

A solitary endoparasitoid (Hymenoptera: Braconidae: Microgastrinae) of the severe *Buxus* pest *Cydalima perspectalis* (Lepidoptera: Crambidae) in the North Caucasus of Russia

Одиночный эндопаразитоид (Hymenoptera: Braconidae: Microgastrinae) опасного вредителя самшита *Cydalima perspectalis* (Lepidoptera: Crambidae) на Северном Кавказе России

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A braconid endoparasitoid, *Protapanteles mygdonia* (Nixon, 1973), of the severe pest of box trees, the moth *Cydalima perspectalis* (Walker, 1859) (Lepidoptera: Crambidae), is re-described and illustrated from the North Caucasus of Russia. This is the first discovery of a native parasitoid of box tree moth in the Western Palaearctic.

С Северного Кавказа России переописывается и иллюстрируется наездник *Protapanteles mygdonia* (Nixon, 1973), являющийся эндопаразитом опасного вредителя самшита *Cydalima perspectalis* (Walker, 1859) (Lepidoptera: Crambidae). Это первая достоверная находка природного паразитоида самшитовой огневки в Западной Палеарктике.

Key words: endoparasitoid wasps, invasive pest, Krasnodar Territory, *Protapanteles mygdonia*, new hosts, re-description

Ключевые слова: паразитоиды, инвазивный вредитель, Краснодарский край, *Protapanteles*, новые хозяева, переописание

INTRODUCTION

The box tree moth, *Cydalima perspectalis* (Walker, 1859) (Lepidoptera: Crambidae), a native pest of box trees (*Buxus* spp., Buxaceae) in Asia, has very rapidly spread throughout several European countries and now it is the most severe pest of ornamental and native box trees in this continent (Kenis et al., 2013; Nacambo et al., 2013). This moth was introduced to the North Caucasus of Russia through planting or-

namental *Buxus* material originating from Italy without deep quarantine control. As result, after penetration on the territory of Sochi, *C. perspectalis* spreads rapidly and now it already occupies almost all localities with box trees of the Black Sea coast and has appeared inside Krasnodar City (Schurov, 2014; Gninenko et al., 2014; Gninenko, 2015).

The study of the natural parasitoids of this pest with potential for its biological control was started immediately after the appearance of the pest in Europe. All potential enemies of *C. perspectalis* discovered

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in the native area of this moth in Asia were already selected (Wan et al., 2012). This list of parasitoids includes three species of each of Tachinidae and Braconidae, and two species of each of Ichneumonidae and Chalcidoidea. In Braconidae, the most hopeful species for biocontrol may be the East Palaearctic-Oriental solitary polyphagous *Microchelonus tabonus* Sonan, 1932 with parasitism level in some areas of China up to 50%, and the Oriental gregarious oligophagous *Dolichogenidea stantoni* (Ashmead, 1904) with average parasitism level in India 37.3% (Wan et al., 2014). Several native parasitoids were suggested as potential enemies of *C. perspectalis* in Europe, among which are ichneumonid *Apechtis compuncator* (Linnaeus, 1758), the braconid *Bracon hebetor* Say, 1836 (*B. brevicornis* Wesmael, 1838) and species of *Trichogramma* (Trichogrammatidae) (Wan et al., 2014).

In this context, the discovery of a solitary braconid parasitoid of this severe pest in the south-western part of North Caucasus is very interesting and important. The Microgastrinae species, *Protapanteles mygdonia* (Nixon, 1973), was reared by the second author in 2015 from caterpillars of *C. perspectalis* collected on *Buxus* trees in the environmental area of Lazarevskoe (Large Sochi). This reared species may be potentially important for the biological control of *C. perspectalis*, and it is re-described in this paper.

MATERIAL AND METHODS

Caterpillars of *C. perspectalis* were collected in the vicinity of Lazarevskoe (Large Sochi) in June 2015 and transported in the laboratory of the Russian Research Institute for Silviculture and Mechanization of Forestry in Pushkino, Moscow Province. Each host's larva developed in isolated box in the laboratory after special control of the bouquet of *Buxus* foliage. Thirteen solitary parasitoids were reared later in June 2015, all certainly only from the caterpillars of *C. perspectalis*. The remains of host caterpillars

with parasitoid cocoons were additionally checked after rearing.

The terminology employed for morphological features and measurements follow Belokobyskij & Maetô (2009). The wing venation nomenclature follows Belokobyskij & Maetô (2009), with van Achterberg's (1993) terminology shown in parentheses. Braconid species was determined with using of the keys by Nixon (1973) and Tobias & Kotenko (1986). We follow Achterberg opinion (Achterberg, 2002; Yu et al., 2012) considering *Glyptapanteles* Ashmead, 1905 as a junior synonym of *Protapanteles* Ashmead, 1898.

Photographs were taken with a Leica IC 3D digital camera that was mounted on a Leica® MZ16 microscope and using the Leica Application Suite® imaging system (Museum and Institute of Zoology PAN, Warsaw, Poland).

The material is preserved in the Zoological Institute of the Russian Academy of Sciences (St Petersburg, Russia; ZISP), except for two specimens in the National Museums of Scotland (Edinburgh, UK; NMS).

TAXONOMIC PART

Order HYMENOPTERA

Family BRACONIDAE

Subfamily MICROGASTRINAE

Genus *Protapanteles* Ashmead, 1898

Protapanteles (*Glyptapanteles*) *mygdonia* (Nixon, 1973) (Figs 1–15)

Nixon, 1973: 181; Tobias & Kotenko, 1986: 383; Kotenko, 2007: 192; Yu et al., 2012.

Material examined. **Russia:** *Krasnodar Territory*, Sochi, Lazarevskoe, from caterpillar of *Cydalima perspectalis* (Walker), collected VI.2015, reared VI.2015, Yu.I. Gninenko coll., 6 females, 7 males (ZISP, NMS); *Yaroslavl' Province*, "Gedenowo, Jarosl g. Dan., 16.VII.[1]916, A. Schestakow", 1 female (ZISP); *Buryatia*, Ulan-Ude, from caterpillar of *Simaethis griseana* Kozhantshikov (= *Anthophilla filipjevi* Danilevsky), 26.VIII.1959, Kolshakova leg., 1 female (ZISP).

Description. Female. Body length 3.5–3.7 mm; fore wing length (from tegula) 4.0–4.1 mm.

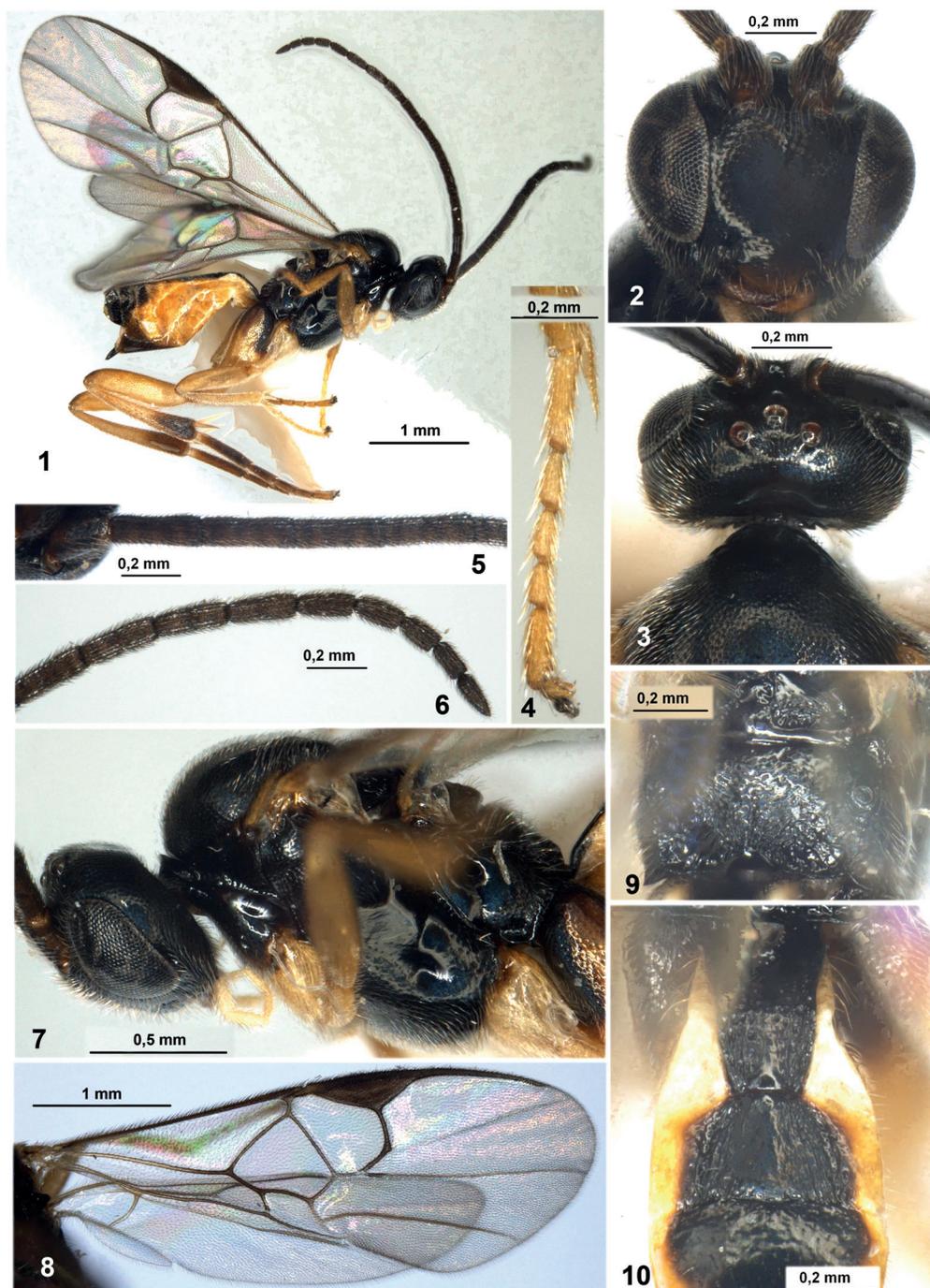
Head. In dorsal view (Fig. 3) 1.7–1.8 times wider than median length, same width across eyes and across temple, almost as wide as mesoscutum. Temple in dorsal view 0.8–0.9 times as long as eye (measurement on straight line), behind eyes almost parallel-sided in anterior half, then distinctly roundly narrowed. Ocelli in low triangle, its base 1.4–1.5 times sides; POL 1.60–1.75 times Od, 0.8–1.0 times OOL; OOL 1.8–2.0 times Od. Eye 1.60–1.65 times higher than wide. Minimum width of face (Fig. 2) 1.0–1.2 times median height (from toruli to middle of supraclypeal groove), width just below toruli about 1.4 times its median height. Clypeus short, separated by shallow and narrow groove, weakly concave ventrally, distinctly separated below from closed mandible forming rather wide open area. Malar space 0.60–0.75 times basal width of mandible. Antenna (Figs 1, 5, 6) 18-segmented, about 1.2 times longer than body. First flagellar segment 3.0–3.6 times longer than maximum width, almost as long as second segment; second segment 3.1–3.3 times longer than maximum width. Penultimate segment 2.0–2.1 times longer than wide, 0.75–0.80 times as long as apical segment.

Mesosoma. In lateral view (Fig. 7) 1.25–1.35 times longer than maximum height. Mesoscutum (Fig. 11) 1.3–1.4 times wider than median length. Prescutellar sulcus (depression) rather deep, with 9–12 fovea of different sizes. Scutellum distinctly convex (lateral view). Metanotum medio-dorsally with distinct lateral curved carinae forming suboval area and fused with posterior small area. Lateral pronotal lobe with rather distinct but fine and partly finely crenulate or smooth upper longitudinal sulcus, with distinct and at least partly weakly crenulate median oblique sulcus. Propodeal spiracle (Fig. 9) rather large, situated before middle of propodeum; median longitudinal carina fine and incomplete anteriorly.

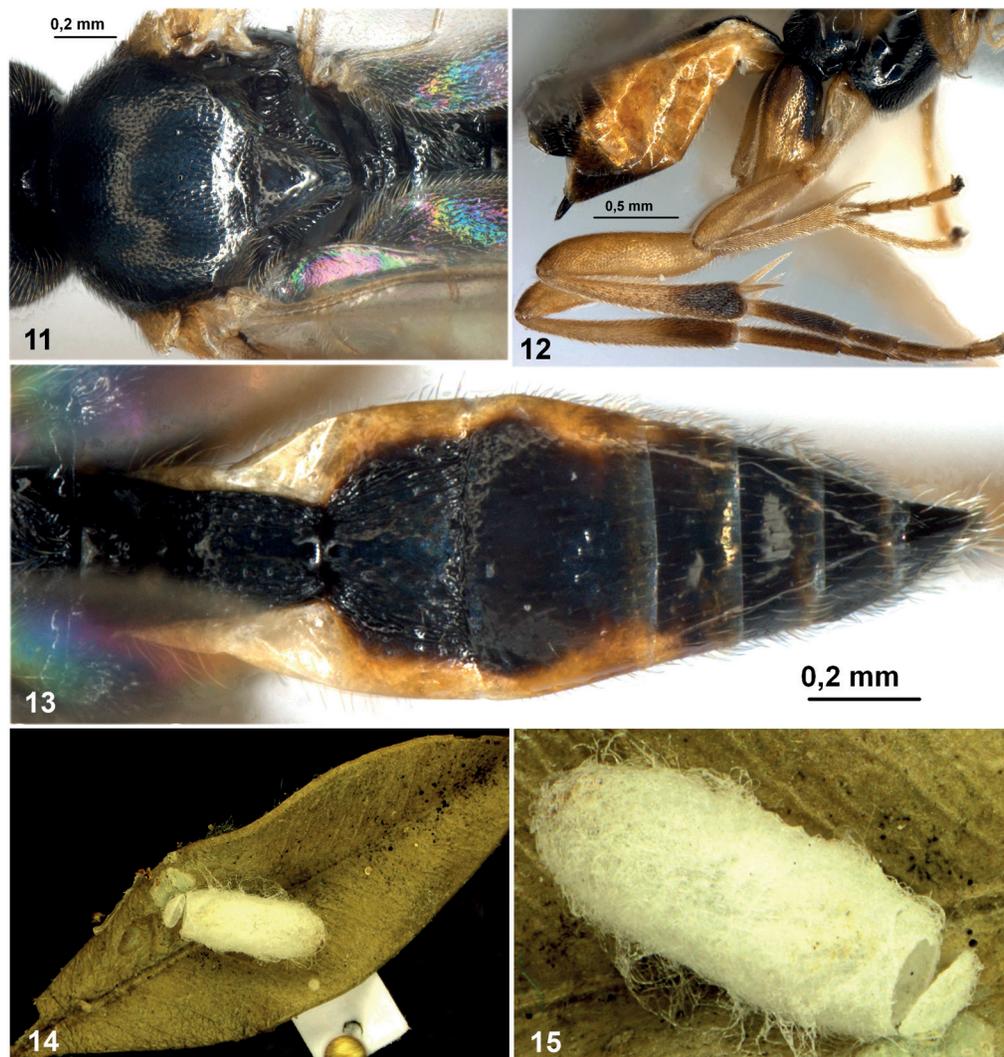
Wings. Fore wing (Fig. 8) 2.65–2.75 times longer than maximum width. Metacarpus (*1-R1*) 1.0–1.1 times as long as pterostigma, 4.4–6.0 times longer than distance from apex of metacarpus to apex of radial (marginal) cell. Pterostigma 2.6–3.0 times longer than maximum width. Radius (*r*) arising beyond middle of pterostigma, from its 0.6. First radial abscissa (*r*) 0.95–1.10 times as long as width of pterostigma, 1.1–1.2 times longer than first radiomedial vein (*2-SR*) and moderately strongly angled with it. Discoidal (first discal) cell 1.35–1.40 times wider than height. Distance (*1-CU1*) between basal (*1-M*) vein and nervulus (*cu-a*) 0.7–0.8 times as long as distance (*2-CU1*) between nervulus (*cu-a*) and recurrent vein (*m-cu*). Setae on median (basal) and submedian (subbasal) cells fairly evenly distributed, but a little sparse basally. Hind wing 3.5–3.8 times longer than maximum width. Plical (vannal) lobe with dense long setae beyond its widest part.

Legs. Fore leg with distinct curved subapical spine on apical tarsal segment (Fig. 4). Middle leg with inner (longest) tibial spur 1.10–1.15 times longer than middle basitarsus. Hind femur (Fig. 12) 4.1–4.3 times longer than wide. Hind tibial inner spur 1.3 times longer than outer spur, inner spur 0.6–0.7 times as long as hind basitarsus. Outer side of hind tibia with long distinct spines rather evenly and densely distributed.

Metasoma (Fig. 1) 0.75–0.90 times as long as head and mesosoma combined. First tergite (Figs 10, 13) distinctly and more or less evenly and linearly narrowed towards apex (dorsal view), distinctly humped subcentrally (lateral view), without median longitudinal sulcus. Length of first tergite 1.6 times maximum basal width, 2.9–3.0 times its minimum apical width, 1.4–1.6 times median length of propodeum, 1.9–2.0 times length of second tergite. Second tergite 2.0–2.3 times as wide apically as median length, basal field coextensive with tergite, but with distinctly crenulate shallow and narrow, weakly divergent posteriorly lateral furrows. Third tergite 1.35 times



Figs 1–10. *Protapanteles mygdomia* (Nixon, 1973), female. **1**, body, lateral view; **2**, head, front view; **3**, head and anterior part of mesosoma, dorsal view; **4**, fore tarsus; **5**, basal segments of antenna; **6**, apical segments of antenna; **7**, head and mesosoma, lateral view; **8**, fore and hind wings; **9**, propodeum; **10**, three basal segments of metasoma.



Figs 11–15. *Protapanteles mygdonia* (Nixon, 1973), female. **11**, mesosoma, dorsal view; **12**, metasoma and hind legs, lateral view; **13**, metasoma, dorsal view; **14**, cocoon on dry leaf of *Buxus*; **15**, cocoon.

longer than second tergite. Hypopygium (Fig. 12) robust, 0.45–0.50 times as long as hind tibia, truncate apically in lateral view, angled about 70° at apex, not projecting beyond apex of metasoma. Ovipositor (Fig. 12) short, weakly projected behind top of hypopygium, its sheath curvedly narrowed towards apex and with very sparse setae.

Sculpture. Vertex (Fig. 3) matt, almost smooth with only weak sculpture of setiferous punctures. Frons shiny smooth. Face

weakly punctate, matt, but shiny below. Mesoscutum (Fig. 11) dull, with dense but shallow small punctures and smooth interspaces; sculpture sparse, fine and more shiny in wide medio-posterior area, trace of notauli not different in type of sculpture. Scutellum shiny, with a few scattering shallow punctures. Propodeum (Fig. 9) distinctly rugose-striate, almost smooth narrowly anteriorly; median longitudinal carina fine or very fine and incomplete

anteriorly, sometimes completely indistinct. Mesopleuron (Fig. 7) mainly extensively smooth and shiny, dull with rather weak and sparse punctation below and near middle coxa, precoxal area complete smooth. Metapleuron widely smooth and shining. Hind coxa (Fig. 12) with outer face distinctly and densely punctate (sculpture stronger than on lower part of mesopleuron). Hind femur entirely weakly and very densely sculptured with a satiny appearance. First tergite (Figs 10, 13) finely and densely punctate-reticulate with several striae, smooth in wide and long mediobasal area. Second tergite (Figs 10, 13) distinctly crenulate with dense and fine reticulation between striae, more or less smooth medially and on wide lateral areas. Third tergite (Figs 10, 13) mainly smooth, with rugulosity just near suture between second and third tergites, with evenly distributed, moderately long and rather dense setae.

Colour. Body mainly black (Fig. 1), metasoma mainly black, laterally mainly light reddish brown to yellow (Fig. 1, 12). Mandible reddish brown, dark basally. Palpi yellow or pale yellow. Tegula and humeral plate yellow or brownish yellow. Legs brownish yellow, hind coxa in basal 0.5–0.6 and sometimes in ventral half brown to black, hind tibia in apical 0.3–0.4 and most part of hind tarsus dark brown to dark reddish brown, partly black, rarely apex of hind femur darkened; spurs of hind tibia pale yellow (Fig. 12). Wings hyaline (Fig. 8), pterostigma dark brown to almost black, venation medially brown to dark brown, pale basally.

Male. Body length 3.1–3.3 mm; fore wing length 3.3–3.6 mm. Head in dorsal view 1.8–1.9 times wider than median length, less width across temple than across eye. Face more distinctly but weakly punctate. Antenna distinctly thickened. First flagellar segment (lateral; view) 2.2–2.5 times longer than its maximum width, 0.90–0.95 times as long as second segment; second segment 2.4–2.8 times longer than maximum width. Penultimate segment 2.5 times longer than

wide, 0.9 times as long as apical segment. Humeral plate sometimes brown. Hind coxa sometimes almost entirely black, rarely hind femur apically distinctly darkened. Length of first metasomal tergite 1.8–2.0 times maximum basal width, 2.8–3.1 times its minimum apical width, 1.4–1.6 times median length of propodeum. Second tergite 2.2–2.4 times as wide apically as median length, smooth medially on rather wide area, sometimes with almost smooth lateral furrows. Otherwise similar to female.

Cocoon. Singular, elliptic shape, white, densely covered by white loose silk (Figs 14, 15). Length 4.5–5.2 mm.

Hosts. *Anthophila filipjevi* Danilevsky, 1969 (**new record**), *Choreutis pariana* (Clerck, 1759), Choreutidae (Tobias & Kotenko, 1986); *Cydalima perspectalis* (Walker, 1859), Crambidae (**new record**); *Operophtera brumata* Linnaeus, 1758, *Phigalia pilosaria* (Denis et Schiffermüller, 1775), *Pungeleria capreolaria* (Denis et Schiffermüller, 1775), Geometridae (Nixon, 1973; Yu et al., 2012).

Distribution. Russia [Yaroslavl' Province, Krasnodar Territory, Buryatia, Primorskiy Territory (Tobias & Kotenko, 1986; Kotenko, 2007; **new record**)]; Ireland, United Kingdom, France, Portugal (Madeira), Spain, Germany, Switzerland, Italy, Finland, Hungary, Slovakia, Bulgaria, Turkey, Iran, Korea (Yu et al., 2012).

Remarks. The lepidopteran hosts from families Choreutidae and Crambidae are not typical for *P. mygdonia*, in comparison with members of family Geometridae, and were usually recorded for the related species *P. vitripennis* (Curtis, 1830), *P. lateralis* (Haliday, 1834), *P. fausta* (Nixon, 1973), and *P. eugeni* (Papp, 1972). Our specimens of *P. mygdonia* reared from the caterpillars of these families distinctly differ from *P. vitripennis* by the entirely densely setose basal and subbasal cells of the fore wing and the hind coxa black only in its basal 0.5–0.7; from *P. lateralis*, *P. fausta* and *P. eugeni* among other differences by the much shorter and distinctly apically narrowed ovipositor sheath (see for diagnoses Nixon, 1973).

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