

Records of Plecoptera (Insecta) species and affects of episodic acidification on physico-chemical properties of their habitats in the Eastern Black Sea Region and Yeşilirmak River Basin (Turkey)

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ABSTRACT

1. This paper provides records of 13 Plecoptera species from streams in the Eastern Black Sea Region and Yeşilirmak River Basin.
2. Physical and chemical variables of habitats such as dissolved oxygen, temperature, pH, conductivity, current speed, turbidity, calcium and magnesium hardness, nitrite, nitrate, ammonia, phosphate and sulphate were also given.
3. The orthophosphate concentrations (between 1.865 and 2.686 mg/l) were high and pH values were low between 4 and 6.8 (episodic acidification) in collecting sites due to increasing floods of melted-snow and rainfall in spring and early summer period. Episodic acidification is a serious problem and has been reported from Turkey for the first time.
4. Global climate change led to earlier snowmelt and increased frequency of floods in the Eastern Black Sea Region.
5. Reasons of low species richness of Plecoptera may be explained either by degradation of their habitat because of the effects of organic pollution, industry, recreation and/or long-term effects of global climate change.

KEY WORDS: Eastern Black Sea Region, episodic acidification, flood, global climate change, Plecoptera species, running waters, snowmelt, streams, Turkey, water quality, Yeşilirmak River Basin.

Doğu Karadeniz Bölgesi'nden ve Yeşilırmak Nehri Havzası'ndan Plecoptera (Insecta) tür kayıtları ve dönemsel (episodik) asidifikasyonun türlerin habitatlarının fiziko-kimyasal özellikleri üzerine etkisi

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ÖZ

1. Bu yayında, Doğu Karadeniz Bölgesi'ndeki çaylardan ve Yeşilırmak Nehri Havzası'ndan 13 Plecoptera tür kaydı verilmiştir.
2. Habitatların çözünmüş oksijen, sıcaklık, pH, kondüktivite, akıntı hızı, bulanıklık, kalsiyum ve magnezyum sertliği, nitrit, nitrat, amonyum ortofosfat, sülfat gibi fiziksel ve kimyasal değişkenleri verilmiştir.
3. Bahar ve erken yaz döneminde kar erimesi ve yağmur nedeni ile ortaya çıkan seller toplama yapılan istasyonlarda, ortofosfat konsantrasyonlarında yükselmeye (1.865 mg/l-2.686 mg/l) ve pH değerlerinin 4 ve 6.8 arasında düşük bir değerde (dönemsel asidifikasyon) olmasına neden olmuştur. Dönemsel asidifikasyon önemli bir sorun olup Türkiye'den ilk defa kaydedilmektedir.
4. Küresel iklim değişikliği, Doğu Karadeniz Bölgesi'nde karın erken erimesine ve sellerin sıklaşmasına yol açmıştır.
5. Plecoptera'nın düşük tür zenginliğinin nedeni organik kirlilik, endüstri, rekreasyon, küresel iklim değişikliğinin uzun süreli etkisiyle habitatlarının bozulması olabilir.

ANAHTAR KELİMELER: Akarsular, çaylar, Doğu Karadeniz Bölgesi, dönemsel asidifikasyon, küresel iklim değişikliği, Plecoptera türleri, sel, su kalitesi, Türkiye, Yeşilırmak Nehri Havzası.

INTRODUCTION

The Eastern Black Sea Region is one of the most biologically rich regions on Earth and accepted as a biodiversity hotspot with other parts of Caucasus Region. The Caucasus Region is one of the “WWF Global 200 Ecoregions” and it is also included in the list of top 25 hotspots in the world (Kreuer *et al.* 2001). In spite of this position the benthic macroinvertebrate fauna and physico-chemical properties of running waters of the Eastern Black Sea Region are not known.

Aquatic fauna of the Eastern Black Sea Region was impacted by various anthropogenic activities. Intensive tourism, pollution, physical alteration, hydroelectric power plants, water withdrawal and physical alteration affect the habitat quality of aquatic ecosystems in Eastern Black Sea Region.

Yeşilirmak River originates from Eastern Anatolia and reach to the Black Sea. The length of the river is 519 km and drainage area is 36129 km². Important pollution sources of the river are industries, sewage from urban areas and agricultural runoff (Jaoshvili 2002).

The benthic macroinvertebrate communities are valuable indicators of running waters. Among the benthic macroinvertebrate taxa, the Plecoptera is the best indicator of ecological conditions of running waters (Rosenberg and Resh 1993). Because their aquatic larvae are inhabitants of reference habitats with high water quality (Wallin *et al.* 2003). Plecoptera species are at higher risk of extinction than other aquatic taxa because of their narrow range of tolerance for environmental conditions, limited dispersal ability and very restricted distributions (Fochetti and Tierno de Figueroa 2008).

In this research, records of 13 Plecoptera species belong to Filopalpia Suborder were given from Eastern Black Sea Region and Yeşilirmak River Basin. Also physico-chemical characteristics of collecting sites were given.

METHODS AND MATERIALS

Sampling was carried out at 16 sampling sites at the beginning of June 2009. Dissolved oxygen (YSI 550 oxygen meter), temperature, pH, conductivity (YSI multiprobe system) and current speed (Hydrobios, rod held current meter) were measured in the field.

Turbidity, calcium and magnesium hardness, nitrite, nitrate, ammonia, phosphate, sulfate (DR/890 Datalogging Colorimeter) were measured according to HACH (2005). Leica MZ75 binocular stereo microscope was used for identifications.

RESULTS

Environmental features of the streams

Physical variables

Stream order ranged from 1 to 3 with two subrenal watercourses and elevation of the sites was between 1000 m and 2600 m . Substratum structure was similar at all sites, and consisted mainly of rocks, boulders, cobbles, pebbles and sands. Water temperature values were between 10.68 °C and 17.18 °C. Turbidity values were high at some sites: 1-41 FAU. Maximum current speed (2.03 m/s) was recorded at upstream site of Altindere Stream (Trabzon). The minimum current speed (0.07 m/s) was measured at one of tributaries of Aksu Stream (Giresun).

Chemical variables

Conductivity values recorded were between 30 mS/cm and 492 mS/cm. The dissolved oxygen values recorded were high between 8 mg/l and 12.5 mg/l. The streams were acidic with pH ranging from 4 to 6.8. Calcium (1.42-0 mg/l) and magnesium (2.66-0.85 mg/l) hardness were low. Nitrite concentrations were between 0.0006 mg/l and 0.001 mg/l. Nitrate (0-0.113 mg/l) and ammonia (0-0.233 mg/l) concentrations were low. Phosphate concentrations were generally high, 1.865-2.686 mg/l except two stations (0-0.33 mg/l). Sulphate concentrations were low, 3-80 mg/l.

Species list of Plecoptera

Brachyptera transcaucasica transcaucasica Zhiltzova 1956

Giresun: Dereli Town, Kümbet Plateau, 1700m, 2. 6. 2009, 25♀; Giresun: Dereli Town, Kümbet Plateau, Koçkayası, 1700m, 2. 6. 2009, 3♂, 4♀; Giresun: Dereli Town, Kümbet Plateau, Erik Stream, 1700m, 2. 6. 2009, 2♂; Trabzon: Zigana Pass, 2010m, 5. 6. 2009, 3♀.

Nemoura carpathica Illies 1963

Giresun: Dereli Town, Kümbet Plateau, Kanlıhan Bridge, 1700m, 2. 6. 2009, 1♂, 3♀.

Nemoura cinerea turcica Zwick 1978

Trabzon: Maçka Town, Altındere National Park, Tributary of Altındere Stream, 1700m, 4. 6. 2009, 2 ♂, 2 ♀; Gümüşhane: Şiran Town, Tomara Fall, Tributary of Kelkit Stream, 1400m, 5. 6. 2009, 4 ♀; Gümüşhane: Şiran Town, Tomara Fall, Tributary of Kelkit Stream, 1400m, 6. 6. 2009, 2 ♂, 1 ♀.

Nemoura martynovia Claassen 1936

Giresun: Dereli Town, Kümbet–Dereli Road, small stream, 1400m, 1. 6. 2009, 3 ♀; Giresun: Dereli Town, Kümbet Plateau, Kanlıhan Bridge, 1700m, 2. 6. 2009, 3 ♂, 5 ♀; Giresun: Dereli Town, Kümbet Plateau, Erik Stream, 1700m, 2. 6. 2009, 3 ♂, 1 ♀; Trabzon: Zigana Pass, 2010m, 5. 6. 2009, 1 ♂, 1 ♀; Gümüşhane: Şiran Town, Tributary of Kelkit Stream, 1400m, 6. 6. 2009, 2 ♀.

Nemoura taurica Zhiltzova 1967

Giresun: Dereli Town, Kümbet Plateau, Erik Stream, 1700m, 2. 6. 2009, 1 ♂, 1 ♀.

Protonemura bacuriana bacuriana Zhiltzova 1957

Giresun: Dereli Town, Kümbet Plateau, Koçkayası, 1700m, 2. 6. 2009, 1 ♂, 3 ♀; Trabzon: Zigana Pass, 2010m, 5. 6. 2009, 4 ♂, 5 ♀; Trabzon: Maçka Town, Altındere National Park, Tributary of Altındere Stream, 1800m, 4. 6. 2009, 1 ♂.

Protonemura microstyla Martynov 1928

Trabzon: Maçka Town, Altındere National Park, Tributary of Altındere Stream, 1700m, 4. 6. 2009, 1 ♂, 2 ♀.

Protonemura triangulata Martynov 1928

Rize: İkizdere Town, Anzer Plateau, 3000m, 22. 7. 2008, 2 ♂.

Leuctra minuta minuta Zhiltzova 1960

Giresun: Dereli Town, Kümbet Plateau, Kanlıhan Bridge, 1700m, 2. 6. 2009, 2 ♀; Giresun: Dereli Town, Kümbet Plateau, 1700m, 2. 6. 2009, 2 ♀.

Leuctra sipahilarae Vinçon and Sivec 2001

Trabzon: Maçka Town, Altındere National Park, Altındere Stream, 1000m, 4. 6. 2009, 2 ♂; Trabzon: Maçka Town, Altındere National Park, Tributary of Altındere Stream, 1700m, 4. 6. 2009, 2 ♀.

Isoperla grammatica (Poda 1761)

Gümüşhane: Şiran Town, Tomara Fall, Tributary of Kelkit Stream, 1400m, 5. 6. 2009, 1 ♂, 1 ♀.

Plesioperla sakartvella (Zhiltzova 1956)

Trabzon: Zigana Pass, 2010m, 5. 6. 2009, 2 ♂, 1 ♀.

Marthamea vitripennis (Burmeister 1839)

Tokat: Zile-Çekerek Road, Çekerek Stream, 1000m, 7. 6. 2009, 2 ♂.

DISCUSSION

Thirteen Plecoptera species belong to Filpalpia Suborder were recorded from Eastern Black Sea Region and Yeşilırmak River Basin.

More than 3497 species have been described in the world and the fauna of Europe contains 426 species (Fochetti and Tierno de Figueroa 2008). Plecoptera Fauna of Turkey includes 93 species and nine subspecies (Kazancı 2009). Fauna of Turkey comprises 3% of World Fauna and 24% of European Fauna.

The faunal composition of Plecoptera of Turkey were revealed by Zwick (1971, 1975, 1978, 1982), Theischinger (1976a,b, 1979), Kazancı (1981, 1982, 1983a, b, 1985,1986, 1994, 2000, 2001, 2008, 2009), Vinçon and Sivec (2001), Sivec and Stark (2002), Vinçon and Zhiltzova (2004).

Decrease in water quality and habitat loss due to various human activities contribute to the decline in Plecoptera diversity with other aquatic insect orders.

The records of 13 species indicates low species richness in early summer period which is the suitable period for emergence of many Plecoptera species belong to Filpalpia Suborder in studied region. Reason of low species richness may be caused by their threatened habitat because of the effects of organic pollution, industry, recreation and long-term effects of global climate change.

The pH values were low (between 4 and 6.8) and orthophosphate phosphor (between 1.865 and 2.686 mg/l) concentrations were high in all collecting sites due to increasing floods of melted-snow and rainfall in research area in spring and early summer.

The reasons of low pH (between 4 and 6.8) values were increasing floods of melted-snow and rainfall in spring and early summer period. The pH values were between 7 and 8.58 in the same region at the end of July 2008. Also high phosphate (between 1.865 and 2.686 mg/l) concentrations of collecting sites associated with two mentioned factors constitute an important water quality threat in studied running waters. The concentration of pollutant in the first meltwater leaving the snowpack is an important water quality threat.

Episodic acidification due to spring runoff is a serious problem and has been reported from various regions of the world. The acid neutralizing capacity (ANC) decrease during periods of high streamflow in melt season. The decrease of the ANC is a result of large inputs of snowmelt. Atmospheric deposition and natural processes can affect nature of episodic acidification (Davies *et al.* 1993, Jacks *et al.* 1986). In this study, episodic acidification was given from Turkey for the first time.

Global climate change led to earlier snowmelt and increased frequency of floods in the Eastern Black Sea Region.

Numbers of summer days have been increasing all over Turkey especially northern part stations have greatest trends. Warm days and warm nights have been increasing all over Turkey while cool days and cool nights have been decreasing (Şensoy *et al.* 2008). Impacts of global climate change on benthic macroinvertebrates in running waters (Kazancı and Dügel 2006, Kazancı 2007, Kazancı and Dügel 2008) and lake ecosystems (Kazancı, Girgin and Dügel 2008a, Kazancı, Girgin and Dügel 2008b) in Turkey were given.

The ANC decline and pH alteration associated with snowmelt and heavy rain are important threat to aquatic communities.

The low species number of Plecoptera may be affected by above mentioned physicochemical structure of larval habitats during study period.

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