

## Two Relatives of *Trechus nakaguroi* (Coleoptera, Trechinae), with Notes on the *Trechus* Fauna of Northeast Asia<sup>1,2)</sup>

By

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**Abstract** Systematic status of two *Trechus* species previously considered to belong to *T.* (s. str.) *nakaguroi* is scrutinized mainly on the basis of a comparative study of their male genitalia. One of them is described as a distinctive new species, *T. sikhotealinus*. The other is considered to be a full species, *T. sachalinensis*, though differentiation between this and *T. nakaguroi* is at a sibling stage. Brief notes are also given on the other species of the subgenus *Trechus* (s. str.) from Northeast Asia.

This paper is primarily designed to introduce a new species of the subgenus *Trechus* into science and to clarify systematic status of another species of the same subgenus. The former, to be named *T. sikhotealinus* S. UÉNO et LAFER, is endemic to the Sikhote-Alin Range in Primorye and the southern part of the Khabarovskij Kray, and the latter, recently described under the name *T. nakaguroi sachalinensis* LAFER (1989, p. 141), has been known from southern Sakhalin. Brief notes on the other species of the subgenus will also be given to illustrate a general sketch of the *Trechus* fauna of Northeast Asia.

In the summer of 1971, two females of the former species were first collected by the second author in a dark-coniferous taiga on the plateau tops of the Sikhote-Alin at the source of the Iman River (now called the Bolshaya Ussurka River) at an altitude of 750–800 m. In the following years (1972–1974), he had opportunities to study on the carabid materials from the Primorskij Kray in the Zoological Institute, Leningrad, under the supervision of Dr. O. L. KRYZHANOVSKIJ, and to compare the two female *Trechus* with the original description of *T. nakaguroi* S. UÉNO from Hokkaido. He

1) Report No. 42 from Russia/Japan Cooperative East Asian Entomological Program.

2) This study is supported in part by the Grant-in-aid No. 06640914 for Scientific Research from the Ministry of Education, Science and Culture, Japan.

then came to the conclusion that the Sikhote-Alin specimens were more closely similar to the Hokkaido species than to Sakhalin specimens of a *Trechus*, which had been provisionally identified by KRYZHANOVSKIJ with *T. ?nakaguroi* S. UÉNO. At about the same time, the first author also examined a pair of the Sakhalin specimens through the courtesy of Dr. KRYZHANOVSKIJ, and concluded that though slightly differing, they might be conspecific with the Hokkaido insect.

For more than twenty years after that, the name *nakaguroi* was applied to the Sikhote-Alin and Sakhalin *Trechus* without further scrutiny, though new materials were accumulated at the second author's hands. In 1977, he made an investigation of the insect fauna with his colleague Dr. V. N. KUZNETSOV at the northeastern side of Mt. Oblachnaya, and found rather a large number of this species both near the foot and below the timber-limit. In the same year, Dr. A. A. NAZARENKO, an ornithologist, obtained some specimens of the same trechine at the source of the Deljuga River near the southernmost of the Khabarovskij Kray. In 1980, LAFER and KUZNETSOV with their assistant Mr. A. V. PLUTENKO, who was then a student of Far East University, took part in an expedition organized by NAZARENKO to Mt. Tardoki-Jani, the highest peak of the Sikhote-Alin, which was, and still is, very difficult of access. This expedition nearly ended in a tragedy to all participants, but they succeeded in collecting a long series of the *Trechus* in question by sifting mosses in an isolated area of spruce forest in a cirque at the source of the Bomboli River about 1,400 m above sea-level. In the same year, Dr. KURCHEVA's material collected earlier at the source of the Sokolovka River was studied by LAFER in Leningrad. And in 1982, PLUTENKO took some more specimens on the southwestern slope of Mt. Oblachnaya.

In the summer of 1991, several specimens of this species were delivered from LAFER to UÉNO for a comparative study with the type series of *T. nakaguroi*, and in the next year, UÉNO himself had an opportunity to collect the trechine in a spruce forest near the timber-limit on the southern slope of Mt. Oblachnaya. Finally in 1993, Mr. Ju. SUNDUKOV took some specimens of the same species on Mt. Olkhovaya of the Partizanskij Range.

To the authors' utmost surprise, dissection of males thus obtained proved beyond all doubt that the Sikhote-Alin *Trechus* was markedly different from *T. nakaguroi* of Hokkaido in spite of their close similarity in external morphology. It must be a new species, and will be named *T. sikhotealinus* in the present paper. Though it shows some local variation, it is not advisable to split it into two or more geographical races, as will be noted on later pages.

The second species, from southern Sakhalin, was briefly described in a key under the name of *T. nakaguroi sachalinensis* (LAFER, *loc. cit.*). It is certainly similar to *T. nakaguroi* in both external and genitalic features, but in this paper, the differences between the two are regarded as being specific rather than subspecific for the reasons to be given later.

The abbreviations used herein are the same as those explained in previous papers of the first author's with the following additions: HL – length of head from the

apical margin of clypeus to the hind edges of temples;  $PL_t$  – total length of pronotum;  $L$  – total length from the tips of open mandibles to the apices of elytra;  $L_s = HL + PL_t + EL$ ;  $N$  – number of measured specimens.

Before going further, the authors wish to express their deep appreciation to the following persons, who kindly helped them in collecting materials of the new interesting species on the Sikhote-Alin Range: Drs. A. A. NAZARENKO, Y. A. TSHISTJAKOV, V. N. KUZNETSOV, G. KURCHEVA and A. B. EGOROV of the Institute of Biology and Pedology, Vladivostok, Mr. A. V. PLUTENKO from Artjem, Mr. Ju. SUNDUKOV of the Lazovskij Reserve, Lazo, Professor Masataka SATÔ of Nagoya Women's University, Nagoya, Professor Yoshiaki NISHIKAWA of Ohtemon-Gakuin University, Osaka, and Dr. Akiko SAITO of the Natural History Museum and Institute, Chiba.

*Trechus* (s. str.) *sikhotealinus* S. UÉNO et LAFER, sp. nov.

(Figs. 1–8)

*Trechus nakaguroi*: LAFER, 1977, Trudy biol.-pochvenn. Inst., Vladivostok, (N.S.), **44**, pp. 8, 22.

*Trechus nakaguroi nakaguroi*: LAFER, 1989, Opred. Nasek. Dal'nego Vostoka, **3** (1), p. 141 [*partim*].

Length: 3.15–3.45 mm (from apical margin of clypeus to apices of elytra); 3.30–3.70 mm (from tips of mandibles to apices of elytra).

Body usually dark reddish brown to dark brown, sometimes light reddish brown, head and elytra often slightly darker than pronotum, the latter sometimes yellowish in basal fourth; antennae, palpi and legs yellowish or clayey brown. Head slightly shiny or mat, pronotum and elytra moderately or strongly shiny, the latter sometimes feebly iridescent. Microsculpture composed of coarse isodiametric meshes on the dorsal surface of head, of transverse lines partially forming meshes on pronotum except along base, where the meshes are isodiametric, and of fine transverse lines on elytra though largely evanescent.

Head rather large (PW/HW 1.28–1.37, M 1.34), with large but slightly convex eyes; genae short though gently convex; dorsal surface smooth and moderately convex, with entire, rather deep frontal furrows widely divergent both in front and behind and arcuate in the middle; two pair of supraorbital setiferous pores present, the anterior one foveolate and situated at the mid-eye level, while the posterior one lies just behind the level of hind margins of eyes, which are obliquely oval in lateral view; clypeus transverse with straight apical margin; neck wide; labrum transverse, deeply emarginate at the apex; mandibles stout though sharply hooked at apices; mentum tooth short and broad, distinctly emarginate at the apex; antennae relatively short and stout, subfiliform, reaching basal fifth to fourth of elytra, segment 2 about nine-tenths as long as scape or segment 3 and about as long as each of segments 8–10, which is sub-oval and a little less than twice as long as wide, segments 4–8 very gradually decreasing in length towards apex, terminal segment the longest, about 1.2 times as long as scape though obviously narrower than the latter.

Pronotum evidently transverse (PW/PL 1.43–1.66, M 1.48), widest at about two-

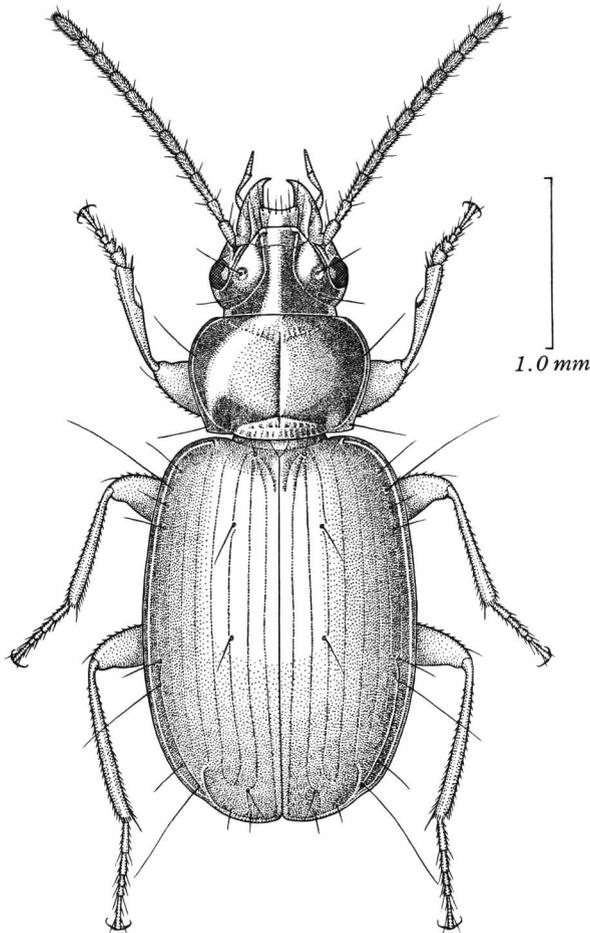
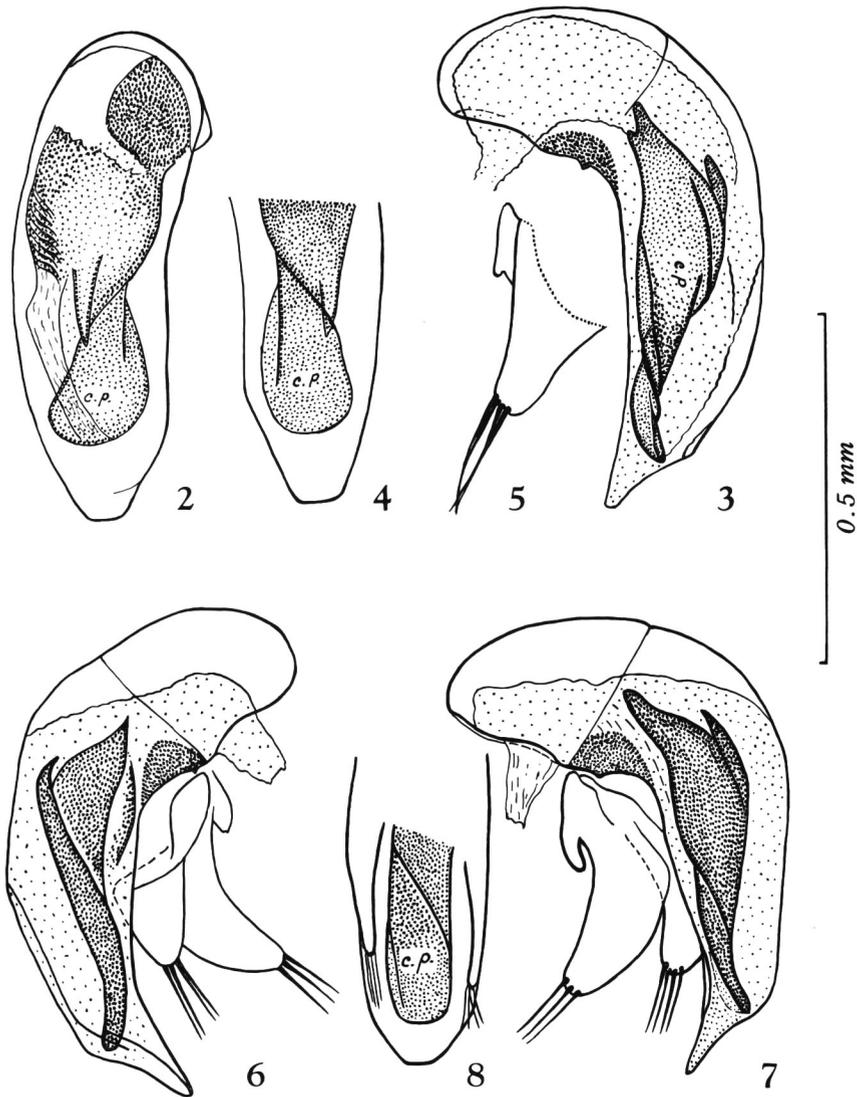


Fig. 1. *Trechus* (s. str.) *sikhotealinus* S. UÉNO et LAFER, sp. nov., ♂, from Mt. Oblachnaya.

thirds from base, and more gradually contracted posteriad (PW/PB 1.19–1.27, M 1.24) than anteriorly (PW/PA 1.37–1.48, M 1.41); sides distinctly reflexed throughout, strongly arcuate at the widest part, very feebly so behind middle, and very briefly sinuate just before small hind angles, which are obtusely denticulate; marginal gutters narrow in anterior halves and becoming narrower near front angles; base wider than apex (PB/PA 1.09–1.21, M 1.15), posteriorly arcuate except for lateral portions which are transverse; apex slightly emarginate, with front angles very obtuse and almost rounded off; surface well convex, median line distinctly impressed, not reaching apex but usually widened and deepened in basal area; apical transverse impression shallow though continuous, longitudinally wrinkled; basal transverse impression deep and continuous, laterally extending into large basal foveae, which are deep and more or less uneven at the bottom; basal area small, longitudinally rugulose.



Figs. 2-8. Male genitalia of *Trechus* (s. str.) *sikhotealinus* S. UÉNO et LA FER, sp. nov.; left lateral view (3, 7), right lateral view (6), dorsal view (2), apical part of aedeagus, ventral view (4, 8), and left style, left lateral view (5); c. p. - copulatory piece. — 2-5. Topotypical specimen from Mt. Oblachnaya. — 6-8. Specimen from Mt. Tardoki-Jani.

Elytra short ovate (EL/EW 1.32-1.43, M 1.38), obviously wider than pronotum (EW/PW 1.42-1.53, M 1.48) and about three times as long as the latter (EL/PL<sub>t</sub> 2.69-3.08, M 2.84), widest at about middle; shoulders rounded, with prehumeral borders arcuate and either perpendicular to the mid-line or slightly recurved at the innermost

Table 1. Geographical variation of body size and measurement of body parts in *Trechus* (s. str.) *sikhotealinus* S. UENO et LAFER, sp. nov.

Mean values are shown in parentheses.

Localities	N	HL	HW	PA	PW	PB	PL <sub>t</sub>
Mt. Tardoki-Jani	10 ♂♂, 10 ♀♀	0.45-0.50 (0.48)	0.74-0.80 (0.77)	0.68-0.75 (0.73)	0.98-1.13 (1.03)	0.78-0.88 (0.83)	0.68-0.78 (0.73)
Deljuga Riv.	2 ♂♂, 1 ♀	0.45-0.50 (0.48)	0.78-0.82 (0.79)	0.73-0.78 (0.75)	1.03-1.10 (1.07)	0.78-0.85 (0.82)	0.70-0.78 (0.74)
B. Ussurka Riv.	1 ♀	0.50	0.83	0.75	1.10	0.88	0.78
Mt. Oblachnaya	9 ♂♂, 10 ♀♀	0.43-0.50 (0.47)	0.70-0.80 (0.77)	0.65-0.78 (0.72)	0.93-1.08 (1.03)	0.78-0.88 (0.83)	0.65-0.80 (0.74)
Mt. Olkhovaya	3 ♂♂, 3 ♀♀	0.45-0.50 (0.48)	0.73-0.79 (0.76)	0.67-0.76 (0.73)	0.98-1.08 (1.02)	0.78-0.83 (0.80)	0.70-0.75 (0.73)

Localities	N	PL	EW	EL	L	L <sub>s</sub>
Mt. Tardoki-Jani	10 ♂♂, 10 ♀♀	0.65-0.75 (0.70)	1.45-1.65 (1.54)	2.00-2.30 (2.11)	3.45-3.95 (3.65)	3.13-3.53 (3.31)
Deljuga Riv.	2 ♂♂, 1 ♀	0.68-0.78 (0.70)	1.50-1.61 (1.54)	2.15-2.20 (2.18)	3.65-3.80 (3.73)	3.30-3.48 (3.40)
B. Ussurka Riv.	1 ♀	0.73	1.58	2.10	3.65	3.38
Mt. Oblachnaya	9 ♂♂, 10 ♀♀	0.63-0.75 (0.70)	1.40-1.60 (1.52)	2.00-2.23 (2.10)	3.30-3.70 (3.55)	3.08-3.48 (3.31)
Mt. Olkhovaya	3 ♂♂, 3 ♀♀	0.68-0.73 (0.70)	1.50-1.60 (1.56)	2.03-2.20 (2.09)	3.55-3.80 (3.60)	3.18-3.45 (3.30)

portions; sides narrowly reflexed throughout, very feebly arcuate before middle, more regularly so behind, and slightly emarginate before apices, which are widely and separately rounded, forming an obtuse re-entrant angle at suture; surface convex though widely depressed on the disc, with steep apical declivity; striae distinct and weakly crenulate on the disc, but becoming shallower and nearly obsolete at the side, 1-2 deeper than the others, 3-5 almost entire though shallow, 8 deeply impressed behind the middle set of marginal umbilicate pores; scutellar striole long and distinct; apical striole deeply impressed, moderately curved and joining stria 5; intervals smooth, slightly convex only near suture; apical carina distinct, costate; stria 3 with two setiferous dorsal pores at about 1/5 and 5/9 from base, respectively; preapical pore located at the apical anastomosis of striae 2 and 3 well behind the level of the terminus of apical striole, and often equidistant from apex and from suture. Inner wings degenerated.

Ventral surface glabrous and smooth; anal sternite with the apical margin more strongly arcuate in ♂ than in ♀, bisetose in the former and quadrisetose in the latter. Legs fairly short and stout; protibiae widely dilated towards apices and slightly bowed, each with a longitudinal groove on the external face; tarsi short and fairly thick; in ♂, two proximal segments of each protarsus widely dilated and stoutly denticulate in-

Table 2. Geographical variation of standard ratios in *Trechus* (s. str.) *sikhotealinus*  
S. UÉNO et LAFER, sp. nov. Mean values are shown in parentheses.

Localities	N	PW/HW	PW/PL <sub>t</sub>	PW/PL	PW/PB	PW/PA
Mt. Tardoki-Jani	10 ♂♂, 10 ♀♀	1.28-1.47 (1.34)	1.37-1.50 (1.42)	1.41-1.57 (1.47)	1.19-1.30 (1.25)	1.36-1.49 (1.42)
Deljuga Riv.	2 ♂♂, 1 ♀	1.32-1.39 (1.35)	1.41-1.47 (1.44)	1.51-1.54 (1.52)	1.29-1.32 (1.30)	1.41-1.44 (1.42)
B. Ussurka Riv.	1 ♀	1.33	1.41	1.51	1.25	1.47
Mt. Oblachnaya	9 ♂♂, 10 ♀♀	1.28-1.37 (1.34)	1.35-1.44 (1.40)	1.43-1.66 (1.48)	1.19-1.27 (1.24)	1.37-1.48 (1.41)
Mt. Olkhovaya	3 ♂♂, 3 ♀♀	1.32-1.39 (1.35)	1.36-1.44 (1.41)	1.41-1.54 (1.47)	1.23-1.31 (1.28)	1.37-1.44 (1.41)

Localities	N	PB/PA	EL/EW	EL/PL <sub>t</sub>	EW/PW
Mt. Tardoki-Jani	10 ♂♂, 10 ♀♀	1.04-1.19 (1.13)	1.29-1.44 (1.37)	2.73-3.07 (2.90)	1.42-1.55 (1.49)
Deljuga Riv.	2 ♂♂, 1 ♀	1.07-1.12 (1.09)	1.37-1.47 (1.42)	2.82-3.07 (2.94)	1.36-1.49 (1.44)
B. Ussurka Riv.	1 ♀	1.17	1.33	2.69	1.44
Mt. Oblachnaya	9 ♂♂, 10 ♀♀	1.09-1.21 (1.15)	1.32-1.43 (1.38)	2.69-3.08 (2.84)	1.42-1.53 (1.48)
Mt. Olkhovaya	3 ♂♂, 3 ♀♀	1.05-1.18 (1.10)	1.28-1.39 (1.35)	2.80-2.93 (2.87)	1.48-1.62 (1.52)

wards at apices.

Male genital organ fairly large though rather lightly sclerotized. Aedeagus about three-tenths as long as elytra, robust, feebly arcuate, and almost rectangularly bent at the basal part, with short apical lobe slightly curved ventrad; viewed laterally, apical lobe short, narrow, and tapered towards the blunt extremity; viewed dorsally, apical lobe subtriangular, wide at the base and subtruncated at the apex; basal bulb large and devoid of sagittal aileron; ventral margin either straight or lightly bisinuate at middle in profile. Inner sac armed with a very large copulatory piece, which is sharply forked in proximal part, twisted in apical half, and almost horizontal in wide lamellar apical part; apical lamella somewhat spatulate and concave on the ventral face. Styles fairly large, left style obviously longer than the right, each usually bearing four apical setae, rarely with only three apical setae.

*Type series.* Holotype: ♂, Mt. Oblachnaya, source of the Zabyty Kljuch River, 1,500-1,600 m alt., spruce forest near timber-limit, Chuguevskij Co., Primorskij Kray, 13-VII-1977, G. Sh. LAFER leg. (IBPV). Allotype: ♀, Mt. Oblachnaya, southern ridge, 1,270 m alt., mossy spruce forest near timber-limit, Chuguevskij Co., Primorskij Kray, 16-VIII-1992, S. UÉNO leg. (NSMT). Paratypes: 4 ♂♂, 21 ♀♀, same locality as for the holotype, 8, 10, 13~15-VII-1977, G. Sh. LAFER leg. (IBPV); 5 ♂♂, 3 ♀♀,

same locality and date as for the allotype, S. UÉNO, G. Sh. LAFER & Y. NISHIKAWA leg. (IBPV & NSMT).

*Further specimens examined.* [Khabarovskij Kray] 89 exs., Mt. Tardoki-Jani, source of the Bomboli River (tributary of the Anjuy River), 1,400 m alt. and higher, spruce forest, Sikhote-Alin Range, Nanayaskij Co., 17-VI~12-VII-1980 (mainly 17~30-VI), G. Sh. LAFER leg.; 6 exs., Mt. Durkhe (45 km NE of Mt. Ko), source of the Deljuga River (tributary of the Chuken River), 1,600 m alt., grassy birch forest at the timber-line, Lazo Co., VII-1977, A. A. NAZARENKO leg. [Primorskij Kray] 1 ♀, plateau at the source of the Bolshaya Ussurka River (14 km N of Taiga Village by the Rudnaja River), 750 m alt., coniferous forests, Dalnegorskij Co., 13-VII-1971, G. Sh. LAFER leg.; 1 ♀, same locality, 9-VIII-1971, G. Sh. LAFER leg.; 3 exs., upper part of the Sokolovka River, coniferous forests, Chuguevskij Co., 30-VI-1973, G. KURCHEVA leg.; 17 exs., same locality and collector, 13~20-VIII-1973; 12 exs., same locality and collector, 24~28-VIII-1974; 38 exs., Mt. Oblachnaya, source of the Zabyty Kljuch River, 1,500-1,600 m alt., spruce forest near timber-limit, Chuguevskij Co., 8~15-VII-1977, G. Sh. LAFER leg.; 6 exs., Mt. Oblachnaya, source of the Bereznjaki Stream, 1,250-1,300 m alt., spruce forest, Chuguevskij Co., 17-VI-1982, A. PLUTENKO leg.; 3 ♂♂, 3 ♀♀, Mt. Olkhovaya, near the top, Partizanskij Co., 27-VII-1993, Ju. SUNDUKOV leg.

*Notes.* Though externally similar to *T. nakaguroi*, this new species does not seem very close to the latter because of the unique male genitalia. Besides, it differs from *T. nakaguroi* in lighter coloration of the body with fainter iridescence on the elytra, and relatively transverse prothorax.

*Trechus sikhotealinus* is rather a homogeneous species. A comparative study of the specimens from five known populations proves that they are not basically different from one another in measurements (Table 1), standard ratios of body parts (Table 2), coloration, microsculpture, and inner armature of male genitalia. Nevertheless, specimens from the southern populations can be distinguished from the northern ones by the following respects:

1) Specimens, especially males, from the southern populations are characterized by the completely obliterated external (6th to 8th) striae of the elytra, whereas these striae are usually visible, though sometimes interrupted, in both males and females from the northern populations, especially in females.

2) In southern specimens, the basal area of the pronotum is briefly produced except for the lateral parts and has more or less arcuate basal margin, but in northern specimens, the basal margin is straight and not arcuately produced.

3) In southern specimens, the pronotal median line is usually widened and deepened in the basal area and accompanied with longitudinal wrinkles, while in northern ones, the median line is finer near the base and devoid of such wrinkles, and the basal area bears an additional transverse stria formed by confluent punctures behind the basal transverse impression.

4) No sexual difference can be observed in the specimens from Mt. Oblachnaya,

but mean values of PW, EW, EL, L and  $L_s$  are somewhat larger in male than in female in the specimens from Mt. Tardoki-Jani.

As *T. sikhotealinus* occupies rather a wide distributional range, and as its habitats are confined to the dark-coniferous taiga near the timber-limit and isolated from one another, this species may be at a beginning stage of splitting up into local races. It is, however, not recommendable to recognize two or more subspecies in *T. sikhotealinus* at present, since there still remains a wide blank in the intervening area between the northern and southern habitats, which may yield populations that fill in the gap.

***Trechus* (s. str.) *sachalinensis* LAFER**

(Figs. 9–11)

*Trechus ?nakagurai* [err.]: KRYZHANOVSKIY & MOLODOVA, 1973, Ent. Obozr., **52**, pp. 64, 66, 69.

*Trechus nakaguroi*: LAFER, 1985, Fauna i Ekologiya Bespozvonochnykh Dal'nego Vostoka, Vladivostok, (Suppl.), p. 59 [partim].

*Trechus nakaguroi sachalinensis* LAFER, 1989, Opred. Nasek. Dal'nego Vostoka, **3** (1), p. 141; type locality: ust'e r. Anny in Dolinskij Co.

Length: 3.15–3.50 mm (from apical margin of clypeus to apices of elytra); 3.35–3.80 mm (from tips of mandibles to apices of elytra). Measurements (in mm) of the holotype: HL 0.50, HW 0.80, PA 0.78, PW 1.10, PB 0.83,  $PL_t$  0.78,  $PL_s$  0.75, EW 1.50, EL 2.10, L 3.70,  $L_s$  3.38.

Closely similar to *T. nakaguroi*, but the dorsum is more brownish in coloration and less shiny in lustre, the microsculpture is more apparent on the pronotum, the frontal furrows are more distinctly angulate at middle, the elytra are more widely depressed on the disc and more deeply striate, especially at the sides, and the aedeagus is slenderer, with longer apical lobe and reduced inner armature.

Colour dark reddish brown; elytra often darker than fore-body, sometimes almost blackish, with basal areas, reflexed lateral margins and sutural intervals usually reddish; mandibles, ventral side of fore-body, and epipleura reddish brown; palpi, antennae and legs yellowish brown. Head slightly glossy or almost mat, with rather coarse microsculpture whose reticulation is partly isodiametric and partly wide; pronotum moderately shiny, covered with fine transverse lines and transverse meshes which become more or less obliterated on the disc, making that part polished; elytra shiny and faintly iridescent, only partially with trace of fine transverse lines.

Head fairly large (PW/HW 1.25–1.38, M 1.32), slightly wider than pronotal apex, with rather large but flat eyes and feebly convex genae, the latter of which are less than a half as long as eyes and strongly contracted towards deep neck constriction; dorsum gently convex, with deep frontal furrows obtusely but distinctly angulate at middle and widely divergent in front and behind; frons and supraorbital areas moderately convex, the latter bearing a pair of foveolate anterior supraorbital pores at the mid-eye level; labrum transverse, deeply and subangulately emarginate at the apex; mandibles stout though relatively long, sharply hooked at the apices; mentum tooth broad, obtusely

Table 3. Variation of standard ratios in *Trechus* (s. str.) *sachalinensis* LAFER.  
Mean values are shown in parentheses.

N	PW/HW	PW/PL	PW/PB	PW/PA	PB/PA
7 ♂♂, 5 ♀♀	1.25–1.38 (1.32)	1.39–1.51 (1.45)	1.26–1.35 (1.31)	1.33–1.44 (1.38)	1.03–1.11 (1.06)

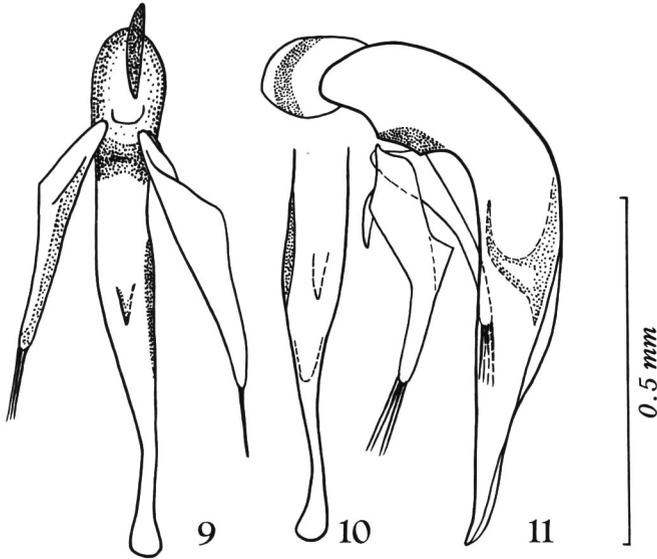
  

N	EL/EW	EL/PL <sub>t</sub>	EW/PW	L	L <sub>s</sub>
7 ♂♂, 5 ♀♀	1.23–1.43 (1.38)	2.44–2.77 (2.64)	1.31–1.55 (1.41)	3.35–3.80 (3.70)	3.13–3.45 (3.33)

bifid at the apex; palpi fairly stout, penultimate segments widely dilated towards apices, apical ones subconical; antennae short and stout, reaching basal fifth of elytra, segment 2 about three-fourths as long as segment 3, which is slightly longer but much narrower than scape and slightly shorter than terminal segment, segments 4–10 very gradually decreasing in length towards apex, segments 6–10 each subovate and a little more than 1.5 times as long as wide.

Pronotum transverse (PW/PL 1.34–1.51, M 1.44), widest at about two-thirds from base, and more gradually contracted towards base (PW/PB 1.26–1.35, M 1.30) than towards apex (PW/PA 1.33–1.44, M 1.38), with lateral margins moderately arcuate in front, feebly so behind middle, and hardly sinuate before hind angles, which form a distinct denticle on each side, the denticle being either rectangular or obtuse; sides rather narrowly reflexed, the reflexed borders becoming narrower near front angles but widening near hind angles and reaching base, with two pair of marginal setae, of which the anterior one is situated just before the widest part and the posterior one on hind angles; base slightly arcuate at the median part or almost straight, slightly wider than apex (PB/PA 1.03–1.11, M 1.06); apex shallowly and evenly emarginate, with front angles narrowly rounded and hardly produced; surface well convex and smooth, median line distinct, sometimes a little widened in basal area; apical transverse impression vague though bearing longitudinal striations; basal transverse impression deep and continuous, laterally merging into deep round basal foveae; basal area longitudinally strigose.

Elytra short (EL/EW 1.23–1.44, M 1.39), ovate, evidently wider (EW/PW 1.31–1.55, M 1.40) than and usually more than 2.5 times as long (EL/PL<sub>t</sub> 2.44–2.77, M 2.64) as pronotum, widest at about or slightly behind middle, and more gradually narrowed towards bases than towards apices; shoulders moderately arcuate, with prehumeral borders short and almost perpendicular to the mid-line at the innermost portions; sides narrowly reflexed throughout, very feebly arcuate before middle, moderately so behind, and widely rounded at apices, which form an obtuse re-entrant angle at suture, each with a slight preapical emargination; surface convex though widely depressed on the disc, with rather steep apical declivity; striae entire, weakly punctate or crenulate, striae 1–5 deeply impressed, 6–8 shallower than the inner ones



Figs. 9–11. Male genitalia of *Trechus* (s. str.) *sachalinensis* LAFER, from the estuary of the Anna River; left lateral view (11), ventral view (9), and apical part of aedeagus, dorsal view (10).

though stria 8 is deeply impressed behind the middle set of marginal umbilicate pores; scutellar striole short; apical striole deep, moderately curved, and joining stria 5; intervals slightly convex near suture, completely flat at the side; apical carina distinct, carinate; stria 3 with two setiferous dorsal pores at about 1/5 and 3/5 from base, respectively; preapical pore situated at the apical anastomosis of striae 2 and 3 behind the level of the terminus of apical striole, and a little more distant from apex than from suture. Inner wings degenerated.

Ventral surface glabrous and smooth; anal sternite bisetose in ♂, quadrisetose in ♀. Legs short and stout as in *T. nakaguroi*.

Male genitalia similar to those of *T. nakaguroi*, but slenderer, with longer apical lobe of aedeagus and reduced copulatory piece. Aedeagus three-eighths as long as elytra, slender, compressed, and hardly arcuate, with long apical lobe which is asymmetrically dilated in apical part and rounded at the tip in dorsal view; basal part rather abruptly bent ventrad, emarginate at the sides of basal orifice and bearing a large elongate sagittal aileron; viewed laterally, apical lobe narrow, distinctly curved ventrad in apical part and obtusely pointed at the extremity; ventral margin either straight or slightly bisinuate in profile. Inner sac armed with a small copulatory piece corresponding to the apical part of that in *T. nakaguroi*. Styles as in *T. nakaguroi*, each bearing four apical setae.

*Specimens examined.* ♂ (holotype), estuary of the Anna River, 28 km SE of Dolinsk Town, Dolinskij Co., southern Sakhalin, 28–VII–1977, sand beach near taiga, G. Sh. LAFER leg. (IBPV); 11 ♂♂, 13 ♀♀, same locality, dark coniferous taiga, 27 &

29-VII-1977, G. Sh. LAFER leg.; 8 exs., Mt. Chekhov, near the top, Susunayskij Range near Juzhno-Sakhalinsk, 6, 7 & 17-VII-1968, L. P. MOLODOVA leg. (1 ♂, 1 ♀ in NSMT); 16 exs., same locality, 16-VII-1970, L. P. MOLODOVA & M. LOKTIN leg.; 1 ex., same locality, 7-VIII-1978, A. B. EGOROV leg.; 1 ♂, Uljanovka River, Anivskij Co., 1 ~ 20-IV-1989, A. BESARUKIN leg.

*Range.* Known so far only from the Susunayskij Range in southern Sakhalin.

*Notes.* This trechine beetle was originally described on a single male, as a subspecies of *T. nakaguroi*, in a key to the trechine species from the Russian Far East. At that time, however, a series of additional specimens were already at the second author's hands and forgotten. They were recently found out, mounted and carefully examined for this study, and the authors are convinced now that the Sakhalin form is a sibling species of *T. nakaguroi*. It is true that this species is very similar to the Hokkaido one, but the differentiation of their male genitalia indicates that the two forms are specifically distinctive. Besides, their distributional ranges seem widely separated by the wide intervening area consisting of the northern half of Hokkaido and the Island of Rishiri-tô, which is occupied by several apterous members of *Epaphius* (cf. UÉNO, 1991).

From *T. sikhotealinus*, this species sharply differs in conformation of aedeagus, which bears a long slender apical lobe, large sagittal aileron, and much reduced copulatory piece. It is also distinguished from the Sikhote-Alin species by much darker coloration and relatively short elytra.

### Biological and Zoogeographical Notes

Six species of *Trechus* (s. str.) have hitherto been known from the northeastern part of the Far East. They are: *T. apicalis* MOTSCHULSKY (1845, p. 347, pl. 5, fig. 6), *T. nakaguroi* S. UÉNO (1960, p. 134, figs. 1-2), *T. sachalinensis* LAFER, *T. sikhotealinus* S. UÉNO et LAFER, *T. tardokijanensis* LAFER (1989, p. 139, fig. 84-1) and *T. kurentzovi* LAFER (1989, p. 140, figs. 84-2, 88-1 & 2). Of these, only *T. apicalis* has a wide range and extends its distribution to northern North America. All the others are restricted to the southern areas of the Russian Far East and northern Japan; *T. nakaguroi* is endemic to Hokkaido, *T. sachalinensis* to southern Sakhalin, and the remaining three to the Sikhote-Alin Range. All the species are apterous in Northeast Asia, but a fully winged female of *T. apicalis* was reported by DARLINGTON (1943, p. 60) from eastern Massachusetts in North America.

Though quite exceptional (only 0.625% of the total 160 specimens from the same population examined by DARLINGTON), this alate specimen is very important for understanding the unusually wide distribution of *T. apicalis*, which covers Northeast Asia from the southwestern part of the Primorskij Kray in the southwest through Magadan and Kamchatka to Chukotka, and then enters into Alaska, extends eastwards through Canada and reaches New England in the southeast. The species seems to have originated somewhere in Northeast Asia, and to have dispersed eastwards into

North America. Its dispersal must have been made primarily by winged ancestors and have rapidly widened its range, while loss of hind wings quickly progressed in old populations. DARLINGTON's discovery of a fully winged individual is symbolical of this process, as it was made near the eastern end of the distributional range of the species, or at the forefront of its dispersal.

*Trechus apicalis* is usually rare in the southwestern part of its range. It is known from Kedrovaya Pad Reserve on the East-Manchurian Mountains in southern Primorye and the Khokhtzir Range near Khabarovsk City. On the Sikhote-Alin Range, it does not occur at higher elevations but on foot hills and at middle altitude with broadleaved or mixed forests (with *Pinus koraiensis* and *Abies holophylla*). Its habitats lie almost always below those of *T. sikhotealinus*, *T. tardokijanensis* and *T. kurentzovi*, but on the plateau tops of the watershed between the Melniki and the Partizanskaya Rivers, it was found in coexistence with *T. kurentzovi*.

From Sakhalin, *T. apicalis* was previously known from only one female collected by V. N. KUZNETSOV on September 3–6, 1975, in a broadleaved forest at the riverside in the vicinity of Dolinsk Town (LAFER, 1985, p. 58), but a second female was recently found out in a series of *Trechus* from Novikovo Village on the Tonnino-Anivskij Peninsula, which had previously been reported as *T. nakaguroi* (LAFER, 1985, p. 59). This specimen was collected by LAFER on August 5, 1977, in a growth of tall grasses near a streamlet at low altitude in the park of old fir trees. Measurements (in mm) of the specimen in question are as follows: HL 0.60, HW 0.90, PA 1.13, PW 1.23, PB 1.00, PL<sub>r</sub> 0.93, PL 0.90, EW 1.70, EL 2.35, L 4.34, L<sub>s</sub> 3.88.

In the Japanese territory, *T. apicalis* has so far been recorded only from the Island of Rishiri-tô in the Japan Sea off northern Hokkaido (UÉNO, 1984, p. 142, 1985, p. 67, pl. 13, fig. 15). On this volcanic island, the trechine is found between 200 m and 1,450 m in altitude, and is always found from beneath dead leaves, in mixed cold-temperate forests at low altitude and in shrubberies of dwarf birch at high elevations. At the latter habitats, it coexists with *Trechus (Epaphius) matsumotoi* S. UÉNO. The Rishiri-tô population of *T. apicalis* seems to have been derived from an ancestor that reached the island by transmarine dispersal.

*Trechus apicalis* is also recorded from three islands of the northern Kurils, Alaid (Atlasov), Paramushir and Onkotan (KÔNO, 1944, p. 78; UÉNO, 1966, p. 70; KRYZHANOVSKIY *et al.*, 1975, pp. 122, 133).

Next to be considered is *Trechus nakaguroi* S. UÉNO. This species has hitherto been known only from Hokkaido, though it may occur also on the Island of Kunashir of the southern Kurils. Two separated ranges of the trechine are confirmed at present; one of them is the Ishikari Mountains inclusive of the Daisetsu Volcanoes at the central part, and the other is the Shiretoko Mountains at the eastern part. Ten localities are recorded on the former (Mt. Hira-yama [in Shirataki-mura], Mt. Nagayama-daké (type locality), Mt. Hokuchin-daké, Mt. Kuro-daké, Mt. Asahi-daké, Yukomanbetsu, Komakusa-daira, Mt. Hira-ga-také, Mt. Furano-daké, Mt. Ishikari-daké and Mt. Maru-yama), and two localities on the latter (Mt. Shari-daké and Mt.

Sashirui-daké). It is primarily alpine or subalpine, and usually dwells under stones or dead leaves in shrubberies of dwarf birch or creeping pine at an elevation of 1,300–2,000 m. In exceptional cases, it occurs at lower places; on Mt. Maru-yama, for instance, three specimens of this trechine were collected at an elevation of 1,180 m (HAGA & MIYASHITA, 1991, p. 17).

*Trechus nakaguroi* has been specially searched for on the mountains in the intervening area between the two known ranges and in northern Hokkaido, but without success. If this absence is really the case, the species should be regarded as the descendant of an ancestor that reached central Hokkaido by sweepstakes dispersal. It is, however, difficult to surmise its derivation, since its direct relative has been known only from southern Sakhalin and not from the continental part of the Russian Far East.

This close relative of *T. nakaguroi* is *T. sachalinensis* hitherto known only from the Susunayskij Range. The second author visited many places of southern Sakhalin in 1977, from Novikovo in the south to Makarov in the north, but the *Trechus* was found only near the estuary of the Anna River at the eastern foot of the Susunayskij Range. All his specimens were collected in a dark-coniferous taiga at low altitude, from the sea-level to an elevation of 300–400 m, with the exception of the holotype which was taken on sandy beach near a coniferous forest. However, on the western slope of Mt. Chekhov, the carabid fauna of which has long been investigated by Dr. L. P. MOLODOVA, this species occurs at various height, from the river valley to the timber-limit, and to still higher places where it lives in shrubberies of creeping pine (*Pinus pumila*) and dwarf bamboo.

Derivation of *T. sachalinensis* cannot be determined with confidence. It must have evolved from a common ancestor with *T. nakaguroi*, as the differentiation between the two species is at a sibling stage. Judging from development of aedeagal inner armature, *T. nakaguroi* seems a little more advanced than *T. sachalinensis*, but this does not necessarily mean that the former has been directly derived from the ancestor of the latter. On the contrary, existing pattern of their distribution seems to suggest that colonization of Sakhalin and Hokkaido may have been accomplished independent of each other by ancestors that arose in the northern part of the Sikhote-Alin. Direct descendant of their common ancestor has been unknown up to the present, but if it is found out by future investigations, it should prove to be conspecific with or very closely similar to *T. sachalinensis*. In any case, it must be different from *T. sikhotealinus*, since this species has become differentiated to another direction.

The remaining three species are autochthonous to the Sikhote-Alin Mountains. Of these, *T. sikhotealinus* is most widespread, extending its distribution from Mt. Tardoki-Jani of the Khabarovskij Kray in the north to Mt. Olkhovaya of the Partizanskij Range in the south. It occurs mainly in the zone of dark-coniferous taiga, and is commoner near the timber-limit above 1,000 m in altitude. Its exact range has not been satisfactorily clarified as yet, but probably reaches the Amur River in the north through high mountains of the Sikhote-Alin. In the southern part of the Sikhote-Alin, however, it does not seem to spread southwards beyond Mt. Olkhovaya and

appears to be replaced by *T. kurentzovi*. It has not been found on Mt. Lysaya of the Partizanskij Range, the watershed mountains between the Melniki and the Partizanskaya Rivers, Shkotovskoe Plateau, Mt. Tumannaya and the Livadiyskij Range. It has not been collected from the East-Manchurian Mountains in southern Primorye and the Khekhtzir Range near Khabarovsk City, either.

It is interesting to note that though its habitats are primarily connected with the dark-coniferous taiga, this *Trechus* is usually found on mountain sides and becomes rarer at plateau tops (750–800 m in height) even if covered with dark-coniferous taiga. The second author made an investigation of the insect fauna at the sources of the Bolshaya Ussurka River from the middle of June to the middle of August, 1971, and was able to collect only two specimens of *T. sikhotealinus* there. Following this investigation, collectings were made on the watershed plateau between the Melniki and the Partizanskaya Rivers from the middle of August to the end of September, but the *Trechus* was not found out at all. On Mt. Oblachnaya, this species can be met at its northeastern foot 500–600 m above sea-level, but is doubtless commoner at higher places near the timber-limit.

On Mt. Tardoki-Jani, 80 of the 89 known specimens of *T. sikhotealinus* were obtained in a spruce forest (*Picea microsperma*) isolated on a very steep slope at a height of about 1,400 m in a cirque at the source of the Bomboli River. They were found in mosses growing on the ground, tree roots and fallen trees. Teneral specimens were collected on August 13–15. The patch of the spruce forest was separated from the fir-spruce zone on the mountain side by an area of tundra about 2–3 km long. Outside the spruce forest, only a few specimens of this species were collected in birch forests and thickets of creeping pine (*Pinus pumila*) and on the ground covered with peat. It occurred neither on the flat tops of the mountain covered with tundras (1,700–2,000 m in altitude), nor in the flat tundra area below the spruce forest (about 1,380 m in altitude).

Coexisting with *T. sikhotealinus* in the spruce forest, *T. tardokijanensis* LAFER is of about half the density of the latter, since 42 specimens of *T. tardokijanensis* were found in 89 specimens of *T. sikhotealinus*. This is a distinctive species so far known only from Mt. Tardoki-Jani, so that it is the most localized of all the six species of *Trechus* (s. str.) hitherto described from Northeast Asia. Its derivation is unknown, but the species can be regarded as a relict of an old fauna that existed in the Glacial Period.

The last species to come within the scope of this paper is *T. kurentzovi* LAFER endemic to the southernmost part of the Sikhote-Alin Mountains. This small trechine is an inhabitant of the dark-coniferous taiga, and is usually found from beneath moss-mats growing on rocks or from heaps of dead leaves accumulated on the ground. Its range is rather small but complementary to that of *T. sikhotealinus*, covering the Partizanskij Range, the watershed plateau between the Melniki and the Partizanskaya Rivers (750–800 m in altitude), and Mt. Tumannaya. It does not coexist with the latter species in almost all the known localities, but their ranges meet on Mt. Olkhovaya

lying at the northern part of the Partizanskij Range, where the two species are found together in the same habitat.

Two more species of *Trechus* (s. str.) have been known from the Changbai Range to the southwest of Primorye (PAWŁOWSKI, pers. comm.). Our sketch of the *Trechus* fauna of Northeast Asia will be completed when the true relationship of these species from southern Manchuria and northern Korea is clarified on the basis of adequate materials.

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