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Full Length Research Paper

Lepidoptera fauna of Yuvacik dam watershed in Kocaeli, Turkey

Vedat BEŞKARDEŞ

Game and Wildlife Program, Vocational School of Forestry, Istanbul University, Istanbul, Turkey.
E-mail: vkardes@istanbul.edu.tr.

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The aim of this study is to determine Lepidoptera fauna of the Yuvacik Dam Watershed in Kocaeli. The study was conducted in 2007 from March to November. 493 specimens were collected from study area. A total of 119 species belonging to 16 families of Lepidoptera order were identified. *Polyommatus dorylas* [(Den and Schiff, 1775) and *Zerynthia cerisy* (Godart, 1822)] are considered as Near Threatened (NT) category according to IUCN Butterflies Red List Criteria.

Key words: Lepidoptera, Yuvacik, Kocaelis, species, fauna.

INTRODUCTION

Species diversity is generally higher in Turkey than in any other country of Europe or the Near East, in plants as well as in animals, not only in butterflies and moths but also in other orders of insects (Wagener, 2006). Lepidoptera order including butterflies and moths are very common insects and well known because of very attractive colors and patterns on their wings. This order is recognized as one of the largest order of insects (Romoser and Stoffolana, 1994). The number of Lepidoptera species was estimated about 255.000 by Heppner (1991). However, according to Kristensen et al. (2007), the number of Lepidoptera species has reached 500.000. In Turkey (Koçak and Kemal, 2009), there has been living 5182 Lepidopteran species belonging to 76 families. The larvae of most lepidopteran species are phytophagous and some of them are very serious agriculturally and forestry pests. On the other hand, adults play an important role in the natural ecosystem as pollinators (Hizal, 2007). However, butterflies do not visit flowers randomly, but have specific flower preferences which can differ between species and even between the sexes of a species. Furthermore, nectar plant distribution can affect dispersion and habitat use of butterflies (Erhardt and Mevi-Schütz, 2005). In addition, their aesthetics play a significant role, butterfly and adults of many species may serve as inspiration for artists and designers (Borror et al., 1989). Butterflies have very specific food and habitat requirements at different stages of their life cycle. They are therefore particularly sensitive to modifications of their environment and serve as an excellent indicator of the status of the ecosystems. They are especially sensitive to changes in habitat management such as overgrazing, under grazing or changes in forestry practice.

More than half of the butterfly species inhabiting grasslands, woodlands and scrubs are home to about a quarter of the species while the rest are found in other types of ecosystems (Van Swaay et al., 2010). In Turkey, first researches on Lepidoptera were initiated by European entomologists in the middle of the 19th century. Up to date, many researches on Lepidoptera have been done in Turkey (Hesselbarth et al., 1995). The main objective of this study was to identify Lepidoptera species living in Yuvacik Dam watershed in Kocaeli.

MATERIALS AND METHODS

Study area

The study area is located at 40°40' N and 29° 58' E. Yuvacik dam was constructed for potable water supply in Kocaeli province. Yuvacik Dam Watershed area is 25800 ha. In this area there are three major streams fed on by numerous creeks. Also Huseyinli pond located at an altitude of 730 m and used for irrigation is within the watershed. Average altitude of the area ranges from 170 to 1300 m. In the watershed, 16 settlement sites, 12 villages and 4 plateaus camping ground are located. There are also lands set

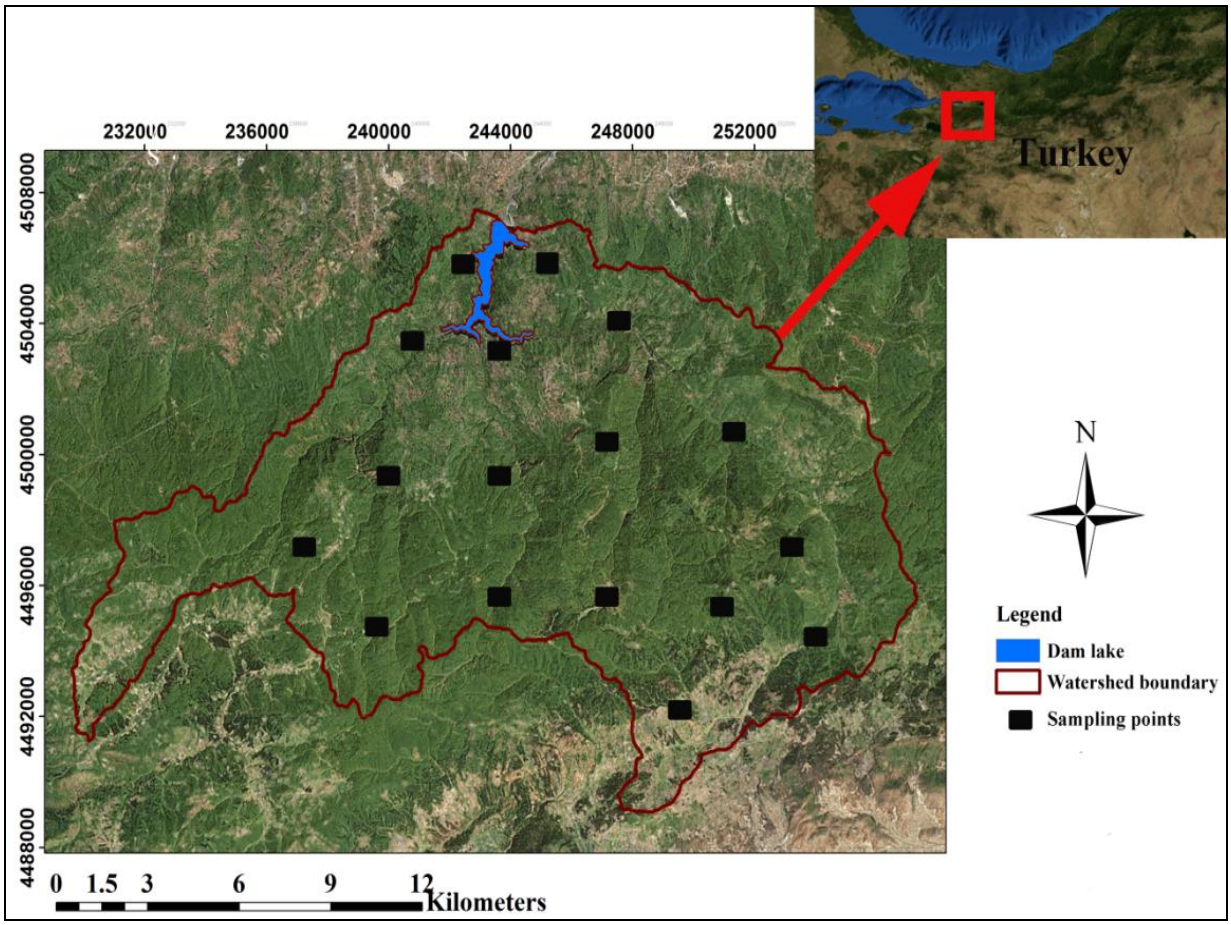

Figure 1. Yuvacik Dam Watershed boundary and Lepidoptera sampling points.

aside for agricultural and livestock grazing and scrub and forest areas. Orientel beech (*Fagus sylvatica* ssp. *orientalis*), oaks (*Quercus* spp.), common hornbeam (*Carpinus betulus*), Austrian pine (*Pinus nigra*.), Scots pine (*P. sylvestris*) and Turkish fir (*Abies nordmanniana* ssp. *bornmülleriana*) are the predominant forest tree species in the watershed. Some other species such as sweet chestnut (*Castanea sativa*), common hazel (*Corylus avellana*), Alder (*Alnus glutinosa*), Euroasian aspen (*Populus tremula*), walnut (*Juglans regia*) are also found in the dam watershed. Forests are made up with pure as well as mixed stands of these particular species. Zengin et al. (2005) reported the mean annual precipitation as 1038.7 mm and the mean annual temperature as 9.5°C. The region, according to Thornthwaite methodology has a climate pattern reflecting somewhat similar oceanic climate parameters such as humidity, temperate warmth and no water shortage.

The study was carried out in Yuvacik Dam Watershed in 2007 from March to November and different localities and habitat types were visited (Figure 1). Specimens were collected using a sweep net and light trap (simply one light source and one piece of white cloth) and by hand picking. Collected specimens were killed in killing jars with ethyl acetate. During the collection, the collection date, GPS coordinates of the locality, vegetation type and altitude was noted on a piece of envelope for every specimen. Each specimen was then put into this envelope and all materials were brought to the laboratory for preparation and identification. Each specimen was pinned using no: 0 to 3 insect pin and the wings were mounted on a spreading board. After the specimens dried, they were numbered and placed in insect boxes. Each Lepidopteran specimen was identified using an Olympus stereomicroscope. For identification, different studies (Spuller, 1908, 1910; Beirne, 1954; Chinery, 1984, 1986; Marini and Trentini, 1986; Hesselbarth et al., 1995) were used. Some important forest pests among the collected species were also reported. The specimens of the identified species are stored at the 'collection museum' of the Forest Entomology and Protection Department, Faculty of Forestry, Istanbul University and some specimens are exhibited at Akifer Company Management Building, Kocaeli - Turkey.

RESULTS

A total of 493 Lepidoptera specimens were collected in the study. A total of 119 species belonging to 16 families of Lepidoptera order were identified and are listed as follows according to Karsholt and Nieukerben (2011). In addition, the Lepidoptera species' number, the most observed butterflies, moths, and their habitat types were given in Tables 1 and 2. Most of the lepidopteran species were caught in June, July and August as 46 species.

Also, most of the individuals were captured in these months (Table 3).

Table 1. Lepidoptera Species' number in Yuvacik dam watershed.

Superfamily	Family	Species number	Individual number
Bombycoidea	Saturniidae	1	1
	Sphingidae	3	15
Cossoidea	Cossidae	1	2
Geometroidea	Geometridae	14	39
Lasiocampoidea	Lasiocampidae	5	6
Noctuoidea	Erebidae	12	24
	Noctuidae	15	35
	Notodontidae	3	4
Papilionoidea	Hesperiidae	7	13
	Lycaenidae	15	47
	Nymphalidae	22	148
	Papilionidae	5	22
	Pieridae	9	128
Pterophoroidea	Pterophoridae	1	1
Pyraloidea	Pyralidae	2	3
Zygaenoidea	Zygaenidae	4	5
		119	493

Table 2. Habitat types of the most observed butterfly and moth species in the study area.

Species	Habitat	Material	Altitude (m)
Macroglossum stellatarum (L., 1758)	5, 7, 8, 10, 11, 12	April - September 2007, 6♀, 7♂	170-800
Autographa gamma (L., 1758)	1, 3, 6, 7, 8, 9	July - November 2007 6♀, 6♂	420-990
Polyommatus icarus (Rottemburg, 1775)	5, 7, 8, 9, 11, 12	April - August 2007 8♀, 10♂	170-930
Vanessa cardui (L., 1758)	1, 2,5, 7, 8, 9, 12	April – November 2007 11♀, 9♂	170-950
Maniola jurtina (L., 1758)	2, 3, 5, 7, 8, 9, 12	May – August, 2007 6♀, 7♂	170-1000
Colias croceus (Fourcroy, 1785)	2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12	April – September 2007 15♀, 15♂	170-1270
Pieris napi (L., 1758)	2, 4, 5, 7, 8, 9, 10, 11, 12	April – September 2007 17♀, 16	170-950
Pieris rapae (L., 1758)	2, 5, 6, 8, 9, 12	March – November 2007 5♀, 5♂	170-880

Habitat types: 1: opening, 2: shrubland and opening, 3: conifer and opening, 4: conifer and agricultural area, 5: shrubland, 6: agricultural area, 7: agricultural and opening area, 8: broadleaf forest (mainly oak, beech and the other species), 9: broadleaf forest and Opening, 10: mixed (conifer and broadleaf), 11: broadleaf and Shrubland, and 12: broadleaf and agricultural area.

Table 3. The abundance of Lepidopteran specimen caught monthly.

2007	March	April	May	June	July	August	September	October	November
Individual number	12	37	70	93	107	73	69	23	9
Species number	8	23	34	46	46	46	27	14	8

Super family: Bombycoidea

Family: Saturniidae

Subfamily: Saturninae

1) *Saturnia pyri* ([Den. & Schiff.], 1775)
Family: Sphingidae
Subfamily: Macroglossinae
2) *Deilephila porcellus* (L., 1758)
3) *Macroglossum stellatarum* (L., 1758)
Subfamily: Sphinginae
4) *Sphinx ligustri* L., 1758
Super family: Cossoidea
Family: Cossidae
Subfamily: Zeuzerinae

5) *Zeuzera pyrina* (L., 1761)
Superfamily: Geometroidea
Family: Geometridae
Subfamily: Ennominae
6) *Abraxas sylvata* (Scop., 1763)
7) *Ematurga atomaria* (L., 1758)
8) Peribatodes rhomboidaria (Den. & Schiff., 1775)
9) *Peribatodes secundaria* (Den. & Schiff., 1775)
10) *Colotois pennaria* (L., 1761)
11) *Ennomos erosaria* (Den. & Schiff., 1775)
12) *Ennomos quercinaria* (Hufn., 1767)
13) *Selenia lunularia* (Hbn., 1788)
14) *Opisthograptis luteolata* (L., 1758)
15) *Gnophos sartata* (Treit, 1827)
Subfamily: Larentinae
16) *Aplocera praeformata* (Hbn., 1826)
17) *Cosmorhoe ocellata* (L., 1758)
Subfamily: Sterrhinae
18) *Scopula caricaria* (Reutti, 1853)
19) *Scopula decorata* (Den. & Schiff., 1775)
Superfamily: Lasiocampoidea
Family: Lasiocampidae
Subfamily: Lasiocampinae
20) *Eriogaster rimicola* (Den. & Schiff., 1775)
21) *Lasiocampa eversmanni* (Eversm., 1843)
22) *Lasiocampa trifolii* (Den. & Schiff., 1775)
Subfamily: Malacosomatinae
23) *Malacosoma alpicola* Staud., 1870
Subfamily: Poecilocampinae
24) *Poecilocampa populi* (L., 1758)
Superfamily: Noctuoidea
Family: Erebidae
Subfamily: Arctiinae
25) *Arctia villica* (L., 1758)
26) *Euplagia quadripunctaria* (Poda, 1761)
27) *Phragmatobia fuliginosa* (L., 1758)
28) *Eilema complana* (L., 1758)
29) *Lithosia quadra* (L., 1758)
Subfamily: Erebinae
30) *Euclidia glyphica* (L., 1758)
31) *Grammodes bifasciata* (Fabr., 1775)
32) *Dysgonia algira* (L., 1767)
Subfamily: Lymantriinae
33) *Leucoma salicis* (L., 1758)
34) *Lymantria monacha* (L., 1758)
35) *Euproctis chrysorrhoea* (L., 1758)
Subfamily: Scoliopteryginae
36) *Scoliopteryx libatrix* (L., 1758)
Family: Noctuidae
Subfamily: Acontiinae
37) *Aedia funesta* (Esp., [1786])
38) *Aedia leucomelas* (L., 1758)
39) *Nyctobrya muralis* (Forst., 1771)
Subfamily: *Heliothinae*
40) *Helicoverpa armigera* (Hbn., [1805])
Subfamily: Noctuinae
41) *Melanchra persicariae* (L., 1761)
42) *Mythimna l-album* (L., 1767)
43) *Mythimna unipuncta* (Haw., 1809)
44) *Agrotis ipsilon* (Hufn., 1766)
45) *Lycophotia molothina* Esp., 1789
46) *Peridroma saucia* (Hbn., [1808])
47) *Noctua comes* (Hbn., [1813])
48) *Noctua fimbriata* (Schreb., 1759)
49) *Tiliacea aurago* (Den. & Schiff., 1775)
Subfamily: Plusiinae
50) *Chrysodeixis chalcites* (Esp., 1789)
51) *Autographa gamma* (L., 1758)
Family: Notodontidae
Subfamily: Notodontinae
52) *Furcula bifida* (Brahm, 1787)
53) *Pheosia tremula* (Clerck, 1759)
Subfamily: Thaumetopoeinae
54) *Thaumetopoea pityocampa* ([Den. & Schiff.], 1775)
Superfamily: Papilionoidea
Family: Hesperiidae
Subfamily: Hesperinae
55) *Ochlodes venata* (Brem., and Grey, 1853)
56) *Thymelicus sylvestris* (Poda, 1761)
Subfamily: *Pyrginae*
57) *Muschampia tessellum* (Hbn., [1802])
58) *Pyrgus armoricanus* (Obth., 1910)
59) *Pyrgus malvae* (L., 1758)
60) *Pyrgus melotis* (Dup., [1834])
61) *Spialia orbifer* (Hbn., [1823])
Family: Lycaenidae
Subfamily: Lycaeninae
62) *Lycaena candens* (H.-S., [1845])
63) *Lycaena phlaeas* (L., 1761)
64) *Lycaena tityrus* (Poda, 1761)
Subfamily: Polyommatinae
65) *Aricia anteros* (Frey., [1838])
66) *Aricia artaxerxes* (Fabr., 1793)
67) *Leptotes pirithous* (L., 1767)
68) *Plebejus argus* (L., 1758)
69) *Polyommatus bellargus* (Rott., 1775)
70) *Polyommatus ossmar (Gerhard, [1851])*
71) Polyommatus daphnis ([Den. & Schiff.], 1775)
72) Polyommatus cornelius (Frey., [1850])
73) Polyommatus dorylas ([Den. & Schiff.], 1775)
74) *Polyommatus icarus* (Rott., 1775)
Subfamily: Theclinae
75) *Callophrys rubi* (L.,, 1758)
76) *Satyrium ilicis* (Esp., [1779])
Family: NYMPHALIDAE
Subfamily: Heliconiinae
77) *Argynnis paphia* (L., 1758)
78) *Argynnis adippe* (Rott., 1775)
79) *Argynnis pandora* ([Den. & Schiff.], 1775)
80) *Issoria lathonia* (L., 1758)
Subfamily: Limenitidinae
81) *Limenitis reducta* Staud., 1901
Subfamily: Melitaeinae
82) *Euphydryas aurinia* (Rott., 1775)

83) *Melitaea athalia* (Rott., 1775)
84) *Melitaea cinxia* (L., 1758)
85) *Melitaea didyma* (Esp., [1779])
86) *Melitaea trivia* ([Den. & Schiff.], 1775)
Subfamily: Nymphalinae
87) *Inachis io* (L., 1758)
88) *Polygonia c-album* (L., 1758)
89) *Vanessa atalanta* (L., 1758)
90) *Vanessa cardui* (L., 1758)
Subfamily: Satyrinae
91) *Coenonympha arcania* (L., 1761)
92) *Coenonympha pamphilus* (L., 1758)
93) *Lasiommata megera* (L., 1767)
94) *Pararge aegeria* (L., 1758)
95) *Maniola jurtina* (L., 1758)
96) *Melanargia galathea* (L., 1758)
97) *Brintesia circe* (Fabr., 1775)
96) *Minois dryas* (Scop., 1763)
Family: PAPILIONIDAE
Subfamily: Papilioninae
99) *Iphiclides podalirius* (L., 1758)
100) *Papilio machaon* L., 1758
Subfamily: Parnasiinae
101) *Zerynthia caucasica* (Led., 1864)
102) *Zerynthia cerisy (God., 1822)*
103) Zerynthia polyxena ([Den. & Schiff.], 1775)
Family: PIERIDAE
Subfamily: Coliadinae
104) *Colias croceus* (Fourcr., 1785)
105) *Colias sareptensis* Staud., 1881
106) *Gonepteryx rhamni* (L., 1758)
Subfamily: Dismorphiinae
107) *Leptidea sinapis* (L., 1758)
Subfamily: Pierinae
108) *Anthocharis cardamines* (L., 1758)
109) *Pieris brassicae* (L., 1758)
110) *Pieris bryoniae* (Hbn., [1804])
111) *Pieris napi* (L., 1758)
112) *Pieris rapae* (L., 1758)
Superfamily: Pterophoroidea
Family: Pterophoridae
Subfamily: Pterophorinae
113) *Cnaemidophorus rhododactyla* Den. & Schiff., 1775
Superfamily: Pyraloidea
Family: Pyralidae
Subfamily: Crambinae
114) *Catoptria pinella* (L., 1758)
Subfamily: Spilomelinae
115) *Palpita unionalis* (Hbn., 1796)
Superfamily: Zygaenoidea
Family: Zygaenidae
Subfamily: Procridinae
116) *Jordanita graeca* (Jordan, 1907)
Subfamily: Zygaeninae
117) *Zygaena brizae* (Esp., 1800)
118) *Zygaena filipendulae* (L., 1758)
119) *Zygaena loti* (Den. & Schiff., 1775)

DISCUSSION

Provincial lists are important sources of regional information about a variety of Lepidoptera species (Clench, 1979). This study provided faunistic knowledge of Lepidoptera species of Yuvacik Watershed for Kocaeli province. Since the area has different ecosystems such as forests, agricultural areas, many streams and riparian areas. It was expected higher numbers of Lepidoptera species. Kaygin et al. (2009) identified for Bartin province 103 Lepidoptera species and Akbulut et al. (2003) found 109 species for Duzce province. In this study, 119 species were determined. In the study area, among captured butterflies, *Polyommatus dorylas* (Den and Schiff, 1775) and *Zerynthia cerisy* (God, 1822) are considered as 'near threatened' status according to IUCN Butterflies Red List Criteria (Van Sway et al., 2010). In this study, *P. dorylas* was represented by one individual and *Z. cerisy* two females and one male. For this reason, they can be thought as least common butterfly species for the study area. Nymphalidae (22 species), Noctuidae (15 species), Lycaenidae (15 species), Geometridae (14 species), Erebidae (12 species), Pieridae (9 species) were found as the most represented families in decreasing order (Table 1). *Zeuzera pyrina* (L., 1761), *Euproctis chrysorrhoea* (L., 1758), *Lymantria monacha* (L., 1758), *Thaumetopoea pityocampa* (Den and Schif, 1775), *Autographa gamma* (L., 1758) are considered to be harmful in forestry in Turkey (Çanakçioğlu and Mol, 1998). *Helicoverpa armigera* (Hbn., 1805) and *Agrotis ipsilon* (Hufn., 1766), found in this study are pest of agricultural crops.

The first is harmful on *Fragaria* sp. (Yildirim and Başpinar 2008) and the second is harmful on maize crop (*Zea mays*) as well (Ölmez et al., 2009). In addition, according to Çakan and Okyar (2007), *M. l-album* is a pest of Poaceae family. However, none of these Lepidoptera species has reached potential damage density for the area during the study.

According to the results, *Pieris napi* (L., 1758), *Leptidea sinapis* (L., 1758), *Colias croeceus* (Fourcroy, 1785), *Vannessa cardui* (L.1758), *Coenonympha pamphilus* (L., 1758), *Pieris brassicae* (L., 1758), *Pieris rapae* (L., 1758), *Maniola jurtina* (L., 1758) were not only most found and common butterfly' species but also could be seen from April to October in the study area.

The most seen moth species were collected from *Autographa gamma* and *Macroglossum stellatarum* (Table 2). The summer months are more appropriate for butterflies and moths' species to mate and regenerating activity (Akbulut et al., 2006; Kaygin et al., 2009; Ayberk et al., 2010).

The moths begin to disappear in autumn due to the shortage of food and cool temperature (Okyar et al., 2009). Thus, in summer, the abundance of variety of Lepidoptera species occurred higher than the other months in the study (Table 3).

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