

**A new subgenus and species of *Mixotrepes*
(Hemiptera: Heteroptera: Helotrephidae)
from Laos and notes on *Mixotrepes punctatus***

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Abstract. *Mixotrepes (Pictotrepes) pictus* subgen. nov. & sp. nov. is described from the Bolaven Plateau in Laos. The new taxon of the tribe Limnotrephini is compared with other two subgenera, *Mixotrepes* s. str. Papáček, Štys & Tonner, 1989 and *Thermotrepes* Papáček & Zettel, 2006. *Pictotrepes* subgen. nov. differs from *Mixotrepes* s. str. and *Thermotrepes* by coarse sculpture of cephalonotum and mesoscutellum, wide mesoscutellum with convex sides, and relatively unmodified terminalia of both male and female. In addition this study also reports on the unusually pale hindwing-micropterous morph of *Mixotrepes (Thermotrepes) punctatus* Papáček & Zettel, 2008 from Meghalaya, northwestern India.

Key words. Helotrephidae, Limnotrephini, *Mixotrepes*, *Pictotrepes*, *Thermotrepes*, new subgenus, new species, micropterous morph, India, Laos

Introduction

This paper reports on a new subgenus, a new species and on the up to the present unknown, unusually pale micropterous morph, based on material of *Mixotrepes* Papáček, Štys & Tonner, 1989 deposited in the collection of the Department of Entomology at the National Museum, Praha, Czech Republic.

The water bug genus *Mixotrepes* has been originally described as *M. hoberlandti* Papáček, Štys & Tonner, 1989, a species from Afghanistan and Iran (PAPÁČEK et al. 1989), and later revised by PAPÁČEK & ZETTEL (2003), who discussed the differences between genera *Mixotrepes* and *Limnotrepes* Esaki & China, 1928, which were being occasionally confused. The nominotypical subgenus includes at least another four closely related species from southern ranges of the Himalayas in India and Nepal. More recently, PAPÁČEK & ZETTEL (2006)

provided a subgeneric classification and established the subgenus *Thermotrephes* Papáček & Zettel, 2006 for two species, *M. (T.) thermophilus* (Papáček & Kovac, 2001) (type species) from Myanmar and Thailand and *M. (T.) freitagii* Papáček & Zettel, 2006 from Nepal. A third species, *M. (T.) punctatus* Papáček & Zettel, 2008 from northeastern India, was described later (PAPÁČEK & ZETTEL 2008).

The new species from Laos described here is morphologically distinct from all other known species of *Mixotrephes*. Although its origin can be traced close to the distribution area of *Thermotrephes*, it cannot be placed in this nor in the nominotypical subgenus. Moreover, it possesses some characteristics that are unique to the entire tribe Limnotrephini. For these reasons we erect *Pictotrephes* subgen. nov.

Furthermore, this paper also provides description of hind-wing micropterous specimens of *M. (T.) punctatus*.

Material and methods

Terminology and methods follow PAPÁČEK & ZETTEL (2003). Stacked digital images were taken with a Leica DFC camera attached to a Leica MZ16 binocular microscope and processed with the help of Leica Application Suite. They were then stacked with ZereneStacker 64-bit and processed with Adobe Photoshop 7.0.

The following acronyms of depositories are used:

NHMW Naturhistorisches Museum, Wien, Austria;
NMPC National Museum, Praha, Czech Republic.

Results

Pictotrephes subgen. nov.

Type species. *Mixotrephes (Pictotrephes) pictus* sp. nov., by present designation.

Diagnosis. Body shape, lateral cephalonotal carina, size of cephalonotum, length of rostrum, general shape of right paramere, and structures of first valvulae of ovipositor as typical for the genus *Mixotrephes*. Ground colour chiefly blackish; with some yellow marks (Figs. 1–6). Cephalonotum (posteriorly) and mesoscutellum coarsely sculptured with minute tubercles (in addition to punctures). Mesoscutellum wide, with conspicuously convex sides (Fig. 9). Midventral abdominal carinae on sterna 2–6. Process of pygophore low and round. Aedeagus simple, unmodified, evenly tapered towards round apex. Subgenital plate of female unmodified, broad, posteriorly widely rounded.

Etymology. Compound from ‘*pictus*’, referring to the type species, and ‘*trephes*’, meaning inhabitant, the most frequent ending of generic epithets in Helotrephidae. Gender: masculine.

Comparative notes and discussion. The new subgenus is erected for the single species *M. (P.) pictus* sp. nov. *Mixotrephes pictus* does not fit well in any generic taxon of Limnotrephini. Its provisional placement in *Mixotrephes* is based on overall similarities, such as the body shape, coloration, median length of cephalonotum not exceeding half the length of the



Figs. 1–6. *Mixotrephes (Pictotrepes) pictus* sp. nov. 1–3 – holotype (male), 4–6 – paratype (female). 1, 4 – frontal; 2, 5 – dorsal; 3, 6 – lateral view. In Fig. 6, base of hemelytron not in normal position, covering posterolateral corner of cephalonotum. © NHMW Hemiptera Image Collection.



Figs. 7–8. Type locality of *Mixotrephes* (*Pictotrephes*) *pictus* sp. nov., Laos, Champasak Prov., Bolaven Plateau, Tad Yueang waterfall. 7 – general view on the Tad Yueang waterfall; 8 – microhabitat of the species – shallow puddles on rocky bank in the ‘spray zone’ of a waterfall. Photographs by Jiří Hájek.



Table 1. Comparison of selected characters and distribution of *Mixotrephes* subgenera.

Characters / Subgenus	<i>Mixotrephes</i> s.str.	<i>Thermotrephes</i>	<i>Pictotrephes</i>
Sides of mesoscutellum	moderately convex	moderately convex	strongly convex
Sculpture of cephalonotum and mesoscutellum	fine	fine	coarse
Ventral abdominal carinae on sternites	2–4	2–4(5)	2–6
Spur-like process of male pygophore	well developed, apically broad	reduced, apically broad or tapered	weak
Phallosoma	long, broadly C-shaped	short, uvula-like	short, pin-shaped
Apex of phallosoma	anteriorly projecting into beak-shaped tip	upright, club-shaped	unmodified, round
Apex of left paramere	tip-shaped or bulbous	tip-shaped or broadly round	hook-shaped, hirsute
Female subgenital plate	symmetrical to asymmetrical, with narrowed long posterior lobe, and distinct or less visible darkly pigmented area forming one caudomedial lobe	symmetrical to subsymmetrical, with narrowed long to short postero-medial lobe and darkly pigmented area forming two caudomesal lobes or one caudomedial lobe	short, round, unmodified, without darkly pigmented area
Distribution	Afghanistan, Iran, N India, Nepal	NE India, Nepal, Myanmar, Thailand	Laos

body, lateral cephalonotal carina arrow-wise penetrating onto the ocular area, lateral pronotal plate without insinuation at the meeting point with genal plate, triangular propleural plate with acuminate apex, short labium reaching between fore coxae, type of pygophore with spur-like process in males, and shape of the 1st valvulae in females. But it cannot be placed in any of the subgenera, *Mixotrephes* s. str. and *Thermotrephes*, because of differences in some characters diagnostic for them (see Tab. 1). A study of Limnotrephini phylogeny is still not available. However, by comparison of several characters, *Pictotrephes* seems to take a very basal position in *Mixotrephes*, if not in the entire tribe Limnotrephini (see also below). The supposedly plesiomorphic characters of *Pictotrephes*, that support its basal position, at the same time distinguish it from one or both congeneric subgenera: weakly modified midsternal thoracic carina; simple aedeagus (phallosoma) without apical modification; simple, almost unmodified subgenital plate of the female; and first valvulae of ovipositor with dense cluster of apical bristles (compare Fig. 16 and Fig. 8 in PAPÁČEK & ZETTEL (2008: 89)).

Two plesiomorphic characters of *Pictotrephes* are worth to be discussed: (i) Medial carinae of abdominal sterna, formed by separated lamellae with posteroventral tips, are located on sterna 2–6 in both sexes (but only minute in male). Extension to sternum 6 is a synplesiomorphy with Pleidae (Pleioidea) (see also discussion on this character by PAPÁČEK & ZETTEL (2006: 29, 30)). However, the simple reduction of carinae on sterna 5 and 6 (in varying extent) is probably not a synapomorphy of all other Limnotrephini genera (see similar convergencies in Helotrephini). (ii) The process on the male's pygophore (= 'spur-like process' in other Lim-

notrephini) is weakly developed as compared to other genera (see also discussion in PAPÁČEK et al. (1989: 120, 121)). Also here, we can see only gradual differences.

A few characteristics of *Pictotrephes* subgen. nov. are unique within Limnotrephini and appear strongly derived: The relatively wide and convex mesoscutellum (compare Figs. 9 and 10) and the tuberculate sculpture of cephalonotum and mesoscutellum. Both are considered to be autapomorphies.

Accumulation of plesiomorphic characters of *Pictotrephes* subgen. nov. showing its possible basal position in the whole genus or in the tribe Limnotrephini respectively, and its provisional placing in *Mixotrephes* based on overall similarities (cluster – or combination of characters respectively), can suggest that present genus *Mixotrephes* is paraphyletic.

Mixotrephes (Pictotrephes) pictus sp. nov.

(Figs. 1–6, 9, 11–16)

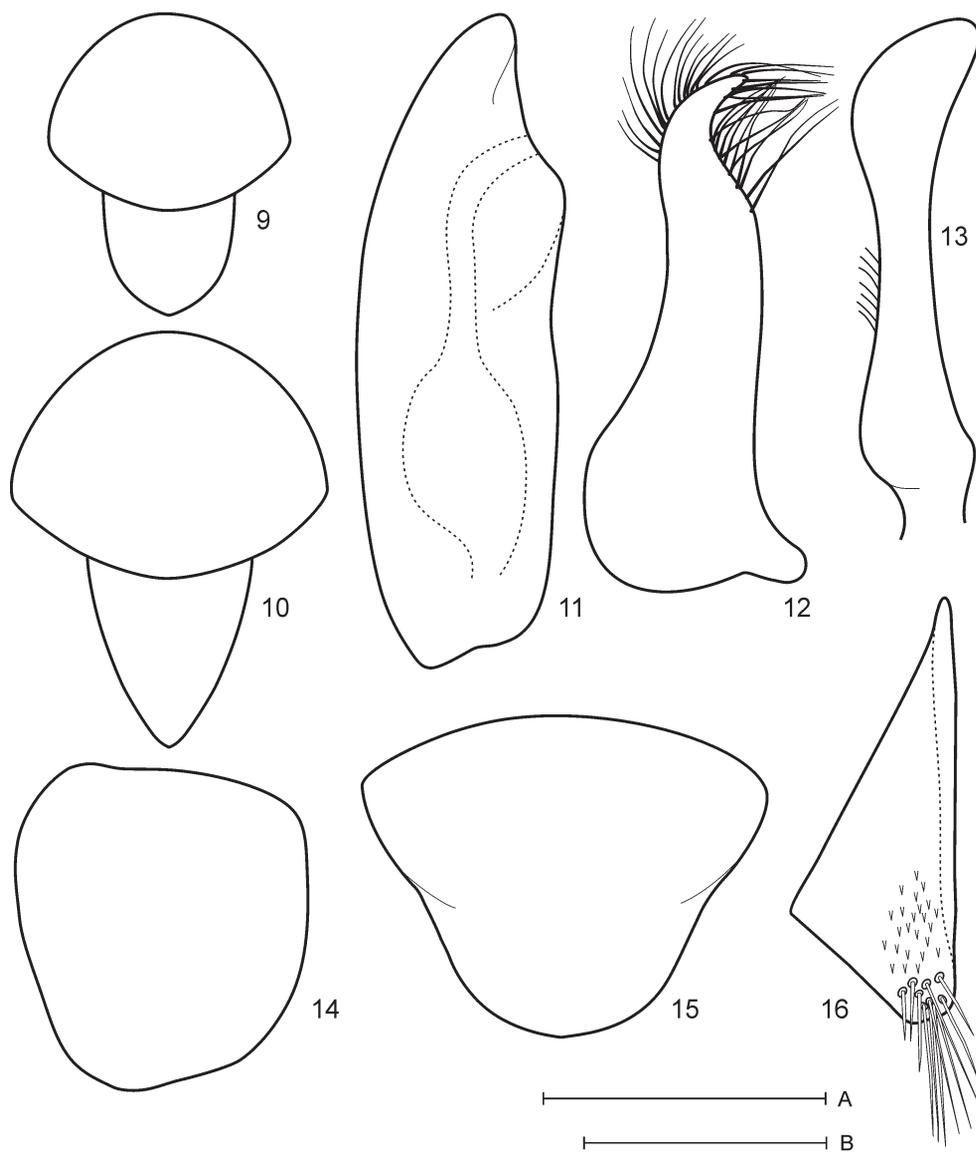
Type material. HOLOTYPE: ♂ (brachypterous, based on structures of forewing), 'LAOS, CHAMPASAK prov. / Bolavens Plateau / ca. 1 km S Ban Lak 40 [vill.] / TAD YUEANG waterfall, 900–970 m / 15°10.8'N, 106°08.3'E / Jiří Hájek leg. 28.iv.2010' (NMPC). PARATYPES: 4 ♀♀ (brachypterous, based on structures of forewing), same labels as holotype (3 ♀♀ in NMPC, 1 ♀ in NHMW).

Description. Size: Body length of male 1.30 mm, of females 1.26–1.38 mm. Maximum body width (= pronotum width) of male 0.89 mm, of females 0.88–0.94 mm. Eye index (= minimum eye distance : maximum eye width) of male 2.8, of females 2.7–2.9.

Colour (Figs. 1–6): Dorsum chiefly blackish. Male (Figs. 1–3) cephalonotum with pair of yellow spots near posterolateral margin and with narrow yellow lateral margins; distal margin on hemielytron yellowish, almost transparent. Female (e.g., Figs. 4–6) cephalonotum, mesoscutellum and hemielytra with several yellow marks of varying shape and extension. Venter of head and thorax mostly yellowish brown, of abdomen dark brown. Legs dark yellow.

Structural characteristics of brachypterous morph: Head part of cephalonotum with sparse, small punctures, shiny, only at sides weakly tuberculate. Pronotal part of cephalonotum and mesoscutellum tuberculate, each tubercle sloping posteriorly, i.e. posterior slope steeper. Hemielytron with very large, deep punctures; most anterior part with a few small, intermittent tubercles. Mesoscutellum (Fig. 9) wide with conspicuously convex lateral margins. Rostrum short, almost reaching level of posteroventral corner of prosternal carina; segment 4 ca. 1.5 times as long as segment 3. Forewing without claval and embolar sutures. Hindwings micropterous (examined only in one species). Midventral carinae weakly modified: Prosternal carina with almost rectangular posteroventral corner; mesosternal carina short and acute; metasternal carina with straight ventral outline, posteroventral corner weakly elevated; carinae of abdominal sterna 2–3 pointed, of abdominal sterna 4–6 present as low tubercles, on sternum 6 only in anterior part (in male less distinct than in female).

Terminalia of male (Figs. 11–14): Abdominal sternum 8 (Fig. 14) slightly asymmetrical, round, longer than wide, processing more caudally on the right side. Pygophore with low, rounded process. Aedeagus simple, phallosoma (Fig. 11) straight, pin-shaped, slightly flattened, with tapered, bluntly rounded, unmodified apex; somewhat longer than both parameres. Left paramere (Fig. 12) slightly longer than right one; basally robust with wide, round posterior



Figs.9–16. Structural characters of *Mixotrephes (Pictotrephes) pictus* sp. nov. (9, 11–16) and *Mixotrephes hoberlandti* Papáček, Štys & Tonner, 1989 (10). 9, 10 – outlines of cephalonotum and mesoscutellum from dorsal view (except *M. (P.) pictus* sp. nov., all other known *Mixotrephes* species have the same basic shape of mesoscutellum as *M. hoberlandti*); 11 – phallosoma; 12 – left paramere; 13 – right paramere; 14 – male abdominal sternum 8; 15 – female subgenital plate; 16 – first right valvula from ventral view. Scale bars: A = 1.0 mm (Figs. 9, 10), B = 0.2 mm (Figs. 14, 15), B = 0.1 mm (Figs. 11–13, 16).

lamella, distally hook-shaped with very conspicuous dense and long setae. Right paramere (Fig. 13) nearly upright, apically antero-posteriorly flattened, spoon shaped; only with few minute setae on posterior surface.

Terminalia of female (Figs. 15, 16): Subgenital plate (= abdominal sternum 7; Fig. 15) unmodified, with broad posterior lobe and only slightly concave lateral margins (this concavity only discernable under high magnification). Proximal part of this plate brown, middle and posterior area dark brown, posteromedial lobe with beige-brown, round spot at hind margin. First valvulae (Fig. 16) of the *Mixotrephes* type, with cluster of robust, peg-shaped, both short and long, thick setae (macrotrichia) on apical lobe, and with numerous microtrichia scattered on well pigmented area proximally to this cluster (microtrichia and differences in macrotrichia are visible only under high magnification of about 400× on microslide).

Comparative notes. *Mixotrephes* (*Pictotrephes*) *pictus* sp. nov. differs from all congeners by coarse sculpture of cephalonotum, mesoscutellum and hemielytra, wide mesoscutellum, ventral medial carina on abdominal sternum 6 that is absent in other *Mixotrephes* species, unmodified aedeagus, hook-shaped, densely hirsute apex of the left paramere, and unmodified subgenital plate of female (for comparison with characters of congeners see Tab. 1).

Etymology. The specific epithet *pictus* means painted and refers to the spotted pattern of the female's hemielytra; adjective.

Habitat (Figs 7, 8). This species was sampled in minute puddles on rock surface in the 'spray zone' of a waterfall. Small water beetles *Microdytes* sp. (Dytiscidae) and *Laccobius* (*Glyptolaccobius*) sp. (Hydrophilidae) (Jiří Hájek, pers. comm.) were also present in the collected samples. It is assumed that this species is part of a complex zoocoenose inhabiting petrolimnic to hydropetric zones of banks along fast streams with rapids and waterfalls.

Distribution. Only known from the type locality in the Bolaven Plateau, southern Laos.

Key to the subgenera of the genus *Mixotrephes*

- 1 Mesoscutellum coarsely sculptured, with strongly convex sides. Ventral abdominal carinae on sternites 2–6. – Male: Phallosoma short, pin-shaped, with round, unmodified apex. – Female: Sternum 7 short, round, unmodified, without strongly pigmented area. *Pictotrephes* subgen. nov.
- Mesoscutellum finely punctured, with weakly convex sides. Ventral abdominal carinae on sternites 2–4(5). – Male: Phallosoma modified. – Female: Sternum 7 with posteromedial lobe and pigmented area. 2
- 2 Male: Pygophore with strongly developed spur. Phallosoma long, curved; apex beak-shaped. – Female: Sternum 7 with distinct or less visible darkly pigmented area forming one caudomedial lobe. *Mixotrephes* Papáček, Štys & Tonner, 1989
- Male: Pygophore with reduced spur. Phallosoma short, uvula-shaped; apex upright and club-shaped. – Female: Sternum 7 with darkly pigmented area forming two caudomesal lobes or one caudomedial lobe. *Thermotrephes* Papáček & Zettel, 2006

Notes on *Mixotrepes (Thermotrepes) punctatus* Papáček & Zettel, 2008

PAPÁČEK et al. (1989: 112–114, 119–120) and PAPÁČEK & ZETTEL (2006: 29; 2008: 88) described and discussed differences among the hind wing macro-, brachy-, and micropterous morph of *Mixotrepes* species. However, below presented new sample of *M. punctatus* from India contained hindwing micropterous specimens whose habitus somewhat differs from the situations known from until recently collected material of micropterous pteromorph of this species.

Material examined: 5 ♂♂ 2 ♀♀ (hindwing-micropterous), 'INDIA, MEGHALAYA STATE (10) / E Khasi Hills, 11 km SW Cherra- / punjee, Laitkynsew, 21-24.iv. / 2008, 25°13'N 91°39'E, 810m / Fikáček, Podskalská, Šipek lgt.' // 'seepage: wet rocks with algae / blue algae / moss ca. 1.5-2 km / via rd. from "Cherapunjee Holid./ Resort" in direct. Cherapunjee, / exposed' (NMPC).

Notes on hindwing-polymorphism. Alcohol-stored specimens in this series are relatively pale – if compared with the type series – and with semi-transparent hemielytra. This makes the strong reduction of hindwings visible without preparation. PAPÁČEK & ZETTEL (2008) described the hindwing-brachypterous morph and the hind wings of three dissected specimens. In fact the type series includes also micropterous specimens with vestigial, unstructured hind wings. It seems that there is a slight difference in colour (micropterous specimens tend to be paler) and body shape (micropterous specimens tend to be more gracile).

Notes on habitat. The original description (PAPÁČEK & ZETTEL 2008) of *M. punctatus* does not contain information on the species' habitat. The new material of *M. punctatus* was sampled under semi-terrestrial, hygropetric conditions. The locality has been described in detail by FIKÁČEK & ŠÍPKOVÁ (2009: 34: Locality #2 + Fig. 2): 'Samples were collected from a series of wet rocks on a steep slope along the road from Laitkynsew to Cherrapunjee, ca 1.5–2.0 km from the Cherrapunjee Holiday Resort. The rocks are extensively exposed and covered with various kinds of algae and blue algae, one species of the algae/blue algae seem to dominate on each part of the seepages, resulting in a patchy mosaic of mats with a different appearance; some parts are overgrown with moss'. This microhabitat harboured rich zoocenosis of various aquatic Coleoptera and Heteroptera (FIKÁČEK & ŠÍPKOVÁ 2009, GENTILI & FIKÁČEK 2009, SHORT 2009). '*Nanotrepes* sp.' listed from this locality by FIKÁČEK & ŠÍPKOVÁ (2009) is actually *M. punctatus*. Their habitat conditions are probably the same or similar to the ones known for *Mixotrepes (Thermotrepes) thermophilus* (see e.g., PAPÁČEK & KOVAC (2001) and PAPÁČEK & ZETTEL (2006) for discussion) and *Mixotrepes (Pictotrepes) pictus* sp. nov.

Distribution. The new material originates from the same area as the type series, i.e., the surrounding of Cherrapunjee in the Khasi Hills (PAPÁČEK & ZETTEL 2008).

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References

- FIKÁČEK M. & ŠÍPKOVÁ H. 2009: New Asian Hydroscapha, with comments on male-female association of co-occurring species (Coleoptera, Myxophaga, Hydroscaphidae). *Zootaxa* **2286**: 31–48.
- GENTILI E. & FIKÁČEK M. 2009: Taxonomic notes on Laccobius, subgenus Glyptolaccobius, with new records and description of four new species (Coleoptera: Hydrophilidae). *Acta Entomologica Musei Nationalis Pragae* **49**: 607–623.
- PAPÁČEK M. & KOVAC D. 2001: Three new species of Limnotrephini (Heteroptera, Nepomorpha, Helotrephidae) from Peninsular Malaysia and Thailand. *Linzer Biologische Beiträge* **33**: 1047–1055.
- PAPÁČEK M., ŠTYS P. & TONNER M. 1989: A new genus and species of Helotrephidae from Afghanistan and Iran (Heteroptera, Nepomorpha). *Věstník Československé Společnosti Zoologické* **53**: 107–122.
- PAPÁČEK M. & ZETTEL H. 2003: On the species taxonomy of the limnotrephine genera Limnotrepes, Mixotrepes, and Tiphotrephes (Hemiptera: Helotrephidae). *Tijdschrift voor Entomologie* **146**: 219–234.
- PAPÁČEK M. & ZETTEL H. 2006: A new subgenus and new species of the genus *Mixotrepes* Papáček, Štys & Tonner, 1989 (Heteroptera: Helotrephidae: Limnotrephini). *Aquatic Insects* **28**: 23–30.
- PAPÁČEK M. & ZETTEL H. 2008: *Mixotrepes* (*Thermotrepes*) *punctatus* sp.n. (Insecta: Heteroptera: Helotrephidae) from India. *Annalen des Naturhistorischen Museums in Wien* **109B** (2007): 87–91.
- SHORT A. E. Z. 2009: Two new species of the hygropetric genus *Oocyclus* from eastern India (Coleoptera: Hydrophilidae). *Acta Entomologica Musei Nationalis Pragae* **49**: 625–630.