Cytogenetic Observations of Pachytodes erraticus (Coleoptera: Cerambycidae: Lepturinae: Lepturini)

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CYTOGENETIC OBSERVATIONS OF *PACHYTODES ERRATICUS* (COLEOPTERA: CERAMBYCIDAE: LEPTURINAE: LEPTURINI)

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Abstract

The paper describes cytogenetic observations of *Pachytodes erraticus* (Dalman 1817) for the first time. Also presented are the distribution of this species in Turkey with a map and in the world, chorotype classification of the species, photos of male genitalia, the mitotic metaphase stage and karyogram. The results indicate that the chromosome number is $2n = 18$.

Key Words: cytogenetic, *Pachytodes erraticus*, Lepturinae, Cerambycidae

Resumen

Se describen las observaciones citogenéticas de *Pachytodes erraticus* (Dalman 1817) por primera vez. También, se presentan la distribución de esta especie en un mapa de Turquía y en el mundo, la clasificación de las especies corotipo, fotos de los genitales masculinos y de los estados metafase mitótica y karyogramatica. Los resultados indican que el número de cromosomas es $2n = 18$.

Palabras Clave: citogenética, Pachytodes erraticus, Lepturinae, Cerambycidae

To date approximately 1,500,000 species of animals have been described worldwide, and 80% of them are insects. Cytogenetic descriptions and analyses have been conducted on only about 1% of all species, and this considered too limited to support comprehensive biological studies. Cytogenetic studies on insects began in the 19th century. The number of chromosomes in various insect species was found to range mainly between $n = 4$ and $n = 20$, but with extremes of $n = 1$ (*Myrmecia croslandi* Taylor, 1991: Formicidae: Hymenoptera) and $n = 217\text{-}223$ (*Polyommatus atlantica* (Elwes, 1905)) (de Lesse 1970; Crosland & Crozier 1986; Gokhman & Kuznetsova 2006).

At the present, unaccompanied external morphological taxonomy is not enough for an indisputable classification of some taxa. Classifications based only on external morphology have caused disagreements and even mistakes in assigning systematic ranks of many taxa. The status of the Vesperidae is a case in point. Svacha et al. (1997) made a study that included the larval morphologies and biologies of a few species, which led them to regard the Vesperidae as a subfamily of the Cerambycidae. Yet Brustel et al. (2002) treated the Vesperidae as a separate family. Dutrillaux et al. (2007) included the karyotype definition of *Vesperus xatarti,* and they, to regarded the taxon as a subfamily of the Cerambycidae. Recently Löbl & Smetana (2010) in their catalog presented the Vesperidae as a subfamily of Cerambycidae. However, current status of knowledge of larval morphologies and cytogenetic data do not support this last designation of the status of the Vesperidae. Consequently the status of this taxon is still under discussion.

Comparative karyology may have some advantages over other methods in taxonomic studies of animals. Chromosomal characters are essentially morphological characteristics. On the other side, some characters of the karyotype, such as the number of chromosomes, arms of chromosomes, nucleolar organizers, heterochromatic blocks, etc., can vary within a species (Gokhman & Kuznetsova 2006).

A number of cytogenetic studies of species of the Cerambycidae have been conducted by investigators in various countries during the past seven decades. For example, Ehara (1956) gave the chromosome numbers of 23 species in Japan belonging to the subfamilies Lepturinae, Cerambycinae and Lamiinae. Teppner (1966) determined the chromosome numbers of 20 species that were distributed in Central Europe. Also Teppner (1968) determined the chromosome numbers of 25 species distributed in Central Europe. Kudoh et al. (1972) gave both the haploid and diploid chromosome numbers of 5 species of the subfamily Lamiinae. Smith & Virkki (1978) compiled all cytogenetic studies on Coleoptera up to 1978 and gave the chromosome numbers of 157 species of Cerambycidae. Vidal (1984) presented the chromosome numbers of 3 long-horned species. Vaio et al. (1985) observed the meiotic chromosomes of 2 species of the genus *Trachyderes.* Lachowska et al. (1996) mentioned both the haploid and diploid chromosome numbers of *Agapanthia violacea* of the subfamily Lamiinae. Holecova et al. (2002) gave the chromosome numbers of 2 long-horned species. Rozek et al. (2004) presenteded the chromosome numbers of 3 long-horned species. Dutrillaux et al. (2007) carried out a karyologic study on the species *Vesperus xatarti* of the subfamily Vesperinae. He presented the chromosome number as $2n = 54 + XX$ (♀) and $2n = 53 + XY_1Y_2$ (♂).

The diploid chromosome numbers of long-horned beetles range between 10 and 36. The sex-chromosome system of long-horned beetles is the parachute type (Xy_p). The most frequent diploid chromosome number in the Cerambycidae is $2n = 20$ ($18AA + Xy_p$) (Smith & Virkki, 1978).

The objectives of this study were to investigate the cytogenetics of the cerambycid species *Pachytodes erraticus* (Dalman, 1817), and to contribute data needed to clarify the taxonomic status of the genus *Pachytodes* Mulsant, 1863.

Materials and Methods

The specimens were collected from Ankara province of Turkey in 2009 and 2010 and were deposited in Gazi University, Ankara, Turkey. The chromosomes were obtained according to the method of Rozek (1994) with some alterations. Thus thee specimens were placed in a killing jar charged with ethyl acetate. Abdomens of the specimens were cut open and the abdominal contents, especially testicular tissue of the male, and mid-gut tissues of both males and females, were transferred into petri dishes with distilled water for 10-15 min. Next the tissues of a single specimen were transferred into a cryotube with 0.05% cholchicine solution, held for 45-60 min at room temperature, and then fixed in 3:1 fresh ethanol-acetic acid solution for at least 1 h. Small pieces from the treated tissues were taken and each piece was mounted on a clear slide. Other tissue pieces were placed in a drop of 45% acetic acid and dissected with a dissection pin and a scalpel. Then, each tissue piece was mounted on a slide, covered either with a cover slip or another glass slide and pressed firmly. These preparations were immersed in liquid nitrogen. The slide and cover slip or the 2 pressed together slides were separated and left to dry. Next the dry preparations were stained with 4% Giemsa Phosphate Buffer (pH = 6.8) for 10 min, and washed with distilled water. After drying, the preparations were examined under a stereo compound microscope (Leica DMLB). The observed chromosomes were photographed with 10X/100X zoom lenses.

Results and Discussion

Subfamily Lepturinae Latreille, 1802

Tribe Lepturini Latreille, 1802

Genus *Pachytodes* Pic, 1891

Type species: *Leptura cerambyciformis* Schrank, 1781

As commonly accepted, the Palaearctic genus, *Pachytodes* Pic, 1891, is represented by only 5 species in the whole world as *P. cerambyciformis* (Schrank, 1781), *P. cometes* (Bates, 1884), *P. erraticus* (Dalman, 1817), *P. longipes* (Gebler, 1832) and *P. orthotrichus* (Plavilstshikov, 1936). The members of the genus are distributed from Spain (western Europe) to eastern Siberia, Far East Russia and China. *P. cerambyciformis* and *P. erraticus* are the most widely distributed members of this genus.

In Turkey, *Pachytode* is represented only by 2 species, i.e., *P. cerambyciformis* (Schrank, 1781), and *P. erraticus* (Dalman, 1817), according to

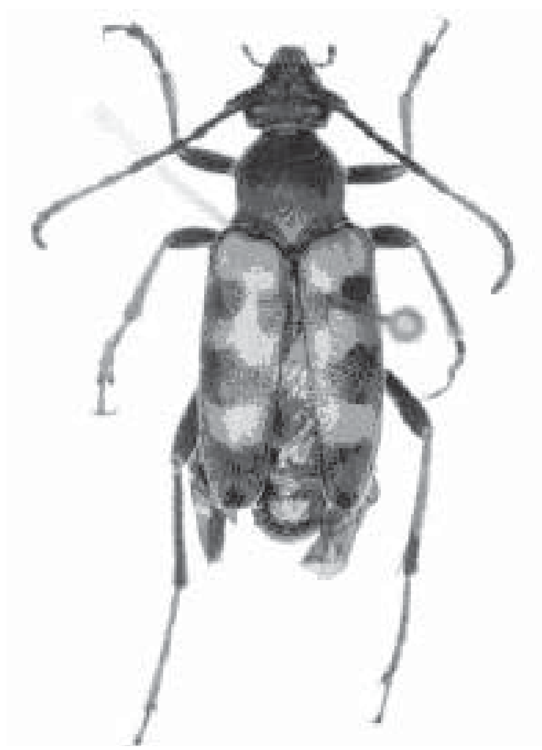
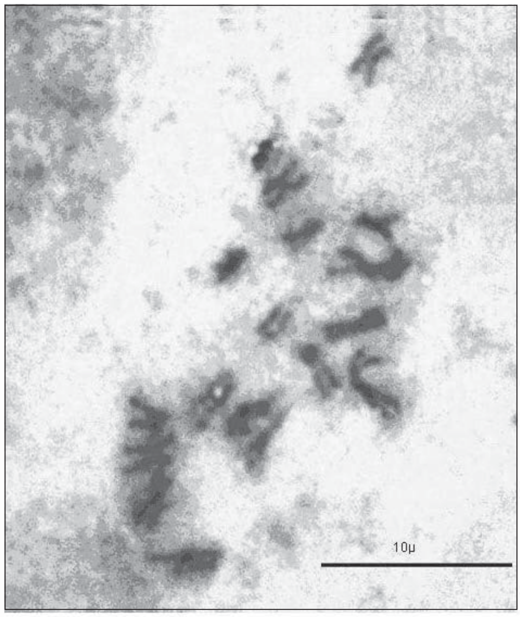


Fig. 1. Habitus of *Pachytodes erraticus* (dorsal view).

A



B

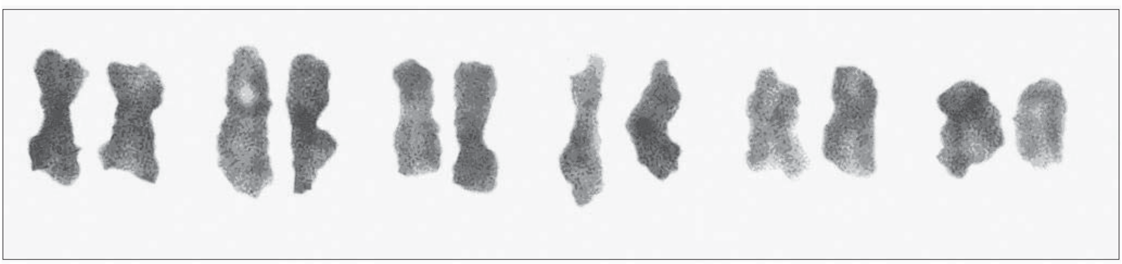


Fig. 2. Chromosomes of *Pachytodes erraticus.* 2A, Mitotic metaphase chromosomes from mid-gut tissue of *P. erraticus*. 2B, Karyogram of *P. erraticus* (2n = 18).

(Özdikmen 2007). Despite this, Löbl & Smetana (2010) mentioned only 1 species for Turkey, i.e., *P. erraticus* (Dalman, 1817).

Pachytodes erraticus (Dalman, 1817)

Original combination: *Leptura erratica* Dalman, 1817

According to Löbl & Smetana (2010), this species has 2 subspecies in the world as the nominotypical subspecies and *P. erraticus bottcheri* (Pic, 1911). The species is represented only by the nominative subspecies in Turkey. It is widely distributed in Turkey (Map 1). The other known subspecies, *P. erraticus bottcheri* (Pic, 1911) occurs in Kazakhstan, West and East Siberia and China.

Pachytodes erraticus erraticus (Dalman, 1817)

Material Examined

TURKEY: Ankara prov.: Beypazarı, İnözü Valley, 03-VI-2009, 1 specimen; 22-VI-2009, 8 specimens; 27-VI-2010, 2 specimens; Ankara prov.: Kızılcahamam, 25-VI-2009, 4 specimens; 11-VII-2009, 1 specimen (Fig. 1).

Cytogenetics

The observed density of chromosomes was low because of the low of mitotic and meiotic activations in the examined material. Like other members of the Coleoptera, long-horned beetles have holometabolous development. In various coleopterans the mitotic and meiotic activities of the larval, pupal and imaginal stages occur diversely. This was evaluated and elaborated by Teppner (1968) with regard to spermatogenesis. He noted that meiosis is initiated in the pre-pupal stage, and that spermatogenesis is accelerated in the last larval instar and is continued in adult. Moreover Teppner observed that time timing of these processes varied among the different taxa, such as subfamilies. Thus, spermatogenesis, which occurs in the last larval instar, decelerates in the adults of the subfamilies Lepturinae and Aseminae, whereas it is continues at the same speed and intensity in the adult stages of the Cerambycinae and Lamiinae. Moreover, the duration of meiosis differs from stage to stage in these taxa.

In the present work, we conducted the cytogenetic investigations in the adults, because the identifications of species of the larvae and pupae are very difficult.

The observed that the chromosomes of long-horned beetles are small, and the centromere regions and the lengths of the arms of the chromosomes could not be clearly discerned. Therefore only the number of chromosomes could be established with precision.

We determined that the diploid chromosome number of the species, *P. erraticus,* was 2n = 18 in the mitotic metaphase in mid-gut tissue of a female (Fig. 2). This diploid chromosome number, namely, 2n = 18, is the first finding for the subfamily Lepturinae (Ehara 1956; Teppner 1966; Smith & Virkki 1978).

The validity of the genus *Pachytodes*, which was described by Pic (1891) as a subgenus of *Judolia* Mulsant, 1863, is under discussion (Özdikmen, 2011). We hope cytogenetic works like this one can provide important data that contributes to the resolution of this discussion. For this reason, at least some North American taxa should be examined cytogenetically.

The male genitalia of *P. erraticus erraticus* are depicted in Fig. 3.

Records of *Pachytodes erraticus erraticus* in Turkey (Fig. 4)

TURKEY: Afyon prov. [Akdağ (Boztepe)] (Özdikmen 2007); Amasya prov. [Merzifon] (Villiers 1959; Adlbauer 1992); Ankara prov. [Beytepe (İncek), Kızılcahamam (Soğuksu National Park, Işık Mountain, Yukarı Çanlı village, Güvem, Yenimahalle village, Yasin village)] (Özdikmen et al. 2005; Özdikmen 2006; Özdikmen & Demir 2006; Özdikmen et al. 2009); Antalya prov. [Akseki, Alanya (Karapınar village), Finike (Alakır dam)] (Adlbauer 1992; Özdikmen & Çağlar 2004; Turgut & Özdikmen 2010); Artvin prov. [Ardanuç] (Sama 1982; Lodos 1998); Bartın prov. [Kalecik village and Gürleyik] (Özdikmen 2007); Bilecik prov. [as *Judolia erratica* var. *erythrura* and *Judolia erratica* var. *rosinae*] (Bodemeyer 1906; Lodos 1998); Bitlis prov. [Reşadiye] (Tauzin 2000); Bolu prov. [Devrek (Dorukhan pass), from Konuralp to Akçakoca] (Sama 1982; Özdikmen 2007); Çankırı prov. (Özdikmen et al. 2005); Çorum prov. [Boğazkale, Kargı (Karagöl village)] (Sama 1982; Özdikmen 2007); Elazığ prov. [Hazar lake as *judolia erratica*] (Fuchs & Breuning 1971); Erzincan prov. [Ballıköy] (Tozlu et al. 2002); Erzurum prov. [and near as *Judolia erratica*, Aşkale, Hacıhamza, Oltu (Başaklı), Şenkaya (Turnalı)] (Özbek 1978; Adlbauer 1992; Tozlu et al. 2002); European Turkey. [Istranca Mountains (Verica valley)] (Özdikmen et al. 2005); Gaziantep prov. (Lodos 1998); Gümüşhane prov. [Kelkit (Günyurdu), Torul, Zigana Mountains] (Villiers 1959; Tauzin 2000; Özdikmen & Çağlar 2004); Hatay prov. [Akbez as *Judolia erratica*, Dörtyol env.] (Fairmaire 1884; Öymen 1987); Isparta prov.[as *Judolia erratica*] (Demelt & Alkan 1962; Demelt 1963; Tuatay et al. 1972; Lodos 1998; Özdikmen et al. 2005); İstanbul prov. [Alemdağ (Reşadiye), Polonez village] (Demelt & Alkan 1962; Demelt 1963; Sama, 1982; Lodos, 1998); İzmir prov. [Agamemnun as *Judolia erratica*, Menderes (Efemçukuru village)] (Gül-Zümreoğlu 1975; Lodos 1998; Özdikmen & Demirel 2005); Karabük prov. [Safranbolu (Bulak village and Gürleyik National Park), Safranbolu–Eflani road (Örencik village), between Eflani–Pınarbaşı, Akçakese–Pınarbaşı road] (Özdikmen 2007); Kars prov. [Sarıkamış (Akkurt)] (Tozlu et al. 2002); Kastamonu prov. [Central, İnebolu, Yaralıgöz (Devrekani), Ballıdağ pass (Daday), Ilgaz pass (Tosya), Yaralıgöz] (Sama

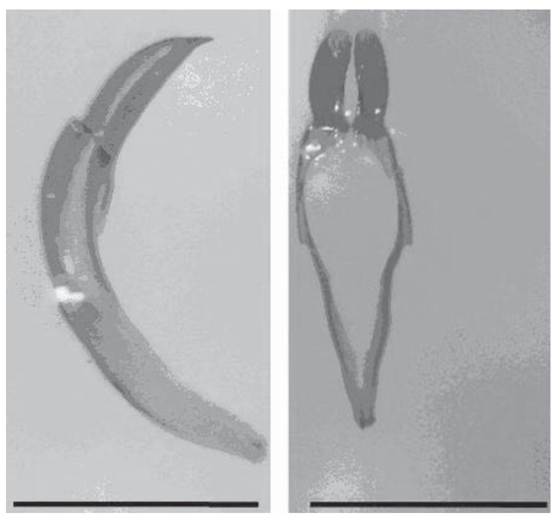

A B

Fig. 3. Male genitalia of *Pachytodes erraticus*. A. Aedeagus, B. Paramers (Scale bar = 1 mm).

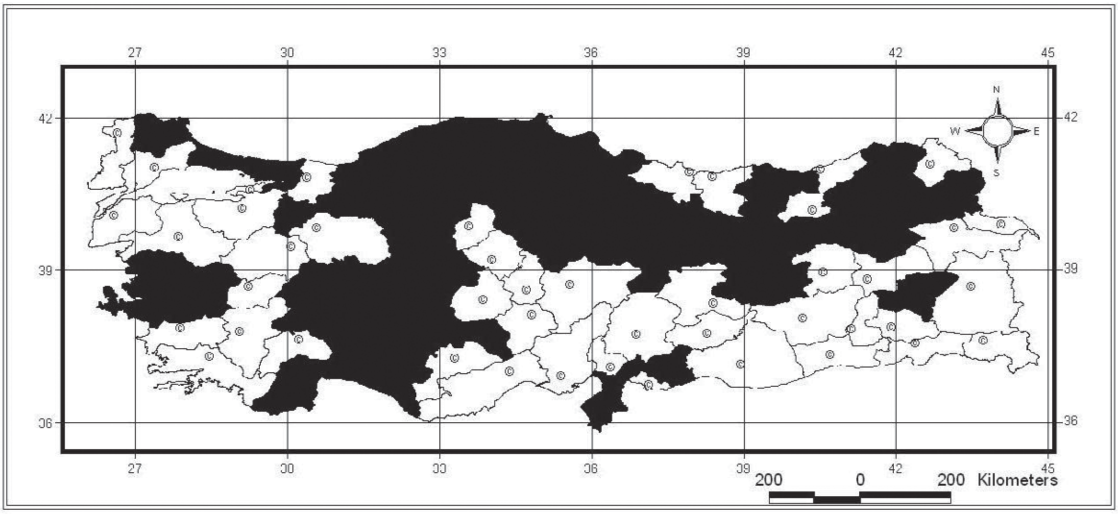


Fig. 4. Distribution of *Pachytodes erraticus* in the provinces of Turkey. The black areas show the provinces in which *P. erraticus* has been recorded to date.

1982; Adlbauer 1992; Tauzin 2000; Özdikmen et al. 2005); Kastamonu prov. [Küre Mts. National Park (Kerte village), Pınarbaşı–Azdavay road (Karafasıl village and Suğla plateau), Azdavay (Ballıdağ Wild Life Protection Area), Küre–Seydiler road (Masruf pass), Yaralıgöz pass, Tosya–Kastamonu road, Dipsiz Göl National Park, Şenpazar–Azdavay road (Yumacık village)] (Özdikmen 2007); Kırklareli prov. [İğneada (Saka lake, Sivriler village)] (Özdikmen & Çağlar 2004); Kocaeli prov. [İzmit (Beşkayalar Natural Park, Ballıkayalar Natural Park)] (Özdikmen & Demirel 2005); Konya prov. [Güneysınır (Gürağaç), Tekebeli pass env., Bozkır–Hadim road (Söğüt and Dereiçi env.), Hadim (Korualan town env.)] (Tozlu et al. 2002; Turgut & Özdikmen, 2010); Manisa prov. [Turgutlu Çardağı (Aysekisi hill, Domunludeve valley)] (Özdikmen & Demirel 2005); Samsun prov. [Ladik] (Tauzin 2000); Sinop prov. [Dranaz Mountain] (Sama 1982); Sivas prov. [Yıldızeli (Cumhuriyet village)] (Adlbauer 1992; Özdikmen & Çağlar 2004); Tokat prov. [Almus, Mezra, Topçam Mountain, Yakacık (Gökdere)] (Sama 1982; Adlbauer 1992); Trabzon prov. [Maçka (Sümela), Pontic Alpes] (Villiers 1959; Sama 1982); Tunceli prov. [Pülümür, Ovacık as *P. erraticus anticedivisa* Pic] (Fuchs & Breuning 1971; Adlbauer, 1992); Yozgat prov. [Yozgat National Park, Akdağmağdeni (Oluközü plateau), Akçakışla] (Özdikmen & Çağlar 2004; Özdikmen & Demirel 2005); Zonguldak prov. [Safranbolu] (Villiers 1967; Özdikmen et al. 2005) (Fig. 4).

Range and Chorotype of *Pachytodes erraticus erraticus*

Europe (Spain, France, Italy, Croatia, Bosnia-Herzegovina, Serbia, Macedonia, Albania, Greece, Bulgaria, European Turkey, Romania, Hungary, Germany, Switzerland, Austria, Czechia, Slovakia, Poland, Slovenia, Belorussia, Ukraine, Moldavia, European Russia, European Kazakhstan), East and West Siberia, Kazakhstan, China, Caucasus (Azerbaijan, Armenia, Georgia), Turkey, Syria, Iran.

Chorotype: Sibero-European.

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