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A new species of the genus *Lixus* (Coleoptera, Curculionidae) from Tenerife (Spain, Canary Islands)

with 11 Figures
by

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Abstract. *Lixus machadoi* sp.n. of the subgenus *Compsolixus* from Tenerife (Canary Islands) is described here. It was found in the central and western part of the island. In addition to morphological characters, first molecular results (DNA barcoding) are presented: The new taxon is included in a phylogram of the most closely related species (*Compsolixus*) from the Canary Islands, Madeira, Northwest Africa and the European mainland. The new species is morphologically and molecularly closely related to *Lixus cheiranthi* Wollaston, 1854 from Madeira and *L. erysimi* Stüben & Behne, 2013 from Gran Canaria. It is also compared with other species of the subgenus *Compsolixus* living in Macaronesia in the attached identification key. The new species lives on plants of the family Brassicaceae, as do the closely related species, *L. erysimi* and *L. cheiranthi*.

Keywords. Coleoptera, Curculionidae, *Lixus*, *Compsolixus*, Macaronesia, Canary Islands, Tenerife, integrative taxonomy, morphology, molecular analysis, barcoding, bionomics, faunistics, key.

Nomenclatural acts
Lixus machadoi sp.n.: urn:lsid:zoobank.org:act: 662A1486-39C3-465E-B54A-293FEA8EB4E3

Introduction

It is truly surprising, about 15 mm large and attractively coloured weevil was unknown from entomologically quite well known island of Tenerife. Curiously, the new species was found fully independently in almost same time in two different localities. The first author found it during joint collecting trip with Antonio Machado to the eastern slopes of the Teide massif, focused primarily on the genus *Laparocerus* (Coleoptera, Curculionidae, Entiminae). It was found shortly after sunset, by beating of the post-blossomed shrubs of *Erysimum scoparium* (Brouss. ex Willd.) Wettst. The third author collected the new species occasionally while checking the *Crambe* plants in Teno Mts. in the west of the island.

Materials and methods

Measurements were taken as follows: body length - from the elytral apex to the anterior margin of the eyes; body width – the width at the widest point of elytra; length of rostrum – from the anterior margin of eyes to the apex of the rostrum; width of rostrum – at the widest point near the apex of the rostrum; pronotal length – from the midpoint of the base to the midpoint of the anterior margin; elytral length – from the level of humeral calli to the apex.
Images were created using Panasonic DC-FZ1000 II Premium Bridge Camera with high-quality attachment lenses, composed using CombineZ software for image-stacking. All pictures used in this article were photographed and created by the second author, if not mentioned others.
Aedeagus or spermatheca, if dissected, were glued to an additional card attached to the specimen pin or to the same label as the respective specimen.

All sequenced *Compsolixus* specimens - for the most part as ethanol samples - come from the collections of the first and second author (in the dendrogram: JKR=Jiří Krátký, PST=Peter E. Stüben). In their collections, there are further specimens of most species from the same localities (subsequent sequencing is therefore also possible here). The CO1-barcodes of the new species (see also Appendix 1) and the most other sequences were provided by the laboratories of the Senckenberg German Entomological Institute (SDEI, Germany: Müncheberg) and the Alexander Koenig Research Museum (ZFMK, Germany: Bonn) in cooperation with the CURCULIO Institute (Germany: Mönchengladbach) as part of the Molecular Weevil Project (MWI, Schütte et al. 2013 and Stüben et al. 2015). In both facilities the widely used Folmer DNA barcode region (Folmer et al. 1994) of Cytochrome C oxidase subunit I gene (CO1) has been sequenced. The barcodes of the new species were amplified with weevil-adopted LCO1490-JJ and HCO2198-JJ primers (Astrin & Stüben 2008) obtaining 658 nucleotides per sequence for full length barcode. The sequenced specimens are deposited at ZFMK and the Naturhistorisches Museum Basel (NMB).

Abbreviations of the depositories:
AAPC – Agustín Aguiar private collection, Santa Cruz de Tenerife, Tenerife, Spain
AMPC – Antonio Machado Carillo private collection, La Laguna, Tenerife, Spain
CTPC – Clive Turner private collection, London, Great Britain
JKPC – Jiří Krátký private collection, Hradec Králové, Czech Republic
NHMB – Naturhistorisches Museum, Basel, Switzerland
POPC – Pedro Oromí-Masoliver private collection, La Laguna, Tenerife, Spain
PSPC – Peter Stüben private collection, Mönchengladbach, Germany
RGPC – Rafael García Becerra private collection, Santa Cruz de la Palma, La Palma, Spain
RVPC – Roberto Valle Llarena private collection, San Cristobal de La Laguna, Tenerife, Spain
TFCM – Natural History Museum of Santa Cruz de Tenerife, Tenerife, Spain

The distribution is mentioned only for the area of Macaronesia, although some species occur more widely.
The identification key follows Stüben (2022) and has been adapted for this article.

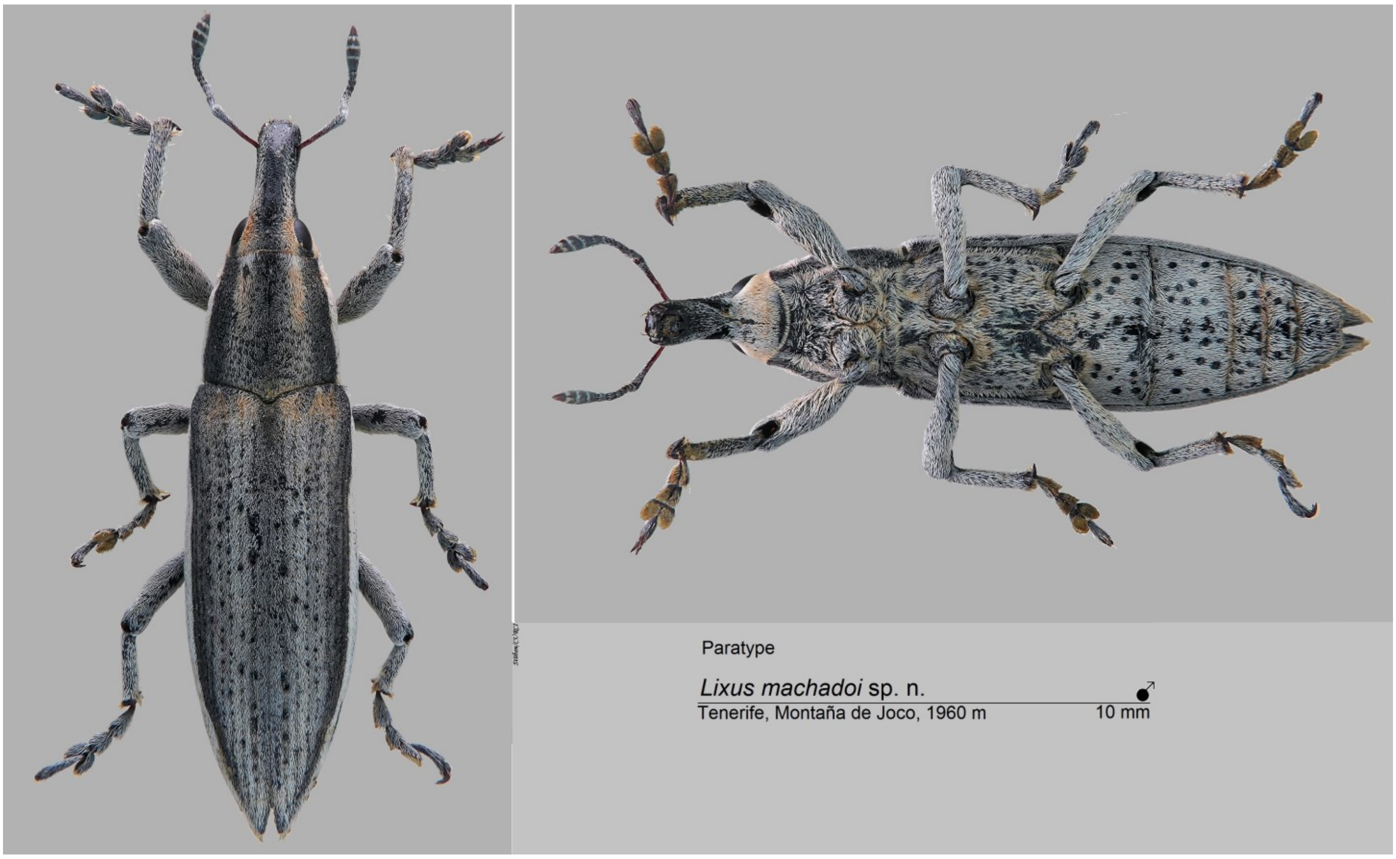

Fig. 1. *Lixus machadoi* sp.n., paratype, male, dorsal and ventral view.

Fig. 2. *Lixus machadoi* sp.n., paratype, female, dorsal and lateral view.

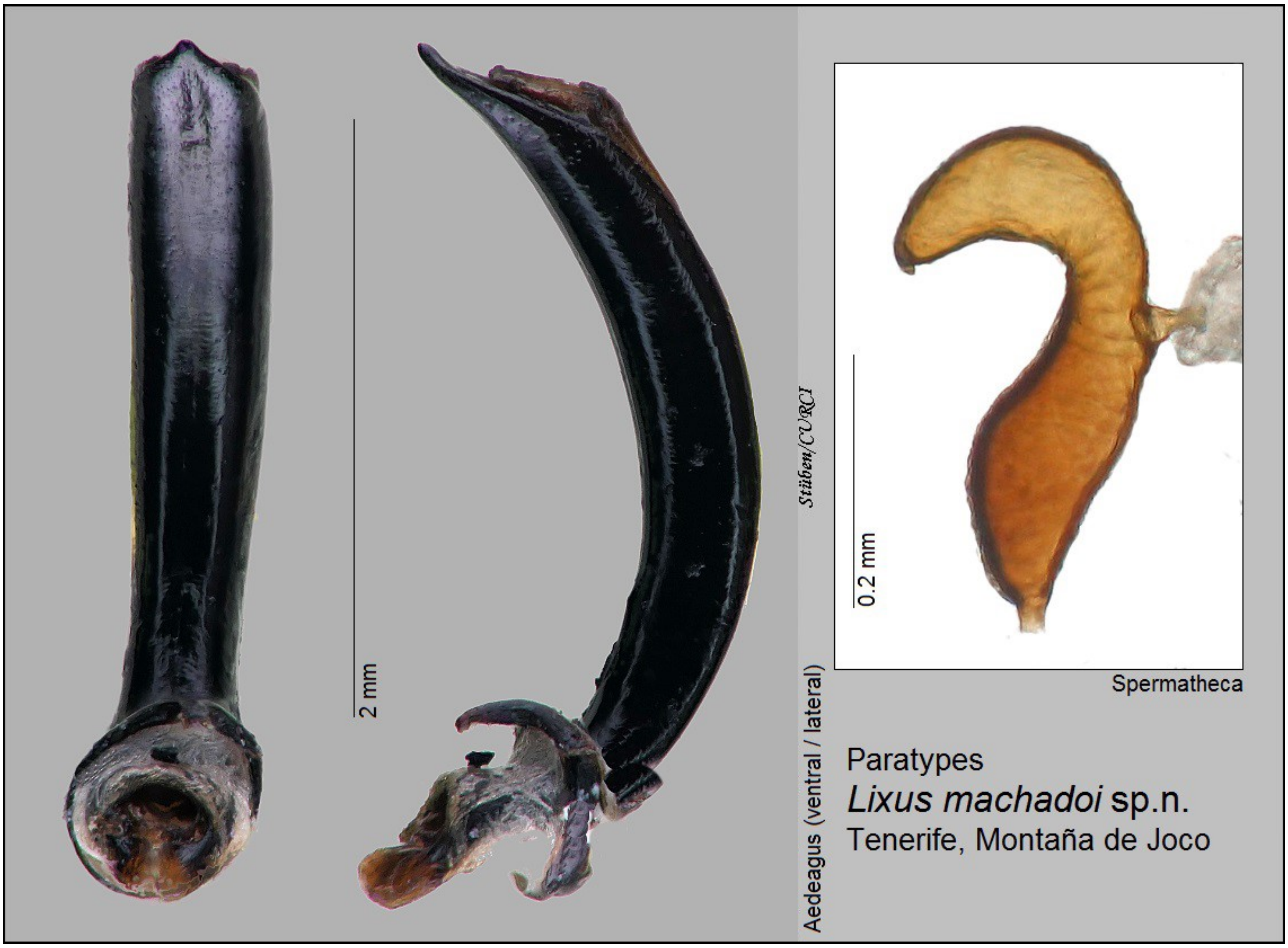

Fig. 3. *Lixus machadoi* sp.n., paratype, terminalia: aedeagus in ventral and lateral view; spermatheca.

Results

***Lixus machadoi* sp. n.** [Figs. 1-3]

Material examined. ***Holotype:*** Spain, Canary Islands, Tenerife, La Orotava, Montaña de Joco, 28°22'09.2"N, 16°27'54"W, 1950 m a.s.l., 31.10.2021, 1 ♂, lgt. A. Machado, *Lixus machadoi* sp. n., J. Krátký des., coll. TFCM. ***Paratypes***: same data as holotype, 1 ♂, lgt. J. Krátký, coll. JKPC; Montaña Joco, 1960 m a.s.l., 13.5.2022, 9 ex., lgt. A. Machado, coll. AMPC, JKPC, POPC; 6 ex. lgt. A. Aguiar, coll. AAPC, PSPC, RGPC; La Orotava, Gollada de Joco, 1940 m, 29.5.2022, 5 ♂♂, 2 ♀♀, lgt. R. Valle, coll. RVPC, NHMB, all J. Krátký des.; Teno Mts., near Las Portelas, 28°19'56"N, 16°51'33"W, 868 m, 28.12.2021, 1 ♀, lgt. C. Turner, P. Stüben des., coll. CTPC. **DNA-Type** (= Holotype, right middle leg) 1 ex., same data as holotype, collection no.: 3731-JKR; 1 ex. (= Paratype, leg), Teno Mts., near Las Portelas, collection no.: 3757-PST, CO1 barcodes see appendix 1.

Description of the holotype (male)

Size: Body length (without rostrum) 13.65 mm, body width 3.75 mm.
Integument and vestiture. Body completely black, only the basal half of the antennal scape is reddish. Dorsal vestiture consists of adherent white hairlike scales sparsely distributed on dorsal and dorsolateral parts of head, pronotum and elytra. These scales are slightly broader and more densely distributed next to the sutural line of the head and pronotum and on elytral intervals 2-5, forming two dorsal whitish stripes more conspicuous on the head and pronotum. Much longer, drop-shaped, snow-white scales form the longitudinal lateral stripe characteristic for the subgenus *Compsolixus*. These scales are very densely distributed on the lateral and lower parts of the head, on the sides of pronotum and on elytral intervals 9 and 10. The scales lining the lower and posterior sides of the eyes are bifurcated. Ventral side and legs are regularly and rather densely covered with hairlike white scales same as the denser ones on the dorsal part of elytra, between them are bare round black spots on the sternum and abdomen.
Head: Regularly tapering toward the rostrum, frons is slightly wider than the base of the rostrum. Eyes almost flat, not prominently protruding from outline of head; eyes irregularly oval, obtusely angled towards the top of the rostrum, protruding at an acute angle towards the lower side of the rostrum. Rostrum 2.4 as long as wide, 0.63x as long as pronotum, slightly expanded toward the apex. Head and rostrum regularly finely punctured, the punctures slightly denser at the apex and slightly larger at the sides of the rostrum; one larger puncture is located in the middle of the frons. Interspaces between punctures glabrous and shiny. Antennal furrow deep, with sharp edges, running almost straight to lower part of rostral base. Antennae inserted in 2/3 of the length of rostrum; the scape almost stright, slightly curved near base, regularly widening toward apex; funicle 7-jointed, the first two segments of almost equal length and almost twice as long as wide, widened apically; segments 3-6 about as long as wide, globose; last segment slightly wider; antennal club spindle-shaped, with 4 indicated segments, 2.5x as long as wide, very densely and finely pubescent, with several longer protruding hairs in the apical half.
Pronotum: 1.06x as long as wide, widest immediately in front of the base, with almost straight sides, regularly tapering toward the front margin; base widely V-shaped, projecting toward the scutellum in the middle. Scutellum V-shaped, well visible, bent down forward.
Elytra: 3x longer than wide together, parallel-sided until ¾ of the length, then regularly tapering to the apex, which is wedge-shaped; the tips of the elytra are not curved outwards and have almost straight inner edges. Elytral rows formed by fine punctures, straight, very narrow and not deepened; only the 1st elytral row with several large deep-

ened glabrous spots. The intervals flat, 3-4x wider than rows; intervals 1 and 3-5 shortly and shallowly deepened immediately behind the base.
Underside: Anterior coxae touching, middle coxae separated by width of antennal funicle in its apical part; posterior coxae in distance of one coxa diameter. Abdomen with 5 segments, of which the apical 3 are movable. Black round spots are distributed on metasternum and on abdominal segments 1-5, each with one long thin hair near the anterior margin.
Legs: Femora slightly clubbed in apical 1/3, lacking any teeth. Tibiae straight, with apical margin rounded and projecting into a long and sharp tooth directed inwards. Inner margin of anterior tibiae with 5 small teeth in apical 2/3. Tarsi with 4 visible segments; 1st segment about 1.5x as long as wide, 2nd segment as long as wide, 3rd lobed segment distinctly wider than the preceding one, 4th segment as long as 1st and 2nd combined. Claws fused at base.
Aedeagus: Dorsally almost parallel-sided, apex subtriangular, indistinctly eccentric, projecting to very small tip; in lateral view, the apex is flat and advanced [Figs. 3a, b].

Female. [Fig. 2] Similar to male, elytra 2.8 as long as wide, elytral base a little wider than that of pronotum; rostrum almost as long but slightly wider than in male, antennae inserted further from its apex; the teeth on inner margin of anterior tibiae very small or missing. Spermatheca: [Fig. 3c].

Variability: Body length (without rostrum) 10.6-16.1 mm, body width 2.9-4.5 mm; rostrum 2.4-2.6 as long as wide; the large deepened glabrous spots on elytra are sometimes present also in rows 2-4, or almost missing; the teeth on inner margin of anterior tibiae sometimes very small or missing also in male.

Morphological differential diagnosis
The new species is morphologically very similar to *L. cheiranthi* [Fig. 4a] from Madeira and *L. erysimi* [Fig. 4c] from Gran Canaria. *L. erysimi* has the anterior tibiae slightly curved inwards, its inner margin is emarginated in apical 1/3 (instead of almost straight and parallel tibiae in the new species) [Fig. 6] and shorter and more curved rostrum in both sexes (2.2-2.4x as long as wide, instead of 2.4-2.6x in the new species) [Fig. 7]. The dark puncture of ventral side is on abdomen limited to segments 1-3 [Fig. 5a] (instead of punctured abdominal segments 1-4 in the new species [Fig. 5b]). *L. cheiranthi* is most similar to the new species, but the coloration of the dorsal side is not as contrasting as in the new species, hairlike scales on pronotum form longitudinal pale stripes only in the apical half and are usually only hinted, often invisible [Fig. 4a] (instead of well developed light stripes along the entire length of pronotum in the new species [Fig. 4b]), also the vestiture of dorsal part of elytra is almost uniform and unicolor [Fig. 4a], instead of denser and wider scales on intervals 1-5, forming indistinct light stripes in the new species [Fig. 4b]. Rostrum of *L. cheiranthi* is longer, 2.6-3.0 as long as wide, instead of 2.4-2.6x in the new species [Fig. 7]. *L. pinkeri*, living also on Tenerife, is distinctly smaller (body length 6.8-11.8 mm instead of 10.6-16.1 mm in the new species), elytra slender and more parallel, with several longitudinal dark and light stripes on the disc [Fig. 4e] (instead of the wider elytra with an unstriped disc in the new species [Fig. 4b]). Ventral side of *L. pinkeri* is lacking distinct round black spots on metarsternum and abdomen, which are only rarely developed on abdominal segments 1 and 2 [Figs. 5d, e] (instead of the always clearly punctured metarsternum and abdomen in the new species [Fig. 5b]). Other species of respective subgenus are not so closely similar and can be distinguished by the characters given in the attached identification key.

Molecular differential diagnosis
Methods for obtaining the COI sequence are presented in the section 'Material and methods' (see above). The resulting Neighbour Joining Tree (Fig. 11) of some Euro-Mediterranean and the Macaronesian species of the subgenus *Compsolixus* Reitter, 1916 including the new species *Lixus machadoi* from Tenerife is of course not yet a comprehensive or robust phylogenetic classification. Testing this hypothesis requires additional genes, especially nuclear ones (see Astrin et al. 2012) and e.g. a deeper Bayesian analysis (Stüben 2022). Nevertheless, this first molecular classification of *Compsolixus* species shows great similarities with the morphological classification of the new species from Tenerife (see above)! This is - in molecular terms - the sister taxon of *Lixus erysimi*; both are separated by about 6% at the mitochondrial CO1 partial gene (see the percentages on the edges of the dendrogram in Fig. 11). The endemic species *Lixus cheiranthi* from Madeira belongs to the same clade, but the p-distance here is already clearly above 12%, so that we can only speak of a somewhat more distant relationship. The latter also applies to the *Compsolixus* species *Lixus pinkeri*, which is endemic to the Canary Islands and has also been found on Tenerife and the neighbouring island of La Gomera almost exclusively on *Artemisia thuscula* Cav. (= *A. canariensis*) (Stüben 2022). The species *Lixus anguinus* (Linnaeus, 1767), which is mainly found on various Brassicaceae in the western Mediterranean region, and which the second author also recorded in large numbers (a mass occurrence) on Lanzarote on *Cakile maritima* Scop. near Famara (Stüben 2018), seems to be somewhat more closely related to the new species. The intraspecific distance of the new species at the CO1 gene between the specimens from La Orotava and the Teno Mountains is only 0.8%. Therefore, these quite clear molecular results speak for the independence of the new species *Lixus machadoi*.

Distribution. Until today, the new species is known only from the island of Tenerife (Canary Islands), to which it is probably endemic.

Etymology. The new species is named after our common good friend and colleague Antonio Machado (La Laguna, Tenerife), who found the first specimen and later also several paratypes of this species.

Bionomics. All specimens of the type series were found on the plants of the family Brassicaceae, which are probably its hosts also for larval development. Specimens from Montaña de Joco were found at high altitude in an open locality surrounded by Canary Pine forest [Fig. 10], by beating of the shrubs of *Erysimum scoparium* [Fig. 8]. The specimens from Teno Mts. were collected while checking the *Crambe* plants [Fig. 9].

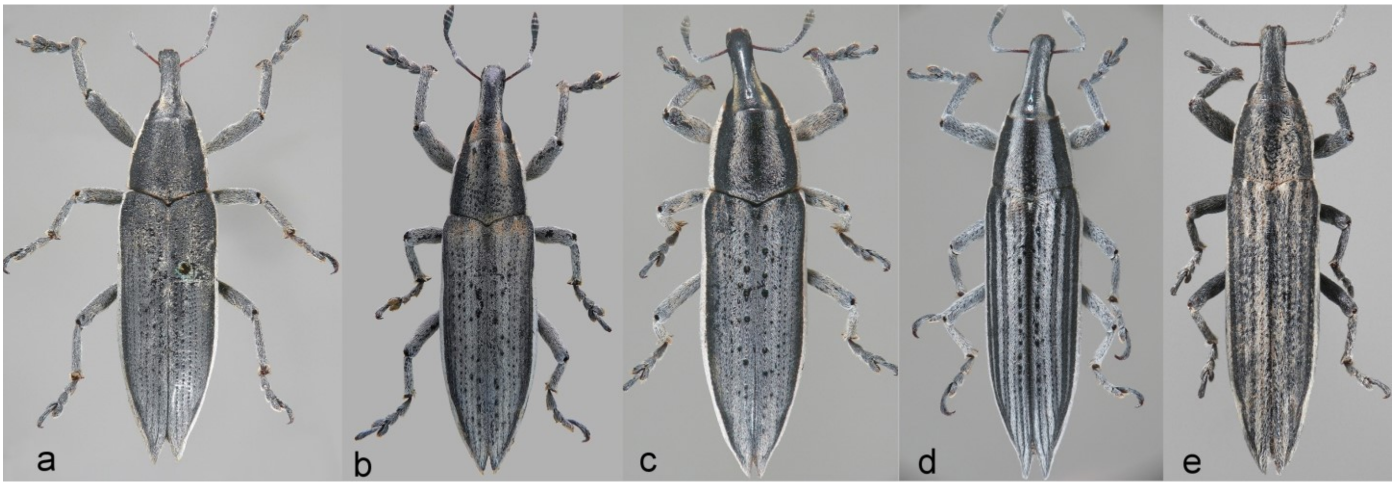

Fig. 4. *Lixus spp.*, dorsal view: a = *L. cheiranthi* Wollaston, 1854, holotype, b = *L. machadoi* sp.n., paratype, c = *L. erysimi* Stüben & Behne, 2013, paratype, d = *L. anguinus* (Linnaeus, 1767), Morocco, e = *L. pinkeri* Voss, 1965, holotype.

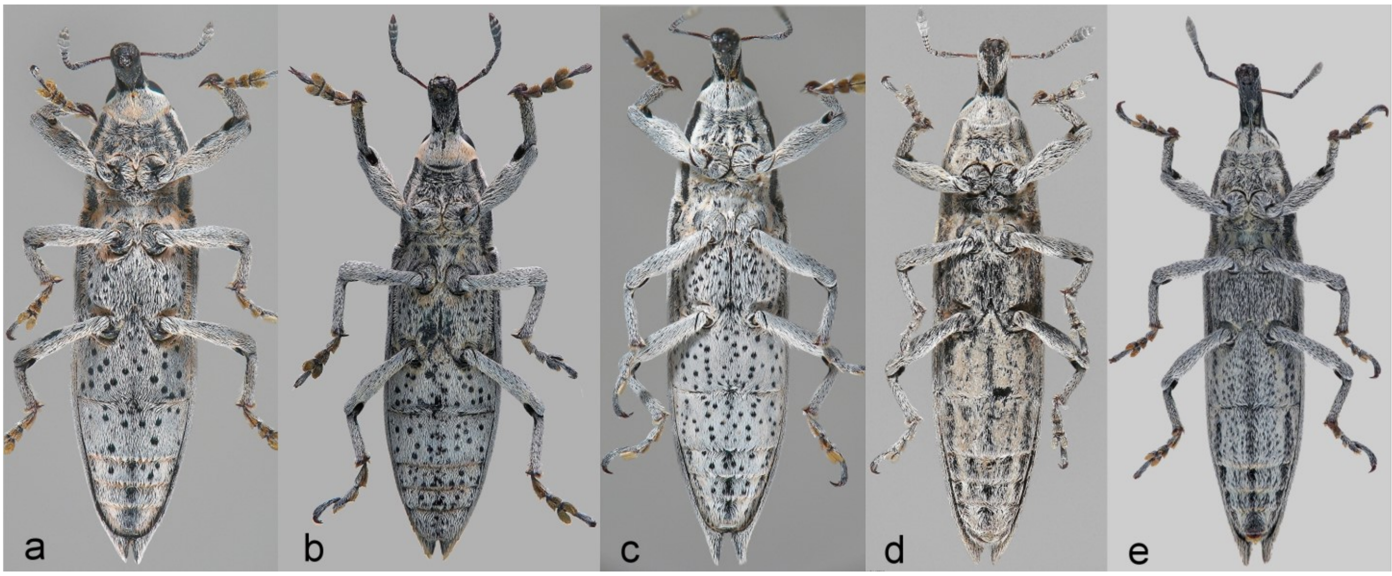

Fig. 5. *Lixus spp.*, ventral view: a = *L. erysimi* Stüben & Behne, 2013, paratype, b = *L. machadoi* sp.n., paratype, c = *L. anguinus* (Linnaeus, 1767), Morocco, d = *L. pinkeri* Voss, 1965, holotype, e = *L. pinkeri* Voss, 1965, La Gomera.

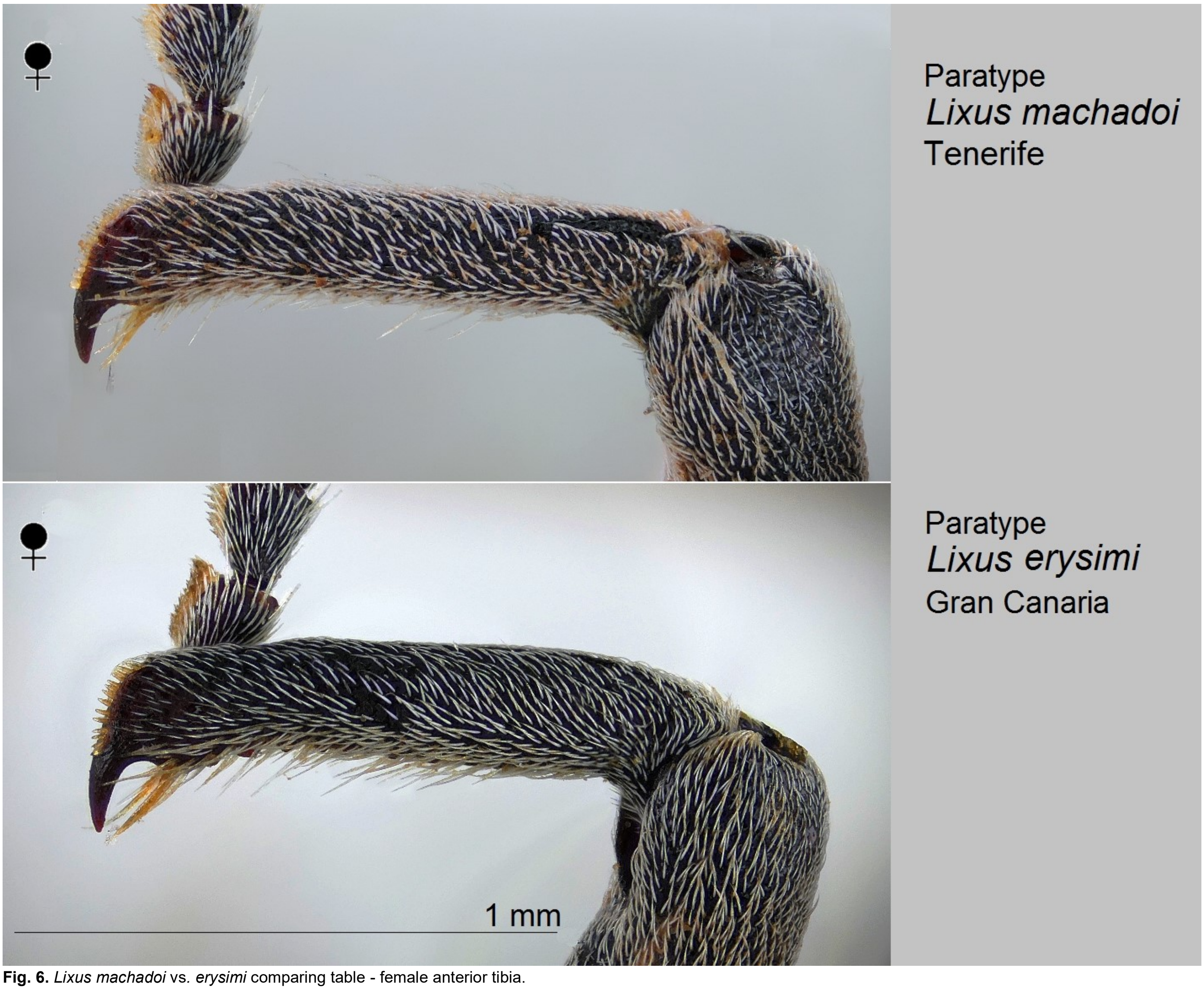

Fig. 6. *Lixus machadoi* vs. *erysimi* comparing table - female anterior tibia.

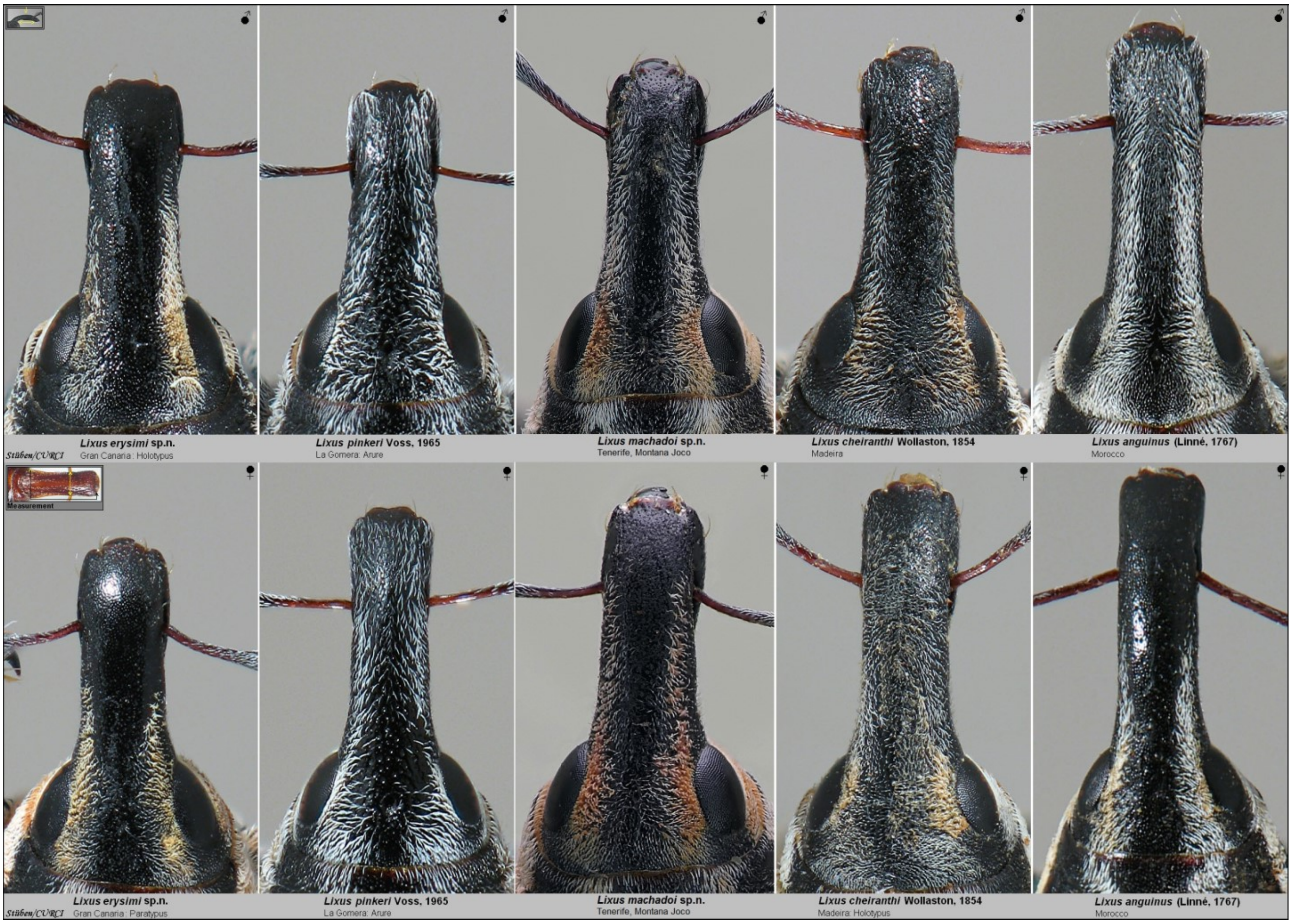

Fig. 7. *Lixus* spp., comparing table – rostrum in dorsal view.

Identification key to the species of Macaronesian *Compsolixus*:

1) Pronotum lacking broad and white, scaly longitudinal stripes on the disc; elytral mucrons very short or missing. ………. **2**

1´) Pronotum with two more or less contrasting, white scaly, broad longitudinal stripes on the disc; elytral mucrons long and strongly acuminate. ………. **3**

2) Elytra broader (L/W < 2.6x), lacking protruding acuminate mucrons; pronotum laterally rounded and widest at the end of the basal third. Body length: 9.6-12.6 mm. Distribution: Questionable reports from Gran Canaria and Fuerteventura. ………. ***Lixus junci* Boheman, 1835**

2´) Elytra broader (L/W > 3.06x), with short acuminate mucrons; pronotum trapezoidal (or sub-parallel), widest at the base. Body length: 7.5 mm. Distribution: Porto Santo (only holotype). ………. ***Lixus vectiformis* Wollaston, 1854**

3) Ventral side with black round spots regularly distributed on metasternum and abdomen and well visible also in lateral view [Figs. 5a, b, c]. Elytral disc conspicuously or weakly striped [Fig. 4]. ………. **4**

3´) Ventral side lacking black round spots, covered with whitish hairlike scales, which may be sparser in some parts [Fig. 5d]. Very rarely, several small black punctures are poorly visible on abdominal segments 1-2; metasternum always lacking such punctures [Fig. 5e]. Elytra with several longitudinal dark and light stripes on the disc [Fig. 4e]. Body length: 6.8-11.8 mm. On *Artemisia thuscula* Cav. Distribution: El Hierro, Gomera, Tenerife, Gran Canaria, Fuerteventura. ………. ***Lixus pinkeri* Voss, 1965**

4) Elytral disc not conspicuously, only weakly, striped [Figs. 4a, b, c]; rostrum shorter, 2.2-3.0 as long as wide [Fig. 7]. ………. **5**

4´) Elytral disc contrastingly striped black and white [Fig. 4d]; rostrum longer, 2.9-3.4 as long as wide [Fig. 7]. Body length: 8.9-13.8 mm. On Brassicaceae. Distribution: Lanzarote. ………. ***Lixus anguinus* (Linnaeus, 1767)**

5) Anterior tibiae almost straight and parallel-sided [Fig. 6]; rostrum and pronotum duller, rostrum longer in both sexes (2.4-3.0x as long as wide). ………. **6**

5´) Anterior tibiae clearly curved inwards, its inner sides emarginated in apical 1/3 [Fig. 6]; rostrum and pronotum more shiny, rostrum shorter in both sexes (2.2-2.4x as long as wide) [Fig. 7]. Body length: 10.5-14.0 mm. On *Erysimum bicolor* (Hornem.) DC. and *Reseda scoparia* Brouss. ex Willd. Distribution: Gran Canaria. ………. ***Lixus erysimi* Stüben & Behne, 2013**

6) Species from Madeira; inner margin of anterior tibiae always with 9-10 small teeth; disc of pronotum almost regularly covered by beige hair-like scales, the light longitudinal stripes only hinted in anterior half [Fig. 4a]. Rostrum longer, in male 2.6x, in female 3.0x as long as wide [Fig. 7]. Body length: 11.8-15.4 mm. On *Matthiola maderensis* Lowe and *Sinapidendron gymnocalyx* (Lowe) Rustan. Distribution: Madeira.
………. ***Lixus cheiranthi*** **Wollaston, 1854**

6´) Species from the Canary Islands; inner margin of anterior tibiae sometimes with 5-6 small teeth or lacking them; disc of pronotum with two longitudinal stripes of light hairlike scales beside the dark middle line [Fig. 4b]. Rostrum approximately 2.6x as long as wide in both sexes [Fig. 7]. Body length: 10.6-16.1 mm. On *Erysimum scoparium* and *Crambe sp*. Distribution: Tenerife.
………. ***Lixus machadoi*** **sp.n. Krátký, Stüben & Turner, 2022**

Fig. 8. *Lixus machadoi* sp.n., paratype, adult on a host plant (*Erysimum scoparium*). Photo: A. Machado.

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Fig. 9. *Lixus machadoi* sp.n., paratype, adult on a host plant (*Crambe laevigata*). Photo: C. Turner.

Fig. 10. Habitat of *Lixus machadoi* sp.n. in Montaña de Joco. Photo: R. Valle.

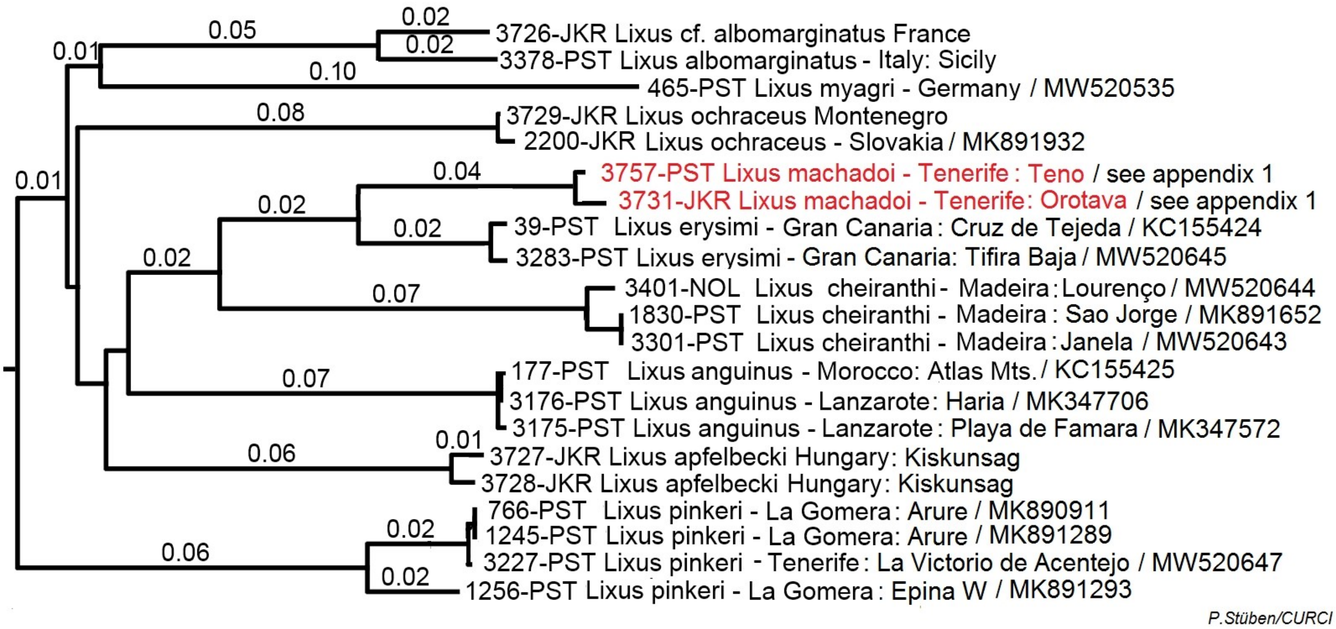

Fig. 11. Neighbor Joining Tree (mtCO1) to some Euro-Mediterranean and Macaronesian species of the subgenus *Compsolixus* Reitter, 1916 and the new species *Lixus machadoi* from the Canary Island Tenerife. The NJ tree was constructed using corrected distances from the nucleotide substitution model of Jukes & Cantor (1969) (see Kearse et al. 2012). These distances (see percentages on the edges of the diagram) are approx. 10% longer than uncorrected distances. On the details of the sequenced specimens: collector number, genus/species, locality, GenBank number (as far as already published by the second author, MWI project).

Appendix 1

DNA-sequence of the mtCO1 gene ("Folmer region") of the new species *Lixus machadoi* sp.n.

Collector’s number 3731-JKR - Spain, Canary Islands, Tenerife, La Orotava, Montaña de Joco, 28°22'09.2"N, 16°27'54"W, 1950 m a.s.l., (see also Material examined).
CACATTATACTTTATTTTTGGGGCATGGTCGGGAATAGTGGGAACCTCTTTAAGAATATTGATCCGAACAGAATTAGGAAACCCTGGCAGTCTGATTGGAGACGACC
AAATTTATAATACAATTGTAACTGCCCATGCCTTTATTATAATTTTTTTTATAGTAATACCGATTATAATCGGGGGTTTCGGAAATTGGCTTATTCCCCTTATATTAGGA
GCTCCTGATATGGCCTTCCCCCGATTAAATAATATAAGATTTTGGCTCCTACCTCCTTCTTTAACACTTTTATTAATAAGAAGAATTGTTAATAAGGGAGCCGGGACA
GGTTGAACTGTTTATCCACCCCTATCATCTAACATTGCACATGAAGGAGCTTCTGTAGACTTAGCTATTTTTAGGTTACATATAGCAGGAATTTCCTCGATTCTTGGT
GCTATAAACTTTATCTCAACTGTATTAAATATACGACCCACGGGAATAAAGCCAGATCAAACCACTTTATTTACTTGAGCCGTAGAAATTACAGCTATTCTACTTCTTC
TATCACTACCAGTATTAGCTGGAGCTATTACTATACTTTTAACAGACCGTAATGTTAATACCTCTTTTTTTGACCCTGCGGGTGGGGGTGACCCTATTTTATACCAAC
ACTTATTT

Collector’s number 3757-PST – Spain, Canary Islands, Tenerife, Teno Mts., near Las Portelas, 28°19'56"N, 16°51'33"W, 868 m, (see also Material examined).
CACATTATACTTTATTTTTGGAGCATGATCGGGAATAGTGGGAACCTCTTTAAGAATATTGATCCGAACAGAATTAGGAAACCCTGGCAGTCTGATTGGAGACGACC
AAATTTATAATACAATTGTAACTGCCCATGCCTTTATTATAATTTTTTTTATAGTAATACCGATTATAATCGGGGGTTTCGGAAATTGGCTTATTCCCCTTATATTAGGA
GCTCCTGATATGGCCTTCCCCCGATTAAATAATATAAGATTTTGGCTCCTACCTCCTTCTTTAACACTTTTATTAATAAGAAGAATTGTTAATAAGGGAGCCGGGACA
GGTTGAACTGTTTATCCACCCCTATCATCTAACATTGCACATGAAGGAGCTTCTGTAGACTTAGCTATTTTTAGGTTACATATAGCAGGAATTTCCTCAATTCTTGGT
GCTATAAACTTTATTTCAACTGTATTAAATATACGACCCACGGGAATAAAGCCAGATCAAACCACTTTATTTACTTGAGCCGTAGAAATTACAGCTATTCTACTTCTTC
TATCACTACCAGTATTAGCCGGAGCTATTACTATACTTTTAACAGACCGTAATGTTAATACCTCTTTTTTTGACCCTGCGGGTGGGGGTGACCCTATTTTATACCAAC
ACTTATTT