

Records of Aquatic Beetles (Helophoridae, Hydrophilidae, Hydrochidae, Dytiscidae) and Physico-Chemical Parameters in a Natural Lake (Artvin, Turkey)

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Abstract: Some ecological requirements of aquatic Coleoptera species were studied in a natural lake. Water beetle samples, collected in 2007 from the National Park Sahara-Karagöl belonging to the families Helophoridae, Hydrophilidae, Hydrochidae, and Dytiscidae were identified and listed. Both physical (conductivity and temperature) and chemical (pH, dissolved oxygen, total dissolved solids, hardness, organic matter, chloride, phosphate, and some metal ions) parameters of the inhabited water were measured.

Key Words: Aquatic Coleoptera, ecology, lake, variety, physico-chemical parameters

Doğal Bir Göl Olan Karagöl'de (Artvin, Türkiye) Sucul Böceklerin (Helophoridae, Hydrophilidae, Hydrochidae ve Dytiscidae) ve Bazı Fiziko-Kimyasal Parametrelerin Kaydedilmesi

Özet: Doğal bir gölde, sucul kınkanatlıların bazı ekolojik istekleri çalışılmıştır. 2007 yılında Sahara-Karagöl ulusal parkından toplanan Helophoridae, Hydrophilidae, Hydrochidae ve Dytiscidae familyalarına ait sucul böcek örnekleri teşhis edilmiş ve listelenmiştir. Böceklerin yerleştiği habitatlardaki suların hem fiziksel (toplam çözünmüş katı, sıcaklık), hem de kimyasal (pH, çözünmüş oksijen, iletkenlik, sertlik, organik madde, klorür, fosfat ve bazı metal iyonları) parametreleri ölçülmüştür.

Anahtar Sözcükler: Sucul kınkanatlılar, ekoloji, göl, çeşitlilik, fiziko-kimyasal parametreler

Introduction

Water pollution has become a problem worldwide. Even countries with little industry have reason to be alarmed by the appalling situation. Industries and households dump waste materials into rivers, oceans, and even local water supplies. This situation affects the living organisms negatively.

Aquatic insects and other benthic invertebrates are the most widely used organisms in freshwater biomonitoring of human impact (Bonada et al., 2006), but studies on aquatic insects often focus on their larvae. There is no study in detail on adults of the families examined here.

Aquatic insect fauna is easily affected by deteriorating water quality and therefore many species migrate to other suitable habitats due to high pollution. In light of this, adults of aquatic insects can be used as a freshwater monitor (Daly, 1984; Ward, 1991).

This is the first study that records aquatic Coleoptera and physico-chemical parameters simultaneously.

Researchers and local officials can use these findings afterwards in order to estimate the lake's current state.

Levels of water quality parameters were determined and evaluated according to Turkish Water Pollution and Control Regulations (TWPCR). There are 4 main classes

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according to TWPCR: high quality water (I), weakly polluted water (II), polluted water (III), and highly polluted water (IV) (TWPCR, 2004).

Materials and Methods

Sahara-Karagöl was declared one of 33 Turkish National Parks by the Turkish government in 1994. The park has 2 main areas: Sahara plateau and Lake Karagöl (totally 3,766,000 m²). Lake Karagöl (Figure) is located in 45 km north of Şavşat district, Artvin Province, north-east Anatolia, and covers a 25,000 m² area at 1615 m altitude. There is no permanent inlet into or outlet from the lake. The surrounding area is covered by dense spruce forest. Two fish species (*Salmo trutta* and *Carassius carassius*) and some rare aquatic coleopteran species are recorded from the lake (Incekara et al., 2004). Lake Karagöl is a natural lake not polluted by either industrial or domestic sewage, and therefore it was selected as the research area.

A transitional climate between the humid Black Sea climate and terrestrial climate is dominant. At the lake and surrounding area the winters are long. The area receives snow from November to April, but the lake surface is never entirely covered by ice.

Water samples and beetle samples were taken simultaneously on the 20th day of every month. The beetles were collected by means of a sieve having a 1 mm mesh aperture from shallow areas of the lake (10 min sampling at the same speed). The material was preserved in 70% alcohol solution and then carefully cleaned with a small paint brush in the laboratory before identification.



Figure. Lake Karagöl.

The water quality parameters pH, dissolved oxygen, temperature, and total dissolved solids were measured on site using a portable multimeter (WTW multiline P-4 F SET-3).

Total hardness and chloride were measured according to Standard Methods (AWWA, 1985). Total organic matter levels were determined as total organic carbon by a TOC analyser (Teledyne-Tekmar Apollo 9000). Metal ions (Fe, Cu, Mn, Zn, Pb, Cd) were measured using an atomic absorption spectrophotometer (Perkin-Elmer).

Results and Discussion

In total, 407 specimens of aquatic Coleoptera were retrieved for this study. Physico-chemical parameters of the sampling habitat and numbers of specimens sampled are presented in Tables 1 and 2. According to TWPCR, sampling waters are class I (high quality water) in regard to TDS, TOC, Fe, Cu, Mn, Zn, and Pb, but the TWPCR class I limits are exceeded temporarily for t, pH, Cl, and Cd (Table 1).

Imagines of most aquatic coleopterans are active flyers and leave the water only for dispersal flights (they generally migrate to another habitat when the habitat changes negatively) (Daly, 1984). Additional beetle material has been collected from Lake Karagöl in different surveys each year since 2001 (total 1856 individuals; in 2001: 211; 2002: 221; 2003: 240; 2004: 262; 2005: 263; 2006: 252; 2007: 407). These results show that this habitat is permanently inhabited by water beetles. A reason for this might be the stability of physicochemical parameters in the lake during the whole summer, which most probably arises from the facts that:

- a) There is no inlet and outlet of water into/from the lake.
- b) Housing development surrounding the lake is planned and regulated by the government.
- c) Inputs of pesticides, herbicides, and fertilisers into the lake from surrounding farmland have been restricted by the government.

Statistical analysis showed that the periodical changes in the numbers of specimens of *Enochrus (L.) fuscipennis*, *Helochaeres punctatus*, *Coleostoma orbiculare*, and

Table 1. Physicochemical parameters of sampling habitat.

Parameters	Sampling date					Class I waters according to TWPCR
	Jun	Jul	Aug	Sep	Nov	
t [°C]	25.40	28.40	28.50	21.90	19.00	25
pH	8.37	8.77	9.35	8.70	8.80	6.5-8.5
DO [sat. %]	82	95	129	85	81	99
Cl [mg/l]	43.20	21.00	19.50	22.00	23.00	25
TDS [mg/l]	105.00	107.00	103.00	102.00	104.00	500
H [mg as CaCO ₃ /l]	31.40	28.80	32.20	29.30	30.27	-
TOC [mg/l]	0.80	0.22	0.56	0.18	0.25	5
Fe [µg/l]	61.80	72.10	81.50	56.90	60.70	300
Cu [µg/l]	0.18	0.23	0.36	0.18	0.29	20
Mn [µg/l]	1.72	1.38	1.49	1.55	1.65	100
Zn [µg/l]	2.80	2.40	3.50	2.10	3.90	200
Pb [µg/l]	3.48	3.17	2.98	2.80	3.32	10
Cd [µg/l]	1.10	9.30	6.90	5.00	7.80	3

Table 2. Species numbers at sampling site.

Species	Sampling date				
	Jun	Jul	Aug	Sep	Nov
<i>Laccobius bipunctatus</i> (Fabricius, 1775)				2	
<i>L. obscuratus</i> Rottenberg, 1874				10	
<i>L. syriacus</i> Guillebeau, 1896				23	
<i>L. striatulus</i> (Fabricius, 1801)				63	
<i>Enochrus fuscipennis</i> (Thomson, 1884)		5	5	6	9
<i>Helochaeres punctatus</i> Sharp, 1869	4	9	4	8	7
<i>Coleostoma orbiculare</i> (Fabricius, 1775)	15	21	17	18	11
<i>Helophorus discrepans</i> Rey, 1885					9
<i>Hydrochus ignicollis</i> Motschulsky, 1860	27	36	18	39	64

Hydrochus ignicollis might be related to the 4 physicochemical parameters t, TDS, Pb, and Cd in Lake Karagöl. Whether these parameters directly affect the beetle populations remains unknown so far as the abundance of beetle species is changing during their generation cycle and is affected by various parameters.

These results are current for this studied lake only, and in order to generalise this suggestion more studies are required in the future.

Nomenclature

t: Temperature (°C); DO: Dissolved Oxygen (saturation %); Cl: Total Chloride Concentration (mg/l); P: Phosphate Concentration (mg/l); TDS: Total Dissolved Solids (mg/l); TH: Total Hardness (mg CaCO₃/l); TOC: Total Organic Carbon (mg/l); Fe: Iron Concentration (µg/l); Cu: Copper Concentration (µg/l); Mn: Manganese Concentration (µg/l); Zn: Zinc Concentration (µg/l); Pb: Lead Concentration (µg/l); Cd: Cadmium Concentration (µg/l).

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