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Full Length Research Paper

Vulnerability of *Megacephala* (*Grammognatha*) *euphratica euphratica* Latreille & Dejean, 1822 (Coleoptera: Cicindelidae) in natural and disturbed salt marsh and salt meadow habitats in Turkey

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This study was carried out to determine the differentiation between populations inhabiting *Megacephala euphratica euphratica* & Dejean, 1822 (Coleoptera: Cicindelidae) in natural and disturbed salt marsh habitats in Göksu (Mersin Province) and Çukurova (Adana Province) Deltas in Turkey, for the period of 2005 and 2010. Correlation between anthropogenic effects (cattle grazing and drainage channels) and population dynamics of *M. e. euphratica* was calculated. Population dynamic of *M. e. euphratica* was not stable during the study years in the disturbed salt marsh and was found as rapidly descent according to the natural habitat. Cluster analysis used to quantify the associations of population of *M. e. euphratica* between sampling years showed that variation of the population of insect species in the natural habitats was not different from each other in the different years as much as in the disturbed habitats. The results showed that population density of the species were more rapidly decreased in the disturbed salt marsh habitats than the natural ones. Threatened category of *M. e. euphratica* was investigated according to IUCN Red List of Threatened Species Categories and its current situation in terms of being a threatened species was also discussed.

Keywords: Distribution, ecology, habitat preferences, IUCN, threatened factors, *Megacephala euphratica euphratica.*

INTRODUCTION

Approximately 2300 tiger beetles species have been described to date (Cassola and Pearson, 2000). They are found nearly all over the world's land surface and most of the species of tiger beetles integrate with their own habitat (Cassola and Pearson, 2000; Pearson and Vogler, 2001; Aydin et al., 2005). Detailed studies of their natural history, population dynamics, communities, patterns of worldwide species richness and taxonomy of particular sub-groups have produced much information. Tiger beetles, as a result, are among the most widely investigated insects, especially in terms of their ecology and geographic distribution. However, the details of this wealth of information have been briefly synthesized in only a few widely available sources (Pearson, 1988; Aydin et al., 2006).

Most of the salt marsh and salt meadow areas where species are present in Turkey are badly influenced by many other human activities (Figure 1). Moreover, some threatening factors such as agriculture, cutting, harvesting and burning plants, grazing, urban development, wrong and/or deficiency practicing management plans and even recreation can cause habitat degradation. In this study, we provided the most important threatening factors for the existence of *Megacephala euphratica euphratica* Latreille & Dejean, 1822 and its' unique habitats were summarized, and the reasons why *M.e.euphratica* should be considered as a vulnerable species for Turkey were explained. Detailed information on tiger beetle species, *M. e. euphratica*, which assumed very important roles in food cycle and valuable importance in bio-diversity and species richness of Turkey, is given. Although, the mentioned species have very important roles for nature, there is no detailed research on tiger beetle before they became vulnerable species

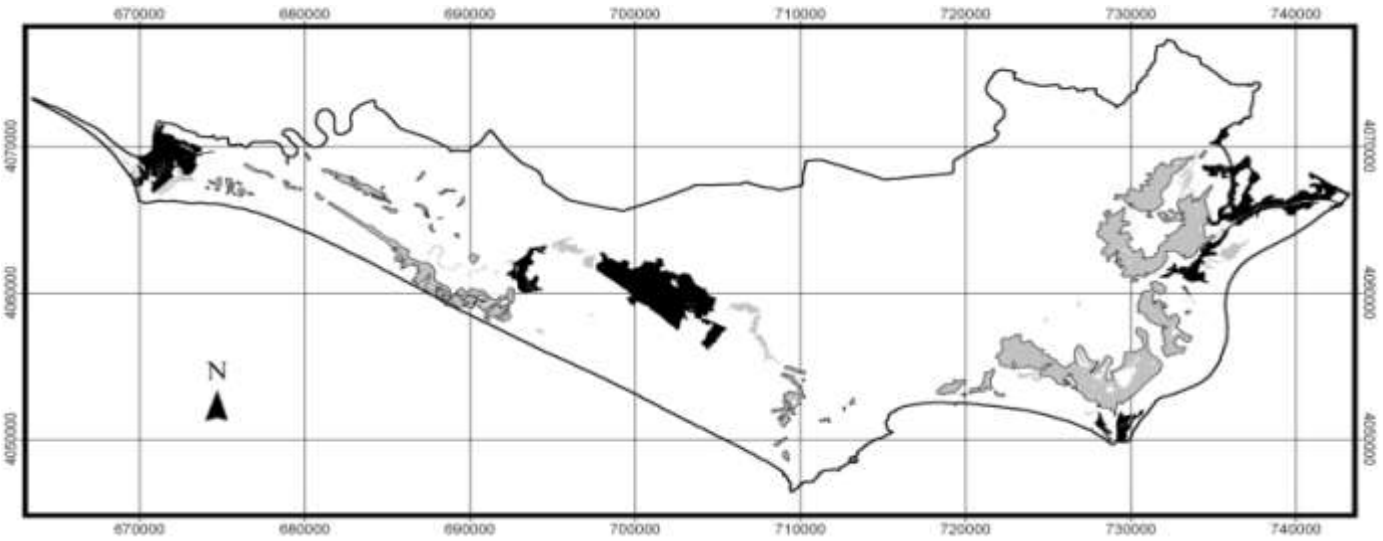

Figure 1. Investigation of salt marsh and salt meadow habitat for habitat degradation in Çukurova Delta, Adana (black, partially protected; grey, high risk for being lost; grey with black line, highly disturbed by agriculture and cattle and sheep grazing).

for Turkish insect fauna. The aim of the study was therefore, to examine the habitat degradation and to take note of declining population of *M. e. euphratica* in the course of this study.

MATERIALS AND METHODS

The species of tiger beetle was observed in the period of 2005 to 2010 in Çukurova (Adana Province), and Göksu Deltas (Mersin Province) where a large amount of *M. e. euphratica* population was found in Turkey. Since adults are nocturnal, portable fluorescent light was utilized during the night to count the adult of the species, for approximately 15 min for each habitat in order to compare the population dynamic of the mentioned species (*M. e. euphratica)* for five years and different intensities of anthropogenic effects. Six salt marsh habitats where species are mainly present were chosen in Göksu and Çukurova Deltas. To demonstrate differentiation between populations inhabiting natural and disturbed habitats, two natural (under tourism activity in summer season) salt marsh habitat in Göksu delta, Mersin Province, three disturbed (by cattle grazing from 2005 to 2010; drainage channels from 2007 to 2010) and one transformed from salt marsh to agricultural habitats were selected in Çukurova Delta, Adana Province. An analysis of variance (ANOVA) (Duncan test) was calculated to test the differences between number of individual adults among the five different sites. To equalize the statistical analysis and compare the individual adults of the species, data was evaluated from May to August in 2005, 2007, 2008, 2009 and 2010. Averages variable were calculated one by one for each month. Analyses of unweighted pair group mean averages (UPGMA) were used to quantify the associations between years. Percentage of similarity test was applied to the resulting UPGMA dendogram. The UPGMA analyses were performed with the multi variant statistical package (MVSP) version 3. 11c (Kovach, 1999).

RESULTS AND DISCUSSION

The average number of *M. e. euphratica* adults of 14.80, 14.25, 10.75, 6.50, and 8.75 was found in the natural salt marshes in Göksu Delta in 2005, 2007, 2008, 2009 and 2010, respectively. Unlike in the disturbed salt marshes, Çukurova Delta, had 22.60, 14.60, 10.50, 6.25 and 5.25 in the study years; however, the data obtained from the salt marsh habitat that was turned into agricultural land in Adana was not assessed because the species could not be sampled during the study years. Population differences of *M. e. euphratica* were not found statistically significant between the year 2005 and 2007 according to Duncan test. However, comparison of populations was found statistically significant in 2009 and also in year 2005 and 2007 in Mersin. Table 1 and Figure 2 show that the increasing population of *M. e. euphratica* in 2010 was found similar with the whole sampling years in the natural and salt marsh habitats. Population density of tiger beetle species in 2005 was found statistically significant according to the population density of *M. e. euphratica* in the other sampling years in Çukurova Delta, Adana. The highest and lowest population density of the species was found to be 22.6 and 5.25 in the disturbed salt marsh habitats in Çukurova Delta in 2005 and 2010, respectively (Figure 2). This relation shows that the features of the habitat had been lost and it is getting in-appropriate for the species to survive in the disturbed habitats.

The results showed that population density of the species decreased in the natural and disturbed salt marsh habitats in Mersin and Adana; however, decline in the population was more rapid in the disturbed salt marsh in Çukurova Delta than in the natural habitat in Göksu Delta (Figure 2).

Population of *M. e. euphratica* in 2007 and 2008 were found to have 78% similarity to each other and 75.2% similarity with the population of the species in 2010, according to the result of percent similarity test in the

Table 1. Yearly mean number of *M. e. euphratica* adults in Adana and Mersin in the period of 2005 to 2010 (Mean ± SE).

Site	2005		2007		2008		2009		2010	
	n	Mean	n	Mean	n	Mean	n	Mean	n	Mean
Mersin	20	14.80±1.75^{a}	8	14.25±2.08^{a}	8	10.75±1.52^{ab}	8	6.50±0.94^{b}	8	8.75±1.05^{ab}
Adana	30	22.60±2.07^{a}	15	14.60±1.33^{b}	18	10.50±0.88^{bc}	12	6.25±0.69^{c}	12	5.25±0.89^{c}

Different letters indicates the significant difference among the means over the years ($p < 0.01$) according to Duncan test.

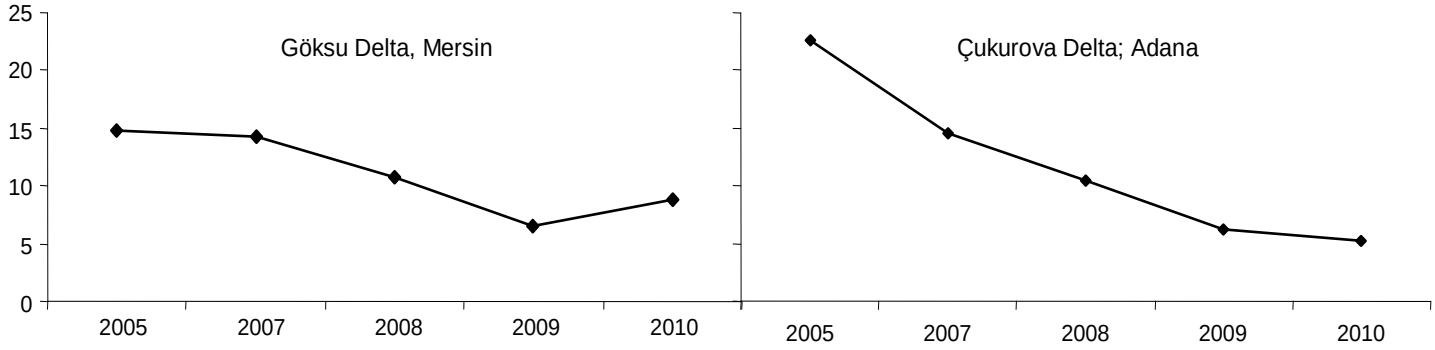

Figure 2. Average number of *M. e. euphratica* adults in the natural (left) and disturbed (right) salt marsh habitats in the period of 2005 to 2010.

natural salt marsh habitats. However, the population of *M. e. euphratica* in 2005 had 37.8% similarity with other sampling years in Göksu Delta. Comparison of the population dynamic in the disturbed salt marsh habitats by cattle grazing and drainage channels in Çukurova Delta showed that the most similar sampling years were found to be 2009 and 2010 (82.6%) while population of the species in 2005 was found to be only 30.8% similar with other sampling years (Figure 3).

It was obvious that the population of *M. e. euphratica* decreased in both the natural and disturbed areas in the period of 2005 and 2010. Nevertheless, species population in the disturbed salt marsh habitats showed a rapid decline when compared with the natural salt marsh habitat. Even if the population of the species declined in the natural salt marsh habitat in Göksu Delta between 2005 and 2009, the population of the species increased by 25.7% in the last study year (2010).

M. e. euphratica had been verified to exist in Çukurova delta since 2001 by Şekeroğlu and Aydin (2002); its population showed downward trend in disturbed habitats. Most of the salt marsh and salt meadow habitats were turned into agricultural lands, destroyed by cattle and sheep grazing (Figure 1).

Almost 80% of the salt marsh habitat was turned into the agricultural lands from 1985 to 2003 in the northern part of Karataş in Çukurova Delta (Tischew et al., 2004) and this circumstance still persist till date. There are numerous studies on the use of these species as bio-indicator for habitat description, destruction and some environmental effects (Şekeroğlu and Aydin 2002; Aydin et al., 2005; Aydin, 2006). The species was found to have a statistical significance for habitat determination (Aydin and Kazak, 2010). Population dynamic and present/past situation of *M. e. euphratica* is positively affected by clay, salinity, potassium and zinc in the soil, while amount of the sand in the habitat negatively affects the present situation of the species (Aydin, 2006). Şekeroğlu and Aydin (2002) and Aydin et al. (2005) declared that *M. e .euphratica* was determined in salty areas and could not be located in any other habitat types in Çukurova Delta. Salt marsh transformed into agricultural lands lost habitat qualifications and the proportion of the sand increased because of the sand carried from the sand dune habitat by local people. Thus, either the population of *M. e. euphratica* is decreased or the present situation of the species in this kind of distorted habitat is negatively affected.

Conclusion

Salt marshes and salt meadows play a very important role in aquatic food web and in the exportation of nutrients to coastal waters. They also provide support to terrestrial animals such as migrating birds as well as providing coastal protection. Salt marsh has a value that is related to its flood and coastal defense function, ecosystem and conservation importance, as well as its role in pollution control, waste disposal and the maintenance of

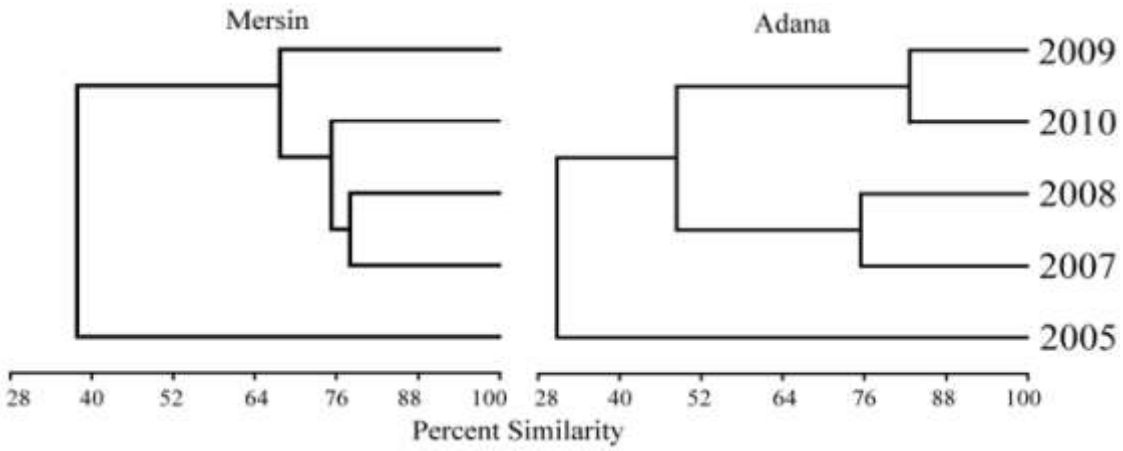

Figure 3. Cluster analysis of individual adults of *M. e. euphratica* similarity among the sampling years.

water quality, fisheries, agriculture, recreation and tourism. This value is based on the interaction of its basic components (soil, water, flora and fauna), their physical shape (including channels and salt marsh surfaces) and the assemblage of plants and animals which they hold. It is therefore, important to develop an understanding of both the requirements of these habitats and when and how to intervene in order to manage it (Adnitt et al., 2010). The unique habitats of *M. e. euphratica* salt marsh and salt meadow are highly attractive natural feature to humans through its beauty, resources and accessibility. Moreover, some threatening factors such as agriculture, cutting, harvesting and burning plants, grazing, urban development, wrong and/or deficiency practicing management plans and even recreation can cause the habitat degradation.

According to the IUCN Red List of Threatened Species Categories (IUCN, 2001), a taxon is vulnerable when the best available evidence indicates that it meets any of the criteria: "(1) reduction in population size; (2) geographic range; (3) population size estimated to a number fewer than 10,000 matured individuals; (4) population very small or restricted; (5) quantitative analysis showing that the probability of extinction in the wild is at least 10% within 100 years" for vulnerability, and it is therefore, considered to be facing a high risk of extinction in the wild. *M. e. euphratica* needs to be considered as a vulnerable species because according to IUCN categories, this study confirmed that population size reduction of the species was ≥30%. Over the last 10 years, antropogenic effects showed that it is projected or suspected to be met within the next 10 years.

Species richness is an important asset for a country, besides its historical and cultural richness. Although, Turkey has 1/5 of the total land covered by European countries, it has an overwhelming number of endemic plant species. The records show that the European countries other than Turkey possess 12,000 species of which 2750 are endemic. In Turkey, the number of plant species was estimated as 9,000 of which 3000 of them are endemic to our country (Ekim et al., 2000). Despite all these information, insect species richness and their threatened categories in Turkey have not been studied as much as floristic studies. Therefore, some insect species have become extinct before we investigated their values for the nature.

In the case of preventing the factors mentioned earlier that are negatively affecting the species presence, the current vulnerable situation of the species which will likely be extinction level can provide suitable environmental condition to preserve these species to function in its role in the trophic system.

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