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RESEARCH ARTICLE

A new subgenus of the weevil genus *Otiorhynchus* Germar, 1822 (Coleoptera: Curculionidae: Entiminae) for a new species from Mediterranean Turkey associated with the carob tree, *Ceratonia siliqua* L. (Fabaceae)

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Abstract: A new species *Otiorhynchus ceratoniae* Davidian, Gültekin & Korotyaev **sp. nov.** is described from eastern Mediterranean Turkey. A new monotypic subgenus *Arnoldinus* Davidian, Gültekin & Korotyaev **subgen. nov.** is erected for this species. The new species was found only under *Ceratonia siliqua* L. trees with lower leaves damaged by adults.

Key words: *Otiorhynchus*, *Ceratonia siliqua* L., new species, new subgenus, taxonomy, Turkey.

Introduction

In the course of the faunistic survey in Mediterranean Turkey in 2015, a number of poorly known or even undescribed weevil species was found on the commonest plants, including widely cultivated ones like olive tree (*Olea europaea* L.), carob tree (*Ceratonia siliqua* L.), Euphrates poplar (*Populus euphratica* Olivier) and Turkish pine (*Pinus brutia* Tenore). In this paper, we describe a new species of the weevil genus *Otiorhynchus* Germar, 1822 associated with the carob tree and erect a new subgenus for it.

Material and methods

In the course of this study, extensive material in the collections of the Zoological Institute, Russian Academy of Sciences, St. Petersburg, Russia (ZIN), and Entomology Museum of Atatürk University [Atatürk University, Faculty of Agriculture, Plant Protection Department, Erzurum, Turkey] (AUEM) has been studied. Type specimens from E. Reitter's collection in the Hungarian Natural History Museum in Budapest (HNHM) and from G. Stierlin's collection in the Senckenberg Deutsches Entomologisches Institute in Müncheberg (DEI) have been examined by G. E. Davidian.

The holotype and six paratypes of *Otiorhynchus ceratoniae* Davidian, Gültekin & Korotyaev **sp. nov.** are deposited in the collection of AUEM, three paratypes are in the ZIN collection, and one is donated to the Natural History Museum, London.

The terms *vagina*, *ostium* and *aggonoporial sclerite* are used herein in accordance with Howden (1995) and Lyal (2015). Photographs of details of genitalia and terminalia were prepared with a Carl Zeiss Axio Imager M-1 microscope in the Biological Control Laboratory, All-Russian Institute of Plant Protection (St. Petersburg). The photographs of the habitus were made with a Canon 60D digital camera.

Results

The carob tree *Ceratonia siliqua* L. (Fabaceae) is an important component of Mediterranean vegetation occurring mostly on calcareous soils. The original distribution of *C. siliqua* is not clear as it has undergone extensive cultivation since ancient times (Batlle & Tous 1997). Its native distribution range included Turkey, Cyprus, Syria, Lebanon, Israel, southern Jordan, Egypt, Arabia, Tunisia and Libya, from where the species was introduced westward at an early stage (Hillcoat *et al.* 1980). This tree is cultivated in the Mediterranean (several countries of the former Yugoslavia, Greece, Italy, France, Malta, Spain, Portugal, Algeria, Morocco), subtropical and tropical areas of South Asia (Pakistan, India, Indonesia), South Africa, Australia, North and South Americas (United States of America, Mexico, Venezuela, Argentina, Chile) (Orwa *et al.* 2009). In Turkey carob tree occurs in the Mediterranean and Aegean regions. It grows in the whole Mediterranean coast along the southern slopes of entire Toros Mts., being most abundant between Antalya and Silifke, and distributed from Alanya, Aksu, Manavgat, Anamur, Gülnar, Silifke, coastal territory between Mersin to Adana including Kozan, Osmaniye, western coast of Amanos Mts. in Hatay including Asi River valley to Samandağ (Günal 1999; Taşlıgil 2011; TÜBİVES 2016). In the Aegean Region *C. siliqua* is known from Urla Peninsula (İzmir) to the south, in Büyükmenderes Valley, Lake Bafa environs, Western Menteşe Mt., Beşparmak Mt., Kuşadası Peninsula, Durmuş Mt. (Söke), Samsun Mt., Didim, Güllük, Bodrum, Marçal Mt., Datça Peninsula, Bozburun, İçmeler, Teke, Dalaman District, Kocaçay, and Alakır (Günal 1999; Taşlıgil 2011; TÜBİVES 2016).

The new species of *Otiorhynchus* is one of the very few probably specialized weevils known to feed on *Ceratonia siliqua* (Fig. 1A). Astrin *et al.* (2012) record *C. siliqua as* a host for three species of Cryptorhynchinae (Curculionidae): *Echinodera incognita* (Hoffmann, 1956), *Echinodera ibleiensis* Stüben, 2003, and *Kyklioacalles maroccensis* (Stüben, 2001). Mifsud & Colonnelli (2010) record from the Maltese Islands in the Central Mediterranean *Araecerus fasciculatus* (De Geer, 1775) (Anthribidae) found on mature fruits of *C. siliqua*, and *Torneuma maltense* Magnano & Mifsud, 2001 (Curculionidae) found in the soil in the Mediterranean maquis including among other trees *Ceratonia siliqua*. A polyphagous

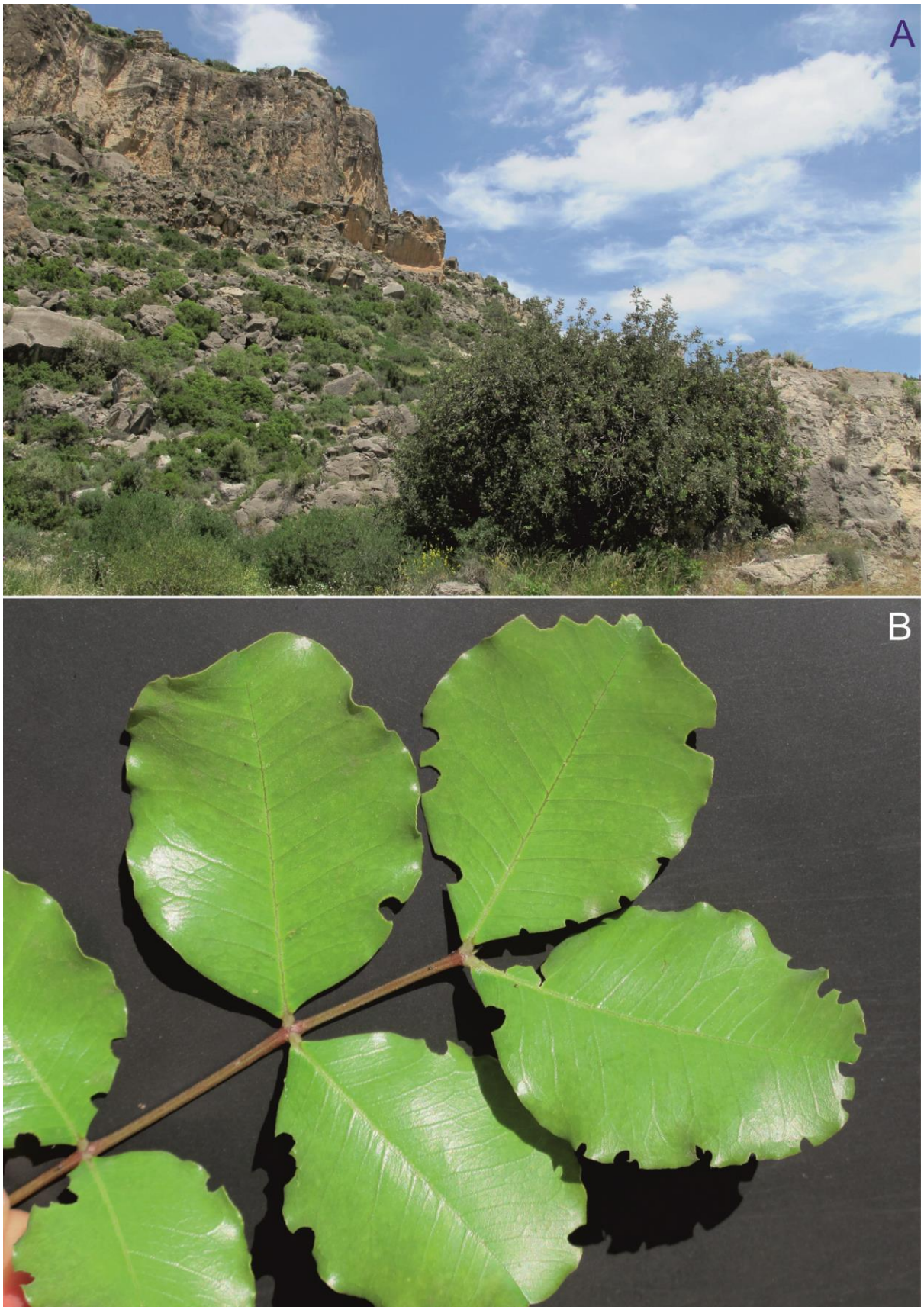

Figure 1. Habitat of *Otiorhynchus ceratoniae* sp. nov. (**A**); leaves of *Ceratonia siliqua* L. damaged supposedly by adults of *O. ceratoniae* sp. nov. (**B**).

ambrosia beetle, *Xylosandrus crassiusculus* (Motschulsky, 1866) is also recorded from *C. siliqua* (Sauvard *et al.* 2010). Friedman & Freiberg (2007) report findings of two apionids on *C. siliqua* in Israel, *Kalcapion semivittatum* (Gyllenhal, 1833) and *Taeniapion rufescens* (Gyllenhal, 1833), but both develop on other plants and are definitely occasional feeders on or visitors of the carob tree.

Some other coleopterans were found or feeding on the carob tree: Nine species of longhorn beetles (Coleoptera: Cerambycidae) are recorded from Cyprus (Ambrus *et al.* 2014). Halperin & Holzschuh (1993) list carob tree as a host for the eight Cerambycidae species in Israel.

In addition, two polyphagous moths damage carob trees in Spain, and a midge damages young pods in Cyprus (Batlle & Tous 1997). While no specimens were collected from the foliage of the carob trees examined damage to leaves found on the lower branches (Fig. 1B) is characteristic of *Otiorhynchus*, and no other beetle or other insect herbivore was seen. Further, while L. Gültekin collected a series of *Otiorhynchus ceratoniae* in the litter beneath the trees no other weevil was found. B. Korotyaev's investigation of the litter under several shrub species in close vicinity to the *Ceratonia siliqua* trees where the series of the new species was collected provided no specimen of the latter or any other *Otiorhynchus* species. These observations are best explained by proposing the new species to be a (probably specific) herbivore of *Ceratonia siliqua.* Its occurrence in the area of the supposed origin of this plant and restricted distribution require closer investigation of this pair in Mediterranean Turkey.

Genus *Otiorhynchus* Germar, 1822

Subgenus *Arnoldinus* Davidian, Gültekin & Korotyaev subgen. nov. (Figs 2–22)

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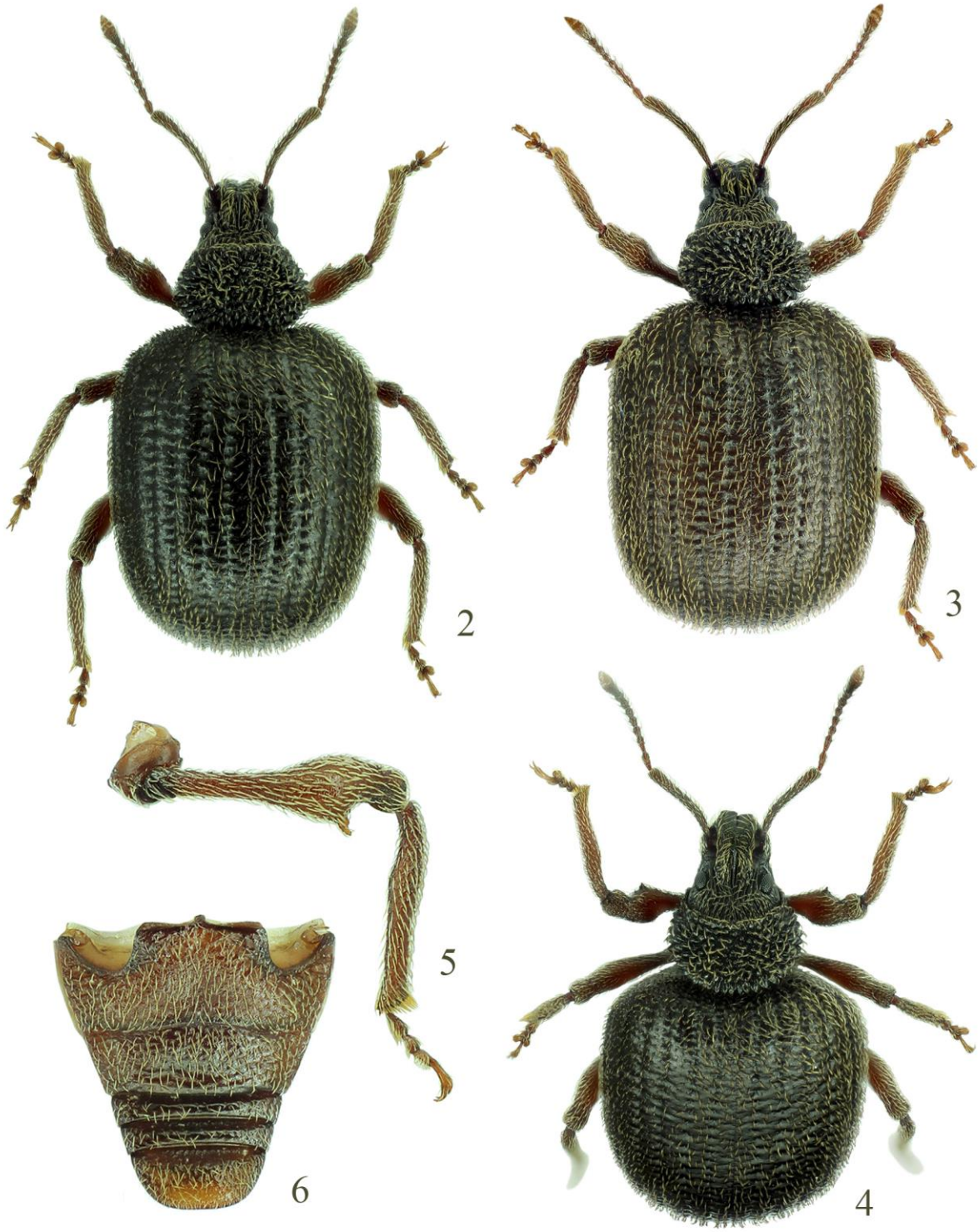
Type species *Otiorhynchus ceratoniae* Davidian, Gültekin & Korotyaev **sp. nov.**

The new subgenus differs from most of the other *Otiorhynchus* subgenera in the following combination of characters.

Disc of pronotum with dense very large sharp, apically setiferous, conical granules; apical margin of pronotum set with distinctly anteriorly-projecting conical granules; elytra broad, subrectangular, twice as broad as the small pronotum, flattened dorsally; humeri covered with well-developed granules projecting from elytral contour. No sexual dimorphism in external characters, including proportions of the head and body, structure of the antennae and legs (Figs 2, 3). Male genitalia characteristic in the unusual structure of the endophallus with preapical large tooth-shaped sclerites (Figs 15–22). Lamella of spiculum ventrale strongly narrowed apicad, with distinct sclerotization along basal margin (Fig. 12); spermatheca with poorly developed, weakly separated collum; ramus large, rather broad (Fig. 13).

In the proportions of the pronotum and elytra the only representative of the new subgenus is similar to *Otiorhynchus rotundicollis* Stierlin, 1876 of the monotypic subgenus *Stierlinellus* Reitter, 1912 (Davidian & Gültekin 2015) and to species of the genus *Eptacus* Desbrochers, 1908 (tribe Holcorhinini Desbrochers des Lodges, 1898). *Arnoldinus* shares with *Stierlinellus* the coarsely sulcate head and very large granules on the pronotum but the new subgenus differs in the vestigial epistomal carina, very weakly projecting pterygia, rather large tooth on all femora, gonocoxites with distinct subapical styli (Fig. 11), and in the



Figures 2–6. *Otiorhynchus ceratoniae* sp. nov. **2–4,** habitus (**2, 4,** male; **3,** female); **5,** left hind leg of female; **6,** ventrites of female.

spiculum ventrale lamella strongly narrowed apicad (male of *O. rotundicollis* unknown). From *Eptacus*, the new subgenus differs in the free tarsal claws, weakly projecting laterally pterygia, coarse sculpture and well-developed vestiture of the body, and absence of the aggonoporial sclerite in the endophallus.

In the structure of the head, including the weakly laterally protruding pterygia and deep depression along midline between rostral dorsum, and also in the sculpture of the body and vestiture, *O. ceratoniae* sp. nov. resembles *O. rugosostriatus* (Goeze, 1777) (type species of the subgenus *Zustalestus* Reitter, 1912 from the *Otiorhynchus* complex of subgenera). The new subgenus clearly differs from *Zustalestus* in the unusual proportions of the body, femoral armament, and the structure of the female genitalia (we have not examined male *O. rugosostriatus*).

In pronotal sculpture, *O. ceratoniae* sp. nov. is very similar to *Otiorhynchus crataegi* Germar, 1824 (subgenus *Crataegodes* Białooki, 2015), but differs in the following characters: rostral dorsum rather deeply depressed medially in basal half (Fig. 7), with lateral margins keeled near eyes (Fig. 8); epistomal carina vestigial; eyes sunken, with furrow-like margins dorsally; frons noticeably wider than fore femur; apical margin of the pronotum sparsely serrate, and femoral tooth largest on hind femur.

The new subgenus, with its rather short rostrum (Figs 7, 8), bidentate tooth on femora of all legs, and fore tibia not dilated outwards apically belongs to the *Tournieria* Stierlin, 1861 complex of subgenera *sensu* Reitter, 1912. It is evident now that this complex of characters is inadequate for constructing a classification of the genus *Otiorhynchus* Germar, 1822 (Magnano 1998; Davidian & Savitsky 2006; Białooki 2015).

Etymology: The new subgenus is named after the Late Prof. Lev V. Arnoldi, an outstanding Russian specialist of the genus *Otiorhynchus*, in appreciation of his valuable contribution to the development of the classification and taxonomy of this genus.

Remarks: Noteworthily, the distribution of the new subgenus is similar to that of *Stierlinellus* and *Eptacus*, all being restricted mainly to the Eastern Mediterranean (Pelletier 2006; Davidian & Gültekin 2015). Probably the unusual "suitcase" shape of the members of these loosely related taxa is associated with adaptation of the relatively large pedobiont weevils to the hot and dry climate of this region. The series of *O. ceratoniae* was sifted from litter under *Ceratonia* on stony slope with a thin soil layer and relatively dry and shallow litter; it is unlikely that the adults can bury themselves deep in the soil to withstand long summer heat. The quadrangular elytra flattened dorsally are common in several genus-group taxa of another weevil subfamily, the Ceutorhynchinae, living in xeric environments, e.g. many Hypurini, Oxyonychini, and in *Ceutorhynchus* Germar, 1824, *Oprohinus* Reitter, 1916, and *Petrocladus* Korotyaev, 1997 (supposedly derived from the less xerophilic and more rounded and convex dorsally *Zacladus* Reitter, 1913) of the Ceutorhynchini.

***Otiorhynchus ceratoniae* Davidian, Gültekin & Korotyaev sp. nov.** (Figs 2–22).

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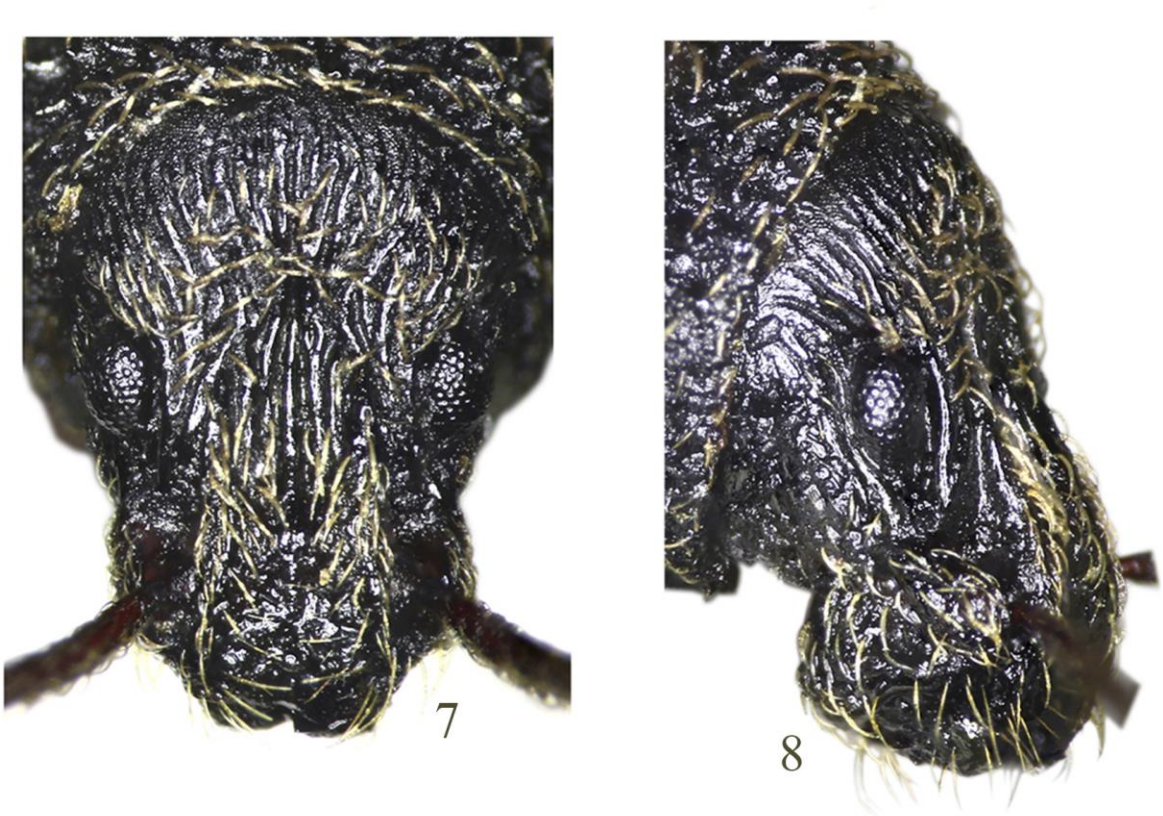
Material: Holotype: **Turkey** (TR15-05), *Mersin Prov.*, 20 km N of Silifke, slope with big limestone boulders, old plantation of *Olea europaea*, 36°25′46" N / 33°42′44" E, 260 m, in litter under *Ceratonia siliqua* along road, 6.V.2015 (L. Gültekin leg.), ♂. Paratypes: 7 ♂♂, 3 ♀♀ collected together with the holotype.

Male: Rostrum (Figs 7, 8) 1.30–1.36 times as broad as long, shallowly constricted at mid-length, with variably distinct excision in narrowest point. Apical margin moderately deeply and somewhat angularly emarginate medially. Pterygia occupying about half-length of rostral sides, scarcely protruding laterally. Lateral margins of rostral dorsum straight in lateral view

in basal 2/3, weakly bending ventrally above antennal insertions only. On dorsum, carinae bending medially toward base and vanishing at half-way from eye to midline at level of mid-length of eyes. Glabrous carina running above eyes from their posterior 1/3 to pterygia and separated from latter by deep depression; space between this carina and lateral margins of dorsum deeply depressed. Head and rostral dorsum depressed from exposed part of vertex to vestigial epistomal carina; latter broad and low at beginning of median carina and, weakly keel-shaped in cross-section, curving toward outer angles of anterior margin of rostrum. Depression deepest on frons, rather deeply sulciform engraved along narrow glabrous median carina running from middle of frons to epistomal carina. Posterior corners of frons and vertex rather coarsely and somewhat irregularly rugose. Eyes small, oblong, moderately convex, not projecting from head outline. Distance from eye to anterior margin of pronotum 2/3–3/4 length of eye. Head capsule rather strongly widening behind eyes. Antennal scape moderately and almost evenly thickening toward apex, noticeably curved proximal to mid-length and more strongly curved in apical 1/5. Funicle slightly thickening apically, slender. 1st segment 2.0–2.25 times as long as broad, as long as, or slightly longer than 2nd, weakly roundly thickening apically and roundly narrowing at apex. 2nd segment slightly narrower than 1st, moderately and almost rectilinearly thickening apically. 3rd segment 1.25 times as long as broad, 2/3 as long as 2nd, somewhat more rapidly thickening apically; 4th about 1.13 times as long as broad; 5–7th slightly longer than broad. Club spindle-shaped, narrow, 2.31–2.43 times as long as broad and only 1.5 times as broad as 7th funicular segment, slightly longer than 5–7th funicular segments combined, with basal segment slightly attenuate and less densely pubescent than rest of club. 1st segment of club constitutes half length of club or slightly more. Funicle rather coarsely hirsute, with bunches of yellow arcuate setae curved toward apex of segments. Club finely densely pilose.



Figures 7–8. Head and rostrum of *Otiorhynchus ceratoniae* sp. nov. **7,** dorsal view; **8,** lateral view.

Pronotum 1.46–1.54 times as broad as long, strongly rounded at sides, widest at mid-length, with ill-defined constrictions at base and at apex (Figs 2, 3). Basal and apical margins of pronotum straight, latter set with anteriorly-projecting conical granules. Disc strongly raised above mesonotum, rather strongly evenly convex, with most convex part somewhat behind middle, more rapidly sloping toward base than toward apex. Disc and sides densely covered with large, sharp conical tubercles each with a narrow arcuate subrecumbent brown scale.

Elytra 1.17–1.23 times as long as broad, 1.89–2.02 times as broad as pronotum, subrectangular, with very broadly rounded humeral angles; nearly straight sides subparallel in basal half and weakly converging in apical part, very broadly and almost evenly rounded apically (Figs 2, 3). Basal margin of elytra slightly emarginate. Disc flattened, strongly raised over disc of pronotum. At base, elytra deeply perpendicularly sloping to mesonotum. All intervals similarly convex at base, none of them strongly convex. Apical declivity flattened along suture on 1st–3rd intervals; in lateral view, arcuately sloping toward apex. Sides somewhat bent ventrally along 7th interval. Striae composed of rather large, moderately deep, rounded punctures separated by shallowly depressed areas about as long as punctures on disc and deepened on sides and on apical declivity. Intervals 1.5–2 times as broad as striae and weakly convex on disc, narrower and more strongly convex on sides and on apical declivity. Surface matte, densely microreticulate, with sparse minute setiferous granules, larger and clearly visible on basal declivity and on humeri, but not on apical declivity. Punctures in rows sometimes producing short projections into intervals giving somewhat wavy appearance to elytral surface.

Legs moderately long. Femora clavate, all armed with well-developed tooth. Surface of femora matte, coarsely microreticulate, finely rugosely punctate over microsculpture, sparsely finely granulate in constricted apical part. Fore femur with medium-sized tooth and 2 or 3 denticles distal to it (Fig. 4); occasionally one of denticles shifted close to base of tooth, giving a bidentate appearance. Middle femur broader than fore femur, with rather large tooth; distal surface of tooth with 2 or 3 denticles of varying size; occasionally apex of tooth obliquely truncate. Hind femur slightly broader than middle femur, with slightly larger tooth similar to that on middle femur (Fig. 5). Tibiae almost round in cross-section, rather slender, matte, evenly and moderately densely covered with small setiferous granules. Fore tibia straight, not widened at apex, its inner margin bisinuate, with basal emargination deeper and shorter than apical one; apical 0.4 of inner margin bearing 7 or 8 yellow stylet-shaped spines sitting on fine angular prominences. Apical comb composed of dense and long yellow spines. Mucro on fore tibia well developed, pointed anteromedially; a shorter denticle half as long as mucro situated at its base. Middle tibia shorter, slightly S-curved, with coarser sharp spiniferous denticles on inner margin in apical part. Spines on apical margin of middle tibia strongly lengthening toward outer angle of margin, this not produced outwards, somewhat angular. Mucro on middle tibia slightly shorter than on fore tibia and more strongly turned medially, accompanied at base by sharp posteriorly-pointed denticle as long as mucro. Hind tibia longer than middle one, with slightly more strongly angular outer apical angle, and with spines on apical margin more strongly lengthening toward outer angle; spines on inner margin finer and sparser than on other tibiae. Mucro on hind tibia minute, inconspicuous under pubescence, pointed medially, accompanied at base by sharp posteriorly-pointed denticle similar to that on middle tibia. Tarsi short and rather narrow; 1st segment of fore tarsus about as long as broad, in middle and hind tarsi slightly longer than broad. 2nd segment slightly transverse, not broader than 1st. 3rd segment bilobate, only slightly longer than and 1.9 times as broad as 2nd, strongly rounded at sides, its lobes only slightly narrower than 2nd segment. Claw-segment protruding from lobes of 3rd segment by 2/3 of its length, moderately

broadening apically. Claws small.

Tergite VII widely and shallowly emarginate. Structure of spiculum gastrale common for many groups of Entiminae, including *Otiorhynchus*, and has no significant specific features (Fig. 14). Venter (all ventrites combined) 1.01–1.04 times as long as broad.

Penis flattened, moderately widening toward blunted, widely rounded apex, weakly bent dorsoventrally (Figs 9, 10). Dorsal wall almost entirely membranous, only near ostial opening noticeably sclerotized in the form of narrow transverse strip. Apophyses 1.5–1.8 times as long as penis. Tegmen ring-shaped, with parameroid lobes separated. Endophallus with fine granule-like sclerites and spicules basally and large tooth-shaped sclerites preapically, with sharp apices of the latter strongly protruding from ostium. Preapical sclerites variable (Figs 15–22)—three males with armament formed of two simple teeth (Figs 15, 16), one with right tooth split (Figs 19, 20), one with left tooth split (Figs 21, 22), one with paired supplementary small teeth between the usual ones (Figs 17, 18). Body length 5.0–5.6, width 3.05–3.5 mm, in holotype 5.55 and 3.5 mm, respectively.

Female. Very similar to male, including tibial apices armament usually manifesting secondary sex characters: one short straight spine at base of mucro present on all tibiae. Rostrum 1.27–1.33 times as broad as long. Pronotum 1.54–1.55 times as broad as long. Elytra 1.20–1.22 times as long as broad, 1.94–2.0 times as broad as pronotum. Apical elytral declivity noticeably depressed at apex on 1st–3rd intervals. All ventrites combined 1.02–1.08 times as long as broad (Fig. 6). Gonocoxites poorly sclerotized, with oblique fold proximal to mid-length. Styli distinct, subapical (Fig. 11). Spermatheca with poorly developed, weakly separated collum; ramus large, rather broad; cornu with narrow apical appendage (Fig. 13). Lamella of spiculum ventrale triangular (Fig. 12), weakly transverse, ca. one-third as long as manubrium, with basal edge distinctly sclerotized.

Body dark brown, pronotum and head darker, occasionally almost black with dark brown antennae, antennal club paler except basal segment. Venter and legs always paler than elytra, with 3rd, 4th, and base of anal ventrite darker than rest of abdomen. Antennal scape moderately densely covered with coarse arcuate yellow setae approximately twice as thick as those on funicle and similar to setae on head, pronotum, elytra, and legs. Setae not protruding beyond lateral contour of pronotum and condensed along its apical margin. On intervals of elytra, reclinate, semi-erect arcuate setae arranged in 4 irregular rows. Anterior slope of strial punctures bearing fine short reclinate seta.

Body length 5.5–5.6, width 3.4–3.5 mm.

Etymology: The name of the new species refers to its host plant, *Ceratonia siliqua*.

Remarks: An unsual variation of the endophallus armament in a short series of specimens taken from under one tree gives no way to attribute it to anything other than individual variation of a style known in other Coleoptera. Kataev (1995) discussed the formation of large sclerites in the Carabid endophallus based on peculiar aberrations of these structures in the Harpali group of genera, citing Antoine (1959), who proposed such new sclerotized structures in the endophallus arise as a result of consolidation of minute sclerotized scales lining inner surface of the endophallus. Kataev (l. c.) believed that a saltatory pattern of this process may be due to a change of a single regulatory gene and may lead both to the diversification of the endophallus armament and its strong reduction up to the disappearance.

In addition to the type series, we have examined a male labeled «Antalya Province, Alanya District, Asmaca Vill., 686 m, 36°36′32,3" N / 32°03′12,4" E, *Pinus*, *Arbutus unedo*

and oak litter, 3.I.2013 (Yu.M. Marusik)». We do not include it in the paratypes because it differs in the more lustrous body with wider elytral striae, almost equal in widths to the intervals. We also have not listed among paratypes a teneral adult with soft, wrinkled elytra.

Figures 9–14. Genital structures of *Otiorhynchus ceratoniae* sp. nov. **9,** penis, lateral view **10,** penis, dorsal view; **11,** gonocoxites; **12,** spiculum ventrale; **13,** spermatheca; **14,** spiculum gastrale.

Figures 15–22. Variability of penis and endophallus armament of the *Otiorhynchus ceratoniae* sp. nov. in dorsal view.

Distribution: Mediterranean coast along the southern slopes of Toros Mts. in Mersin Province (Fig. 23).

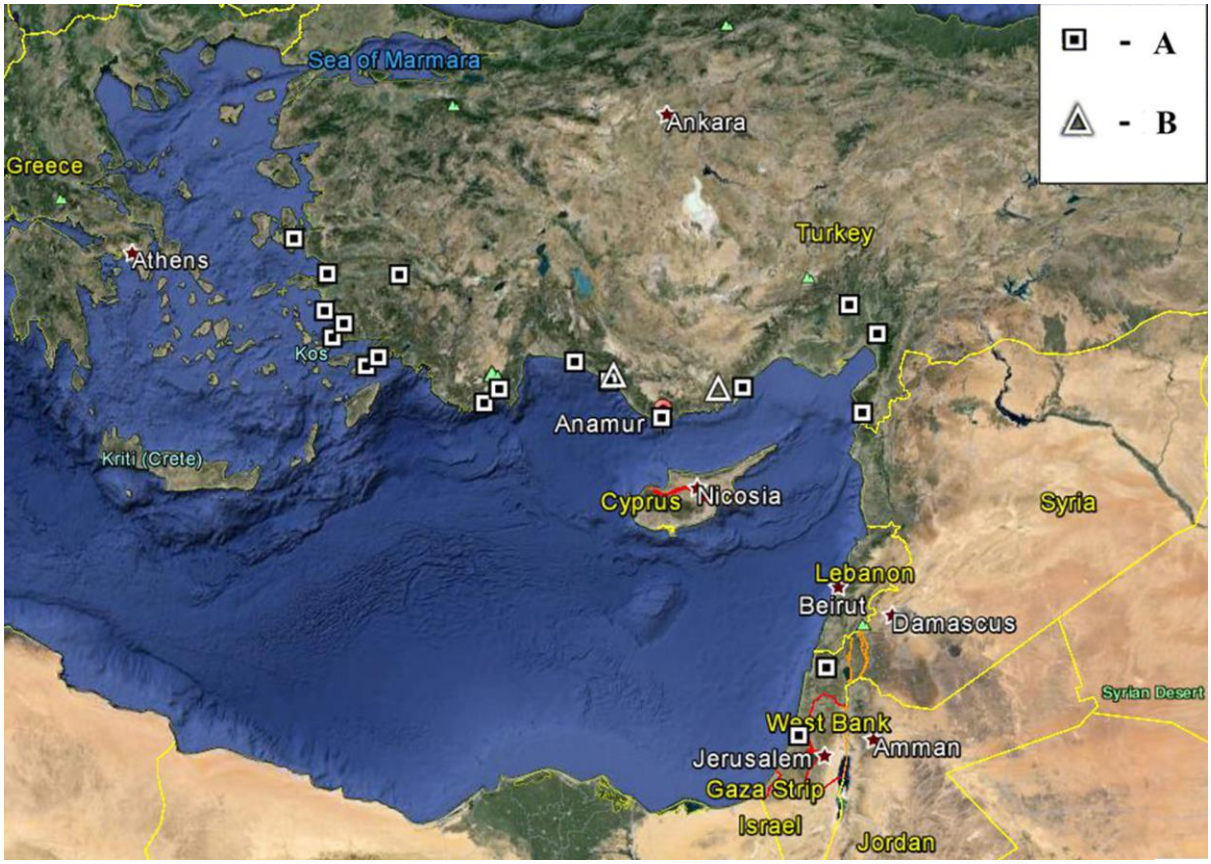


Figure 23. Distribution of *Ceratonia siliqua* L. (**A**) and *Otiorhynchus ceratoniae* sp. nov. (**B**).

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