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# Human Threats to Population of Endemic Sand Dune Cricket (*Schizodactylus inexpectatus*)

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## ABSTRACT

Endemic sand dune cricket, *Schizodactylus inexpectatus*, (Orthoptera: Schizodactylidae) occupy only in the sand dune habitats of Adana and Mersin provinces of Turkey in the world. Although human presence is prohibited on these sand dune protected areas, (Çukurova Delta & Göksu Delta) without a government permit the law is not enforced and tourism, grazing, sand excavation and agricultural lands to the protected areas are increasing. In this study, all localities, where *S. inexpectatus* lives were examined and relation between population dynamic of endemic sand dune cricket and some anthropogenic affects were determined. Endemic sand dune cricket was found with low population in disturbed sand dune habitats according to natural ones. © 2011 Friends Science Publishers

**Key Words:** Indicator species; Sustainable land usage; Human effects; Endemism; Turkey

## INTRODUCTION

Schizodactyloidea has the single family Schizodactylidae. Schizodactylidae, or splay-footed crickets, are an unusual group of large, fearsome-looking predatory insects related to the true crickets, katydids and grasshoppers, in the order Orthoptera (Sciencedaily, 2011). The members of the family include fossil, 100 million year-old ancestor of the family, broadly expanded by the possession of lobelike or digitiform processes, which enable the crickets to run across dry sandy surface with efficiency. They get their common name from the large, paddle-like projections on their feet, which help support their large bodies as they move around their sandy habitats, hunting down prey. Two genera, Schizodactylus occur in parts of India, Myanmar, soutwest Asia and Comicus in South Africa, together 15 species are known (Resh & Carde, 2009; Sciencedaily, 2011).

The first speciment of *Schizodactylus inexpectatus* (Werner, 1901) (Orthoptera: Schizodactylidae) was accidentally found from the Cilician Taurus near to Gülek in Turkey by MARTIN HOLTZ in 1897 and described as *Comicus inexpectatus* by WERNER in 1901 (Ramme, 1931; Uvarov, 1952). RAMME formally transferred it to *Schizodactylus* in 1931 (Uvarov, 1952) and described differences between the genus *Comicus* and *Schizodactylus* in the same year (Ramme, 1931). The second time the adult *S. inexpectatus* was sent from Turkey, Mersin, Alata in 14 April 1950 to UVAROV by KARABAG (Karabağ, 1958) and it was described by MAX BEIER. It generally was thought as the extinction of the species from Turkey (Demirsoy, 1999). After more than 50 years later from the second record, the third record was exposed by Aydın (2005) and investigated to obtain basic information related to distribution and habitat preferences of the species in Cukurova Delta. Except its distribution there was only one detailed study about biology, nymphal stages, and life habits of *S. inexpectatus* (Aydın & Khomutov, 2008).

Some of the other members of the family, Schizodactylidae, such as *S. monstrosus* and *S. minor*, occur along the shores of River Indus in Pakistan and River Ganga (India), have been investigated and their biology discovered nowadays (Channa, *et al.*, 2011). The rest of the members of the family, except three species, *S. inexpectatus*, *S. monstrosus* and *S. minor* could not been studied and we just known that they had extinct species and/or the species which has insufficient data.

In this study we examined population dynamic of endemic sand dune cricket *S. inexpectatus* in natural and disturbed sand dune habitats in Turkey. The aim of the study was also provide information about population decline of *S. inexpectatus* to find out and give possibilities for the protection strategies of the species to the Turkish government authority to prevent from becoming extinct of the mentioned species.

## MATERIALS AND METHODS

The study was carried out in 26 sand dune habitats in Adana and Mersin provinces (Turkey), where are

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exclusive localities for endemic sand dune cricket in the world between November 2007 and November 2008 (Table I). All sand dune habitats were classified under eight main groups for different anthropogenic affects, such as; goat paths, disturbed by cattle grazing, sand excavation, agricultural land, tourism. Natural and disturbed sand dune habitats were examined 60 min for determining population of *S.inexpectatus* weekly. Since endemic sand dune cricket is nocturnal after midnight adults and nymphs were recorded on the schedule by at least two persons walking through the habitat with the aid of portable fluorescent light and projector.

The hierarchical agglomerative classification analysis unweighted pairgroups method using arithmetic averages (UPGMA) was used to examine the compositional similarity of the insect population layer at each study site (Kovach, 1999). Data of the population data was used in classification analysis for each site, and percentage similarity was chosen as the similarity measure.

One-way analysis of variance (ANOVA) was used to examine differences in population of the *S. inexpectatus* in natural and disturbed sand dune habitats Duncan multiple range test was used to distinguish means when ANOVAs were significant.

## RESULTS

During the study, we recorded 7204 individuals of *S. inexpectatus* from natural and disturbed sand dune habitats. In the natural habitats, 787, 1535 and 943 individuals of *S. inexpectatus* from D1, D2 and D3, respectively of *S. inexpectatus* was counted as 2416 in the all disturbed sand dune habitats by the goat paths (between P4 & P14). Disturbed sand dune by cattle grazing was also examined and 322, 296 and 232 individuals were recorded in B15, B16 and B17, respectively. The other affect, sand excavation and agricultural land badly affected population of endemic cricket and they were found only 357 individuals in whole year in KT19-22. Tourism activity in sand dune habitats also negatively affected population of *S. inexpectatus* and it was counted 316 individuals during the study year (T23-25) (Fig. 1). Population of *S. inexpectatus* was sighted whole year. However, increasing of the population was determined in June and September especially in natural habitats (Fig. 1). Sand excavation and agricultural lands negative affected population dynamic of the insect and irregular population was seen the whole year. Population of endemic sand dune cricket was determined with low population around June and July in disturbed sand dune habitats by tourism.

According to DUNCAN test, population of the insect species in natural sand dune habitat was found statistically different than the population found in disturbed habitats (Table II). The population of cricket in

**Fig. 1: Population of endemic sand dune cricket *S.inexpectatus* in natural and disturbed sand dune habitats in Turkey**

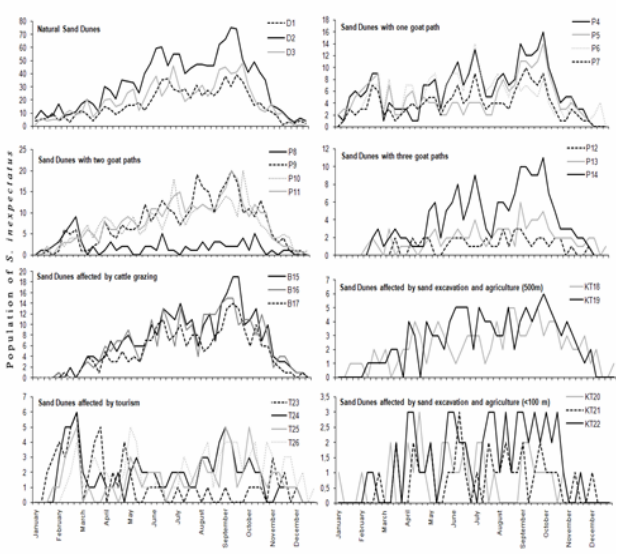
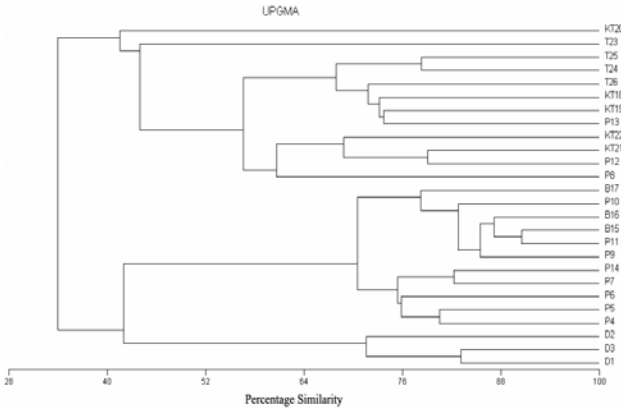



**Fig. 2: An analysis of Unweighted Pair-Group Mean Averages (UPGMA) shows the clustering relationships of population dynamic of *S. inexpectatus* among 26 sand dunes**




sand dunes with two goat paths (P9, P10 & P11) and disturbed sand dune by cattle grazing (<50) (B15) are not found statistically significant to each others. Although P8, P12, P13, KT22, T23, T24, T25 and T26 were chosen as sand dune habitats with different anthropogenic affects, population of S. inexpectatus in these habitat were not found statistically important (Table II).

Fig. 2 shows classification of 26 sand dune habitats chosen for different anthropogenic affects. According to analysis of Unweighted Pair-Group Mean Averages (UPGMA) the most similar habitats were P11, with two goat paths and B15 disturbed by cattle grazing (<50) with 90.5%. The group composed by P11 and B15 was found 87.139% similar with B16, which was disturbed by cattle

**Table I: Determined natural and disturbed sand dune habitats of endemic sand dune cricket, *Schizodactylusinexpectatus,* in Turkey**

| Code | Village names | Anthropogenic affects | Coordinates(Lat/Lon° - WGS 84) |
|---|---|---|---|
| D1 | Kapı (Adana) | Natural | N36.61'012 E35.25'119 |
| D2 | Kaldırım (Adana) | Natural | N36.68'647 E35.65'476 |
| D3 | Deveciuşağı (Adana) | Natural | N36.76'777 E35.73'051 |
| P4 | Kapı (Adana) | with one goat path | N36.62'045 E35.23'271 |
| P5 | Kaldırım (Adana) | with one goat path | N36.70'309 E35.64'306 |
| P6 | Deveciuşağı (Adana) | with one goat path | N36.76'957 E35.74'845 |
| P7 | Yumurtalık (Adana) | with one goat path | N36.76'799 E35.79'059 |
| P8 | Karataş (Adana) | with two goat path | N36.56'048 E35.34'705 |
| P9 | Kaldırım (Adana) | with two goat path | N36.68'692 E35.63'633 |
| P10 | Yumurtalık (Adana) | with two goat path | N36.75'766 E35.76'539 |
| P11 | Alata (Mersin) | with two goat path | N36.37'340 E34.20'390 |
| P12 | Karataş (Adana) | with three goat path | N36.55'375 E35.35'265 |
| P13 | Erdemli (Mersin) | with three goat path | N36.60'356 E34.32'366 |
| P14 | Göksu Delta (Mersin) | with three goat path | N36.17'450 E33.55'430 |
| B15 | Kaldırım (Cattle <50) (Adana) | Disturbed by cattle grazing (<50) | N36.69'950 E35.62'288 |
| B16 | Kaldırım (Cattle 50-100) (Adana) | Disturbed by cattle grazing (50-100) | N36.67'996 E35.62'202 |
| B17 | Kaldırım (Cattle >100) (Adana) | Disturbed by cattle grazing (>100) | N36.66'783 E35.61'250 |
| KT18 | Tuzla (Adana) | sand excavation and 500 m far from agricultural land | N36.68'153 E35.08'805 |
| KT19 | Kaldırım (Adana) | sand excavation and 500 m far from agricultural land | N36.70'017 E35.60'522 |
| KT20 | Tuzla (Adana) | sand excavation and 100 m far from agriculture land | N36.69'411 E35.05'053 |
| KT21 | Karataş (Adana) | sand excavation and 100 m far from agriculture land | N36.57'845 E35.34'033 |
| KT22 | Kaldırım (Adana) | sand excavation and 100 m far from agriculture land | N36.70'152 E35.59'570 |
| T23 | Karataş (Adana) | Tourism | N36.54'656 E35.35'097 |
| T24 | Yumurtalık (Adana) | Tourism | N36.75'856 E35.79'619 |
| T25 | Erdemli (Mersin) | Tourism | N36.60'670 E34.33'307 |
| T26 | Göksu Delta (Mersin) | Tourism | N36.18'320 E33.52'330 |

grazing (50-100). The sand dune habitats chosen as natural D1 and D3 were 83.1% similar to each other. The other natural sand dune habitat, D2, was 71.6% similar with the group composed by D1 and D3, which was supported by the UPGMA analysis. All sand dune habitats contained goat paths and disturbed by cattle grazing were seen that they created groups in the UPGMA dendogram. The habitats affected by tourism were similar and they composed group (T24 & T25; 78.3%). KT20 was only 33.9% similar for the all other habitats.

## DISCUSSION

Among 26 sand dune habitats based on UPGMA, the greatest similarity of the population of endemic sand dune cricket was between P11 and B15 (90.5%). According to UPGMA analysis population of *S. inexpectatus* in natural sand dune habitats were also 83.1% similar to each other. The present study showed that endemic sand dune cricket, *S. inexpectatus*, had high population in undisturbed sand dune habitats. The present study also confirmed that population of the endemic cricket, *S. inexpectatus* decreased because of habitat destruction.

*S. inexpectatus* is found in all types of sand dunes present in the embryonic shifting dunes, shifting dunes along the shore-line, fixed dunes, fixed grey dunes, maquis dunes, secondary shifting dunes and *Pinus*-dune woodland however most of the unique habitat of *S. inexpectatus* sand dunes are a highly attractive natural feature to human through its beauty, resources and accessibility. Moreover, some threatening factors; such as cattle and sheep grazing, cutting, harvesting and burning plants, tourism, urban development, sand excavation, wrong and/or deficiency practicing management plans and even recreation can cause of habitat degradation.

According to the IUCN Red List of Threatened Species Categories (IUCN, 2001); A taxon is Critically Endangered when the best available evidence indicates that it meets any of the following criteria;

(A). Reduction in population size based on any of the following;

(1). An observed, estimated, inferred or suspected population size reduction of ≥90% over the last 10 years or three generations, whichever is the longer, where the causes of the reduction are clearly reversible AND understood AND ceased, based on (and specifying) any of the following;

(a). Direct observation, (b). An index of abundance appropriate to the taxon, (c). A decline in area of occupancy, extent of occurrence and/or quality of habitat, (d). Actual or potential levels of exploitation, (e). The effects of introduced taxa, hybridization, pathogens, pollutants, competitors or parasites.

Tischew *et al*. (2004) declared that almost 90% of the sand dune habitats in Çukurova Delta, which is the unique habitats for the endemic sand dune cricket, were

**Table II: Yearly mean number of *S. inexpectatus* in natural and disturbed sand dune habitats in Turkey**

| Habitat Codes | n | Population (Mean±SE) | |
|---|---|---|---|
| D1 | 48 | 16,395±1,587 | C |
| D2 | 48 | 31,979±2,972 | A |
| D3 | 48 | 19,645±1,918 | B |
| P4 | 48 | 6,1666±0,581 | DE |
| P5 | 48 | 4,7500±0,467 | DEFG |
| P6 | 48 | 5,2291±0,445 | DEF |
| P7 | 48 | 3,7708±0,367 | EFGH |
| P8 | 48 | 1,8541±0,273 | HI |
| P9 | 48 | 7,4166±0,801 | D |
| P10 | 48 | 7,0625±0,653 | D |
| P11 | 48 | 7,5625±0,739 | D |
| P12 | 48 | 0,9791±0,141 | HI |
| P13 | 48 | 1,8125±0,201 | HI |
| P14 | 48 | 3,7291±0,462 | EFGH |
| B15 | 48 | 6,7083±0,758 | D |
| B16 | 48 | 6,1666±0,693 | DE |
| B17 | 48 | 4,8333±0,578 | DEFG |
| KT18 | 48 | 2,2083±0,204 | GHI |
| KT19 | 48 | 2,5416±0,271 | FGHI |
| KT20 | 48 | 0,6875±0,123 | I |
| KT21 | 48 | 0,7083±0,115 | I |
| KT22 | 48 | 1,2916±0,176 | HI |
| T23 | 48 | 1,2708±0,228 | HI |
| T24 | 48 | 1,7916±0,217 | HI |
| T25 | 48 | 1,5625±0,200 | HI |
| T26 | 48 | 1,9583±0,202 | HI |

* Different letters indicates the significant difference among the means over the years ($p < 0.05$) according to DUNCAN test

taken into the agricultural lands between 1985 and 2003 supported by the Landsat 5 TM and Landsat 7 ETM satellites (Tischew *et al.*, 2004).

Although there is not enough study about *S. inexpectatus* except during the last decade (Aydin, 2005; Aydin & Khomutov, 2008), it is clear that the population of *S. inexpectatus* seems to be decreasing, as many of their unique habitats are destroyed by anthropogenic factors. Endemic sand dune cricket should be included in IUCN (World Conservation Union)'s Red List of Endangered Species as "critically endangered species (CR)," because its population decline cause of habitat destruction.

All members of the family Schizodactylidae include *S. monstrosus*, *S. minor* and *S. inexpectatus* occur along the shores of River Indus in Pakistan, River Ganga (India) and Cukurova and Goksu Delta (Turkey), preferred to live in moist sandy places, because they could not survive in dry, hard or water-logged soil (Aydin, 2005; Aydin & Khomutov, 2008; Channa *et al.*, 2011). Even the habitat preferences of *Schizodactylus* have changed little in over 100 million years (Sciencedaily, 2011). Taking of the mentioned species in this category may be caused of protection of the sand dune habitats and some anthropogenic factors might be prohibited and/or carried on under control in sand dunes with protection laws by the government.

The study about population dynamics of the endemic and/or rare insects like the members of Schizodactylidae under natural and disturbed habitats by anthropogenic affects may be supplied benefit to protect the endemic and/or rare species. Suchlike conservation studies have been carried out for the animals (marine turtles, Mediterranean Monk Seal, etc.), which are easily visible to obtain enough information for protect them in Turkey and many other countries (Gücü *et al.*, 1998; Aureggi, 2003). Conservation studies should be increased also for rare and/or endemic insect species. Also other exist members of Schizodactylidae family such as *S. monstrosus* and *S. minor* should be considered for the tolerance of the habitat destructions and anthropogenic affects to protect them. Otherwise some endemic and rare species such as *S. inexpectatus* endemic for Turkey, *S. monstrosus* (Pakistan) and *S. minor* (India) might be extinct before we could recognize them.

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