

## Study the taxonomy of Iranian species of *Laccophilus* Leach, 1817 (Coleoptera, Dytiscidae)

<sup>1</sup>Rokhsareh Malekpour and <sup>2</sup>Amir Houshang Shiva

<sup>1</sup>Department of Biology, Kazeroun Branch, Islamic Azad University, Kazeroun, Iran

<sup>2</sup>Department of Biology, Jahrom Branch, Islamic Azad University, Jahrom, Iran

**Abstract:** In this study, the taxonomy of five new species of *Laccophilus* are described from Iran: *L. hyalinus*, *L. minutus*, *L. sharpi*, *L. maindroni* and *L. poecilus*. They can be easily distinguished from each other by the differences between the pattern of their elytra, shape of their prosternal process, hind coxal process. Additionally, size and shape of their penis and parameres, the position of denticles on their penis can be as other diagnostic features which be seen between these five species. Pattern of elytra is testaceous, without stripes in *L. hyalinus* and *L. minutes*, testaceous with wavy lines in *L. poecilus* and yellow to brown with blakish zigzag line in *L. sharpi*. Prosternal process doesn't reach to midcoxa in *L. hyalinus* and *L. minutes*. Penis has a small denticle at the apex of the dorsal surface in *L. hyalinus*, microdenticle medially in *L. minutes*. However, penis does not have any denticles in *L. sharpi*, *L. maindroni* and *L. poecilus*. Illustrations and photos of habitus, genitals and other morphological differences are provided for each species, as well as a key of the species is made ready.

**Key words:** Coleoptera, description, dytiscidae, Iran, *Laccophilus*, taxonomy

### INTRODUCTION

*Laccophilus* Leach (1817) is undoubtedly one of the largest and most widespread genera of the family Dytiscidae, with 256 species worldwide, mainly distributed in the tropics (Balke *et al.*, 1997, Nilsson, 2001 and Toledo *et al.*, 2003). They are particularly abundant in lotic habitats (running water), but some species occur in lentic ones (non-running water). These beetles eat primarily insect larvae, but also scavenge bits of detritus from the pond bottom. More recently, the taxonomy of oriental *Laccophilus* is comparatively well known- mainly due to the excellent revision of Oriental and Australian species by Brancucci (1983), who redescribed all the known species and added several new ones. Also, additional papers have increased our knowledge about the distribution and taxonomy of this genus in the Oriental region and New Guinea (Rocchi, 1986; Gueorguiev and Rocchi, 1992; Balke and Hendrich, 1997; Balke *et al.*, 1997; Hendrich and Balke 1995, 1998; Balke *et al.*, 1998; Nilsson, 2004; Hendrich and Brancucci, 2005). This paper is the first kind, trying to decrease the gap in world knowledge about Iranian fauna and to be a guide for their identification.

### MATERIALS AND METHODS

The specimens were collected from different cities of Iran during 20 years and were preserved in the museum.

Identification was based on some parts of the body such elytra, prosternal process and male external genitalia. Line drawing with a drawing apparatus mounted on a compound microscope and photography were made from the whole specimens and these parts of the body. In order to prepare external genitalia, fixed specimens were relaxed in hot water. Two or three segments of the abdomen were carefully cut away with fine needles and then pull out the genitalia (Borror *et al.*, 1989). To clean and clear the genitalia, they were kept in 10% KOH for a few hours and washed in water with little acetic acid added (about one drop per 50cc of water), then examined on microscope slides in glycerol (Borror *et al.*, 1989) and studied them. After the treatment, genitalia were kept in microvial with glycerol for further studies.

### RESULTS

Five species of the genus *Laccophilus* are described:

***L. hyalinus* (Degeer, 1774):** Elongate-oval, body length 4.6- 5.1 mm, width 2.7- 2.8 mm (Fig. 1a), head and pronotum testaceous, yellowish brown in elytra, although in some specimens, when alive, greenish- testaceous. Head, short and broad, usually testaceous in color with a very delicate network of polygonal lobes on a smooth background. Antennae and palpi uniformly reddish yellow, apex of antennae and palpi often dark brown. Pronotum, testaceous- yellow, with almost straight sides

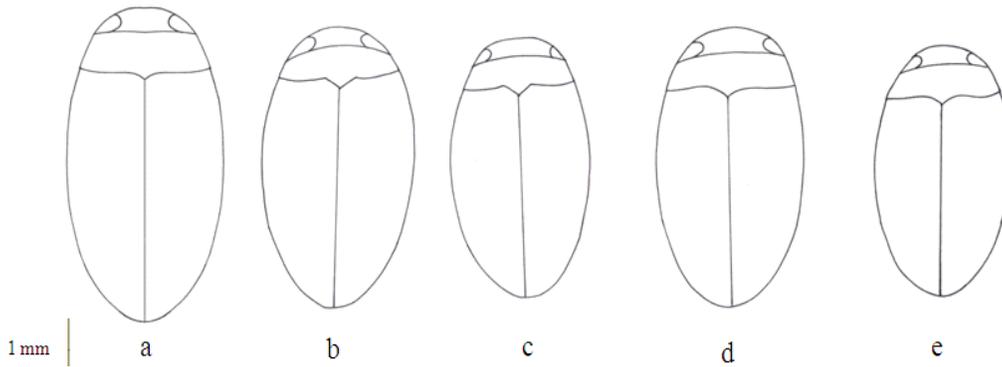


Fig. 1: *Laccophilus* species habitus, dorsal view. (a) *L. hyalinus*, (b) *L. minutus*, (c) *L. sharpi*, (d) *L. maindroni*, (e) *L. poecilus*

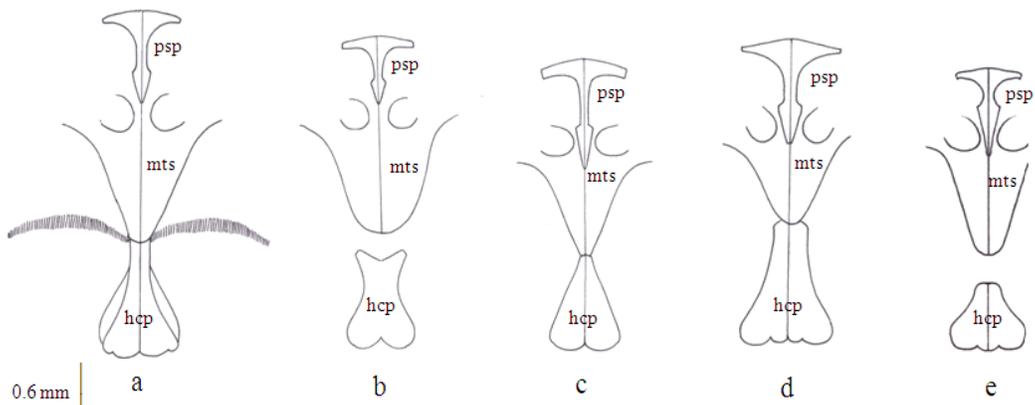


Fig. 2: *Laccophilus* species left elytra, dorsal view. (a) *L. hyalinus*, (b) *L. minutus*, (c) *L. sharpi*, (d) *L. maindroni*, (e) *L. poecilus*

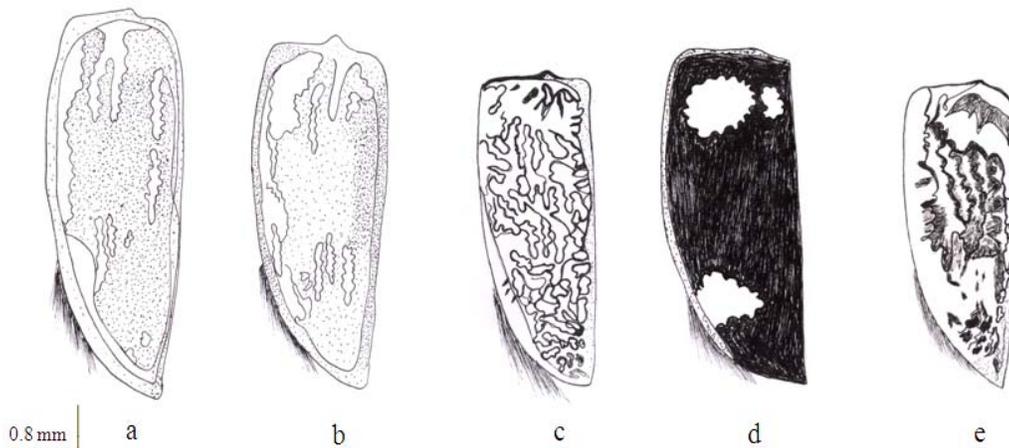


Fig. 3: *Laccophilus* species prosternal process (psp), metasternum (mts) and hind coxal process (hcp). (a) *L. hyalinus*, (b) *L. minutus*, (c) *L. sharpi*, (d) *L. maindroni*, (e) *L. poecilus*

strongly converging anteriorly, anterior slightly rounded, middle of base projecting posteriorly (Fig. 1a). Elytra, yellowish-brown, with an indistinct pattern of yellowish

ridges at the sides, the pattern dark brown on a lighter background, elytra with a delicate double network, one network more distinct, almost the same on head and

pronotum, second network thinner, consisting of irregular cells, and almost invisible in the anterior half, but more distinct in the posterior half (Fig. 2a). Venter, rufo-brownish or testaceous-brownish, abdomen 6 segmented, first and second segments lighter, sixth abdominal sternum rounded apically truncate or notched. Prosternal process, strongly laterally compressed, almost throughout keeled, not reaching to the mid coxae (Fig. 3a). Hind Coxal process, with margins parallel anteriorly, divergent posteriorly as lobes over base of metatrochanters (Fig. 3a), base of hind coxae slightly curved, hind coxae with a stridulatory apparatus near middle of body which consists of an oblique row of short impressed, slightly bracket-shaped dashes, brackets in middle longer than in the first and end. Legs, testaceous. Penis, long narrow with a small denticle at the apex of the dorsal surface, denticle slightly directed to the right, more sclerotized in the terminal half (Fig. 4a). Parameres, asymmetrical, scale like, more sclerotized in the sides in form of a longitudinal sclerotized band from base to apex, right parameres in form of an oblong scale with broadly rounded apex and with some long hairs which stick together. Left parameres, its upper part triangular, also with some long hairs (Fig. 5a).

***L. minutus* (Linnaeus, 1758):** Elongate-oval, body length 4- 4.5 mm, width 2.5- 2.6 mm (Fig.1b), head and pronotum reddish yellow, brownish yellow or brownish green in elytra. Pronotum with posterior margin strongly and abruptly produced medially (Fig. 1b). Elytra uniformly reddish yellow, without distinct stripes or marking, elytra reticulation of moderate strength, network double, the large meshes distinctly more strongly impressed and consisting of polygonal cells, visible on the background of the delicate network which consist of small cells, second network with small meshes and less deeply impressed (Fig. 2b). Venter, testaceous, ventral surface of abdomen lighter than ventral surface of thorax. Prosternal process, almost keeled, apex acute, strongly laterally compressed, not reaching to the mid coxae (Fig. 3b). Hind Coxal process, with margins diverging anteriorly and posteriorly as lobes over base of metatrochanters (Fig. 3b), hind coxae without a stridulatory apparatus. Legs, testaceous. Penis, narrow apically, apex without broad ventral flattening, micro denticulate medially, in lateral view not strongly dilated at its base and with distal portion distinctly recurved (Fig.4b). Parameres, asymmetrical, scale like, right parameres in form of an oblong scale, both parameres with small fascicle of hairs near the apex (Fig. 5b).

***L. sharpi* (Regimbart, 1889):** Oval, body length 3.2- 4 mm, width 2- 2.3 mm (Fig. 1c). Dorsum yellow to brown in the head and pronotum, elytra yellow to brownish with dark oblique longitudinal lines. Head, yellow to brown

background, anterior with dark brown disc. Discs consisting of large polygonal cells. Antennae and palpi uniformly yellow to brown with slightly dark apex. Pronotum yellow to brown, in the middle of anterior and posterior margins with black border which is either broad and narrow, sometimes absent. Elytra, yellow to brownish with thin dark zigzag lines which are usually repeating anastomoses, usually in pairs, near base and apex interrupted, so that the background remains free in form of more or less marked transverse spots or bands (Fig. 2c). Venter, yellow to testaceous, first and second segments lighter. Hind coxae and abdomen sometimes more or less dark. Prosternal process with elongate extremely narrow and pointed, reaching to the mid coxae (Fig. 3c). Hind coxal process, converging anteriorly, diverging posteriorly as lobes over base of metatrochanter. Legs, yellow to testaceous. Dorsal surface of penis narrow, lateral surface sclerotized and very broad, its apex thickened, the ventral and surface and its base sclerotized (Fig. 4c). Parameres, asymmetrical, right paramere irregular triangular, with a small fascicle of hairs near the apex. Left paramere very short and triangular with a small fascicle of hairs near the apex (Fig. 5c).

***L. maindroni* (Brancucci, 1983):** Elongate- oval. Body length 4.2-4.5 mm, width 2.3-2.6 mm (Fig. 1d). Dorsum testaceous to dark brown in the head and pronotum, elytra testaceous to dark brown with two or three yellow spots. Double network on head consisting of large polygonal cells and hardly visible, darker than background (Fig. 2d). Antennae and palpi testaceous Pronotum dark brown, network double, consisting of large polygonal cells, most of them placed anterior of pronotum, others scattered on the surface. Venter, dark brown, two first segments lighter than others. Prosternal process with long rather wide and bluntly pointed extremity, reaching to mid coxae (Fig. 3d). Hind coxal process, with margins subparallel anteriorly, divergent posteriorly as lobes over base of metatrochanters (Fig. 3d). Legs, testaceous to brown. The apical part of penis broad, middle part slightly curved, basal part sclerotized and broad (Fig. 4d). Parameres, asymmetrical, right paramere scale like, basal part and mid-lateral part sclerotized with a small fascicle of hairs near the apex, left paramere approximately triangular, ventral part sclerotized with a small fascicle of hairs near the apex (Fig. 5d).

***L. poecilus* (Klug, 1834):** Oblong- oval. Body length 3.4- 4 mm, width 1.9-2.1 mm (Fig. 1e). Dorsum testaceous in the head and pronotum. Head, double network consisting of large polygonal cells. Antennae and palpi uniformly testaceous with slightly dark apex. Pronotum dark brown at the base and in the middle of the anterior margin, double network consisting of large polygonal cells,

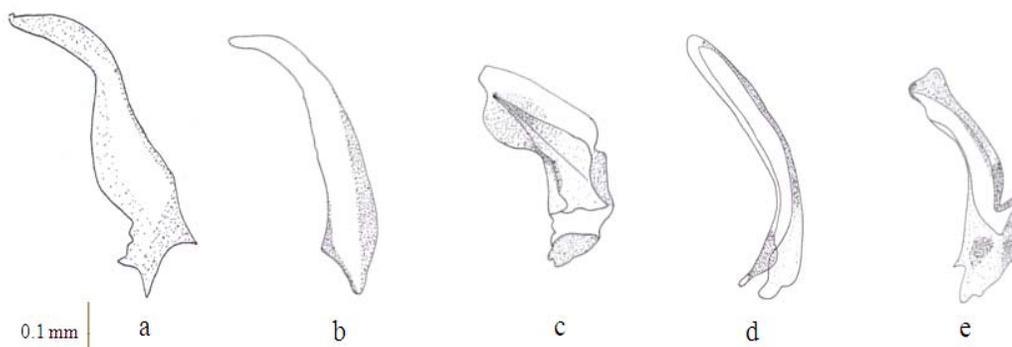


Fig. 4: *Laccophilus* species penis, side view. (a) *L. hyalinus*, (b) *L. minutus*, (c) *L. sharpi*, (d) *L. maindroni*, (e) *L. poecilus*

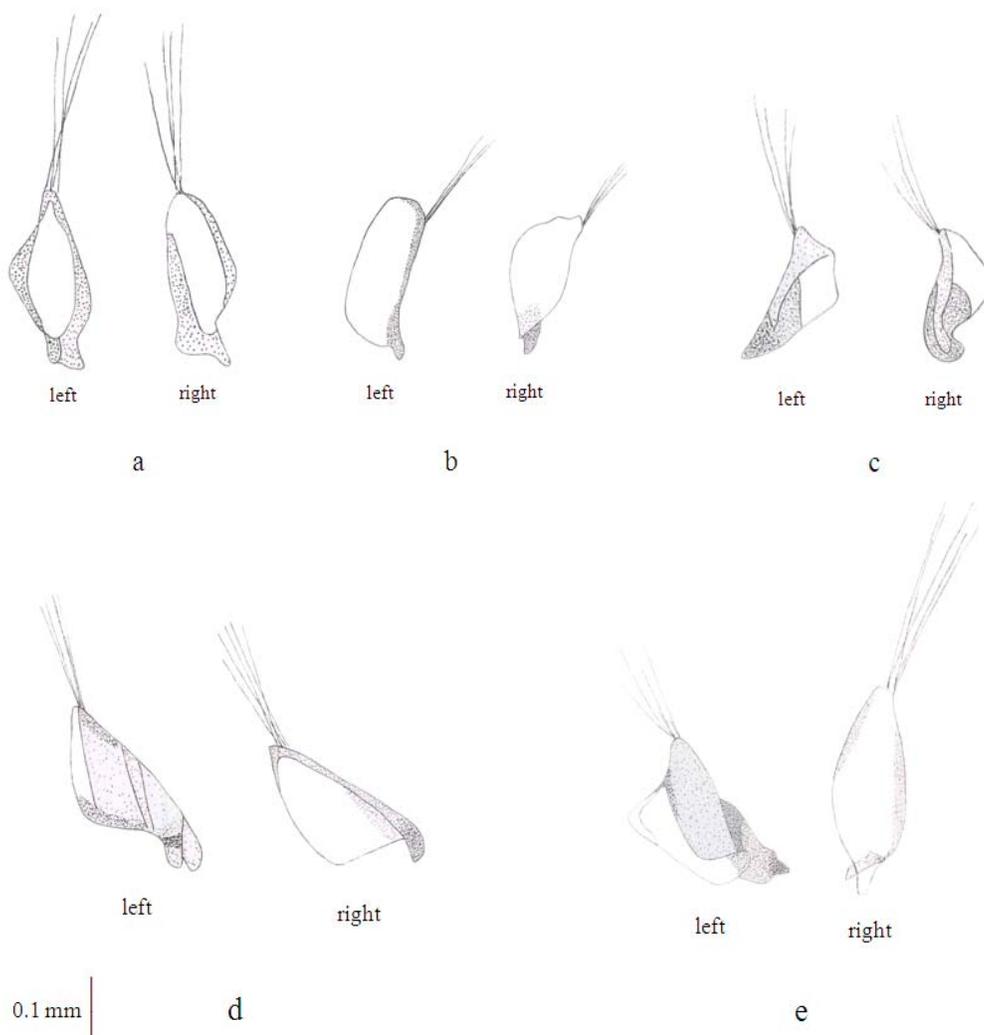


Fig. 5: *Laccophilus* species left and right parameres, dorsal view. (a) *L. hyalinus*, (b) *L. minutus*, (c) *L. sharpi*, (d) *L. maindroni*, (e) *L. poecilus*

middle of base distinctly projecting posteriorly. Elytra testaceous with sinuous stripes and with wavy lines, always distinctly interrupted (Fig. 2e). Venter, testaceous to brown, hind coxae sometimes more or less dark, first segment lighter. Prosternal process with elongated extremity, with a very long stripes, reaching to mid coxae (Fig. 3e). Hind coxal process with margins subparallel anteriorly, divergent posteriorly as lobes over base of metatrochanter (Fig. 3e). Legs, testaceous. Penis narrow, its dorsal surface broad and sclerotized, its apex thickened and almost truncate (Fig. 4e). Parameres, asymmetrical, right paramere leaf like with a small fascicle of hairs at the apex, left paramere in form of a triangular pyramid and its ending with a blunt spine, bearing a small fascicle of setae (Fig. 5e).

### DISCUSSION

These five species are compared with each other for some morphological characters which were described, trying to find the extent of the apparent differences or similarities between them. The largest species is *L. hyalinus* (length 4.6- 5.1 mm) and the smallest one is *L. sharpi* (length 3.2-4.0 mm). In terms of dorsum habitus, the general form of *L. hyalinus*, *L. minutus*, *L. maindroni* is elongated- oval, but oval in *L. poecilus* and *L. sharpi*. Pattern of elytra is testaceous, without stripes in *L. hyalinus* and *L. minutes*, testaceous with wavy lines in *L. poecilus* and yellow to brown with blakish zigzag line in *L. sharpi*. Prosternal process doesn't reach to midcoxa in *L. hyalinus* and *L. minutes*. However, it reaches to mid coxa in *L. poecilus*, *L. sharpi* and *L. maindroni*. Hind coxal process is with margin parallel anteriorly and two lobes over base of metatrochanter with stridulatory apparatus in *L. hyalinus*, with margin parallel anteriorly and two lobes over base of metatrochanter without stridulatory apparatus in *L. minutus*, anterior margins come close to each other and two lobes over base of metatrochanter, without stridulatory apparatus in *L. sharpi*, with margin subparallel anteriorly and two lobes over base of metatrochanter without stridulatory apparatus in *L. maindroni* and with margin subparallel anteriorly, divergent posteriorly as lobes over base of metatrochanter without stridulatory apparatus in *L. poecilus*. Penis is long narrow with a small denticle at the apex of the dorsal surface in *L. hyalinus*, narrow apically, microdenticle medially in *L. minutus*, dorsal surface narrow, without denticle in *L. sharpi*, apical part broad without denticle in *L. maindroni* and narrow with dorsal surface broad without denticle in *L. poecilus*. Right paramere is oblong scale in *L. hyalinus* and *L. minutes*, irregular triangular in *L. sharpi*, scale like in *L. maindroni* and leaf like in *L. poecilus*. Left paramere is triangular in *L. hyalinus*, *L. sharpi*, *L. minutes*, scale like in *L. minutus* and triangular pyramid in *L. poecilus*.

A key for Iranian species of *Laccophilus* is provided:

- Hind coxae with an oblique row of short thin dashes near middle of body (stridulatory apparatus). Base of pronotum slightly projecting in the middle... *L. hyalinus*
- Hind coxae without dashes, middle of base of pronotum distinctly projecting posteriorly
- Species of large size (4- 4.9 mm in length), elytra uniformly testaceous- brown or with a pattern of parallel longitudinal stripes which join to form a large patch on the elytra disc
- Smaller species, elytra dark brown or testaceous, with brown wavy or sinuous longitudinal marking
- Prosternal process almost keeled, apex acute strongly, laterally compressed, not reaching to the mid coxae... (*L. minutus*)
- Prosternal process with elongated extremity, narrow and a very long spine reaching to the mid coxae
- Elytra testaceous to dark- brown with two or three spots. Apical part of penis narrow... (*L. maindroni*)
- Elytra testaceous with brown marking (sinuous stripes, wavy lines). Penis broad
- Length of species 3.6- 4.1 mm. penis without a short dorsal process... (*L. sharpi*)
- Length of species 3.4- 4.3 mm. penis with a short dorsal process... (*L. poecilus*)

### CONCLUSION

The results of this study indicate that five species of *Laccophilus* from Iran namely *L. hyalinus*, *L. minutus*, *L. sharpi*, *L. maindroni* and *L. poecilus* can be identified based on the pattern of elytra, shape of prosternal process, hind coxal process, size and shape of the penis and parameres. Also, the position of denticles on the penis can be as a character which can distinguish these five species.

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