as: "Suddenly one feels oneself in a foreign country, among an unfamiliar fauna from the central or eastern Anatolian steppes, or from the mountainous regions of northern, eastern, or western Anatolia" (Koswig, 1955). Main reason of this is rather high mountain barriers. In the south and in the north, high mountains separated the central Anatolian lake from the mediterranean as well as from the Black Sea (Fig. 3).

Firstly, Euro-Siberian elements entered the Anatolia from the North-East Anatolia and Eremian elements from the East and South. (East: Iğdır-Aralık province; South: Hakkari-Van plateau) (Demirsoy, 1999). Secondly, entrance of major aquatic beetle groups into central Anatolia was more or less open and facilitated by the upper reaches of the eastern Anatolian rivers, which flow from east to west.

Of 194, 111 species/subspecies are common for Lake Van Basin, Euro-Siberia, Mediterranean and Eremia (Table 1). Our investigations shows that the modern for Lake Van Basin aquatic Coleoptera fauna is a remnant of movements at various times, and Euro-Siberian and Mediterranean fauna are concurrent with Eremian elements, entering from eastern and southern, in the research area.

About 11 Dryopidae species are known from Turkey, but no Dryopidae species were collected from the Lake Van Basin (Kodada and Jäch, 2006).

Most aquatic species live in stagnant or slowly and rapid streams or pools, ponds, lakes, marshes, ditches, canals, brooks, rivers etc., however, members of the Elmidae reside in rocky-bottomed rapid streams from high mountain (Ward, 1992). In Turkey, 16 Elmidae species have been recorded so far (Jäch, 1982, 1984). As in Dryopidae, no Elmidae species were collected from the lake Van basin.

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