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Taxonomy of the European Species of *Neotypus* FÖRSTER, [1869], with a Key for their Identification

(Hymenoptera, Ichneumonidae, Ichneumoninae, Listrodomini)

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Zusammenfassung

Die europäischen Arten der Gattung *Neotypus* sind in dieser Arbeit mit Verbreitungsangaben und Synonymen zusammengestellt. Charakteristische morphologische Merkmale wurden an Hand von licht- und rasterelektronenmikroskopischen Untersuchungen dargestellt und diskutiert. Ein illustrierter Bestimmungsschlüssel für die europäischen Arten von *Neotypus* wird vorgestellt.

Im Methodenteil werden allgemeine Hinweise zur Untersuchung entomologischer Objekte im Rasterelektronenmikroskop ohne vorheriges Besputtern mit Gold gegeben.

Abstract

The European species of *Neotypus* are compiled, their distribution and synonymies are listed. Distinguishing characters are discussed and reinvestigated with the use of scanning electron microscopy. An illustrated key to identify the European species of *Neotypus* is given.

Technical remarks are given on the investigation of entomological objects in the scanning electron microscope without sputtering the specimens with gold.

Introduction

The genus *Neotypus* FÖRSTER, [1869], belongs to the tribe Listrodomini and is distributed in the Ethiopian, Indo-Australian, Nearctic and Palearctic regions. One species, *Neotypus cabrerai* BERTHOUMIEU, 1904, was described from the Canary Islands (Tenerife). The genus *Neotypus* is closely related to the type genus of the tribe, *Listrodomus* WESMAEL, [1845].

According to HEINRICH (1967), the genus *Neotypus* is especially important in the Ethiopian region because there it reaches the highest degree of specialization. In the Palearctic region 5 species occur (TOWNES et al. 1965): 4 species are found in Europe, one of these is represented by a different subspecies in the Eastern Palearctic (*Neotypus nobilitator orientalis* UCHIDA, 1930) and one further species is found in the Eastern Palearctic only (*Neotypus sinister* MEYER, 1930). This species, however, was not mentioned by RASNITSYN (1981).

PERKINS (1959) used the differences in structure of the sternaulus, of the area coxalis, and of the subalar prominence to differentiate the species of *Neotypus*. HEINRICH (1967) added other distinctive characters: the size of spiracles of the propodeum, the curvature of scutellum, the presence or lack of notauli, the presence or lack of striate sculpture on the interthyridial space, and the white marks on the thorax and gaster. RASNITSYN (1981) more recently differentiated the species, as did PERKINS, by the structure of the sternaulus and the area coxalis, furthermore he noted the curvature of the clypeus.

Up to now taxonomical studies about this genus are incomplete because they do not contain all of the European species, except the paper of HEINRICH (1934). He did not, however, propose a key for their determination, and the differentiating morphological characters are scattered in the literature. Also the key proposed by GREGOR (1940) is incomplete. In this paper, the original references and the distribution in the Palaearctic region of each species of *Neotypus* occuring in Europe is compiled. Some morphological features, not described previously, are integrated in an illustrated key, separately for ♂♂ and ♀♀.

Methods

As in comparable previous works (e.g. BLANK and TAEGER 1992) we investigated rare specimens in the scanning electron microscope without sputtering. Since this possibility is hardly known, some methodological remarks are given which might be of broader interest.

The advantages of the scanning electron microscopy are specially the possibility to depict three dimensional structures with a very large depth of focus, and the fact that the image is built up almost purely from the surface of the specimen. Usually biological specimens are sputtered with gold to produce a conducting coating on the surface. This is to avoid charging, which is a well known problem to all those working with biological specimens: During imaging the surface of the area under investigation is gradually building up a negative charge as the beam repeatedly scans over it. This negative charge is fixed and quickly becomes large enough to produce a dark region at the charging area. Charging is especially frequent on the tips of hairs and prominent edges, where it causes dark lines in the image. These problems can be reduced by using a very low acceleration voltage.

Sometimes it may also be helpful to change the orientation of the specimen within the chamber.

Since in entomological investigations it is frequently not possible to sputter rare specimens or even types, it is very important to know that good scanning electron microscopes enable reasonably good image formation with an electron beam of an acceleration voltage of only 1 or a few kV. SCHARF (1977) even showed that it is possible to investigate living (!) insects in the scanning electron microscope at low acceleration voltages.

For the present investigation we used a Philips XL-20 which is equipped with a special Wehnelt assembly for low voltage use. The acceleration voltage used was 1.6 kV. The pinned specimens were mounted on the stubs with Leit-C-Plast ("plastic conductive carbon cement", Fa. G. Neubauer, Münster). EISENBEIS and WICHARD (1985) demonstrated that contrary to the widely held view it is no disadvantage to scan animals mounted on small needles. In some cases the pins had to be shortened to enable a small working distance. These specimens were later remounted on new pins.

A further enhancement is the digitization in modern scanning electron microscopes which enables the use of frame stores compatible with computers (cf. WAGENER 1990). This also enables relatively fast working, which furthermore helps to reduce charging. In the present manuscript we used videoprints which is an additional enhancement of the work since no photo processing is required. Acceleration voltage, spot size, working distance and magnification are indicated in the figures (kV, Strahl, Vergr., Abst., respectively).

European species of *Neotypus* FÖRSTER

Genus *Neotypus* FÖRSTER, [1869]

Neotypus FÖRSTER, [1869]. Verh. naturh. Ver. Rheinl. 25: 124. Type species: *Ichneumon lapidator* FABRICIUS, 1973, designated by ASHMEAD 1900. The type species is regarded as synonym of *Neotypus coreensis* UCHIDA, 1930 (CARLSON 1975).

Cillimus TOSQUINET, 1896. Ichneumonides d'Afrique 5: 122. Type species: *Cillimus adornatus* TOSQUINET, 1896, designated by ASHMEAD 1900.

***Neotypus intermedius intermedius* MOCSÁRY, 1883**

Neotypus intermedius MOCSÁRY, 1883. Hymenoptera nova Europae et exotica 13: 10. ♀.

Neotypus bolivari BERTHOUMIEU, 1894. Rev. sci. Bourb., 7, 181. ♂.

Distribution: Peninsular Spain, Canary Islands and Northern Africa.

***Neotypus coreensis* UCHIDA, 1930**

Neotypus melanocephalus coreensis UCHIDA, 1930. Insecta Matsumurana 5: 99. ♀ and ♂. (c.f. CARLSON 1975).

Ichenumon lapidator FABRICIUS, 1793. Entomologia systematica 2: 160. ♀.

Distribution: England, France, Germany, Hungary, Peninsular Spain, Rumania, Russia and Sweden.

***Neotypus melanocephalus* (GMELIN, 1790)**

Ichneumon melanocephalus GMELIN, 1790. Caroli a Linné Systema Naturae 1 (5): 2677. ♀.

Neotypus melanocephalus pusillus GREGOR, 1940 Ichneumonologické studie. I. (Ichneumonologische Studien I.), Sbornik Klubu Prirod Brno, 1940, 22: 68. ♀. **syn. nov.**

(*Neotypus melanocephalus pusillus* var. *petiola* GREGOR, 1940. Infrasubspecific taxon, literature see above).

(*Neotypus melanocephalus pusillus* var. *nugrita* GREGOR, 1940. Infrasubspecific taxon, literaure see above).

Distribution: England, France, Germany, Hungary, Peninsular Spain, Rumania, Poland, Russia and Sweden.

***Neotypus nobilitator nobilitator* (GRAVENHORST, 1807)**

Ichneumon nobilitator GRAVENHORST, 1807. Vergl. Übers. zool. System. 20: 235. ♀.

Distribution: Austria, England, Germany, Peninsular Spain, Rumania and Russia.

Morphological Characters

Two character groups are important for the taxonomy of the genus *Neotypus* FÖRSTER in Europe: morphological and chromatic characters.

The important morphological characters concern size of thyridiae, sculpturing of basal middle part of gastral tergit 2, curvature of the temples, morphology of the apical edge of the clypeus, shape of the gaster, in the ♀♀ length of the ovipositor and of the hypopygium, and in the ♂♂ size of the gastrocoeli.

The chromatic characters are more important in ♂♂ than in ♀♀. Important are the colour of the hind femora, the length of the white marks on the head, the presence or lack of white marks on the coxae, and the presence or lack of red colour on the head and the thorax; this last character is also important in the ♀♀, and the presence or lack of a white ring on the flagella. The colour of the gaster is quite constant in both sexes.

Neotypus intermedius intermedius MOCSÁRY is the most easily distinguishable for its Ethiopian morphological characters; and the remaining subspecies of *Neotypus intermedius* MOCSÁRY occurs in the Ethiopian region (HEINRICH 1967, TOWNES & TOWNES 1973). *Neotypus intermedius* MOCSÁRY is closely related to *Neotypus melanocephalus* (GMELIN), because both have a long oviscaptus, small gastrocoeli and thyridiae. However, the global aspect of *Neotypus melanocephalus* (GMELIN) is similar to the remaining European species.

Neotypus coreensis UCHIDA and *Neotypus nobilitator* (GRAVENHORST) are probably also closely related. They are very similar, and for a long time the latter species was considered to be a synonym of the first.

Key of the European Species of *Neotypus* FÖRSTER

Females

1 (4) Ovipositor short (Fig. 1, 2), in dorsal view less than the length of segment 5 of the hind tarsi 2

2 (3) Thyridiae wider than the distance between them. Basal middle part of the gastral tergit 2 with few points. Face completely black. Propodeum predominantly black or blackish-brown ..... *Neotypus nobilitator nobilitator* (GRAVENHORST)

3 (2) Thyridiae narrower than the distance between them. Basal middle part of the gastral tergit 2 dense and strongly pointed. Face black, with basal white marks. Propodeum predominantly red ..... *Neotypus coreensis* UCHIDA

4 (1) Ovipositor long (Fig. 3, 4), in dorsal view larger than the length of segment 5 of the hind tarsi 5

5 (6) Clypeus with a middle tooth on its apical edge. Antennae short. Basal middle part of the gastral tergit 2 almost smooth and shining. Gastrocoeli and thyridiae weakly marked. Hypopygium normal. Gaster oval and short. Face with red colour. Flagella with no white ring. Hind femora predominantly or completely black ..... *Neotypus intermedius intermedius* MOCSÁRY

6 (5) Clypeus with no middle tooth on its apical edge. Antennae long. Basal middle part of the gastral tergit 2 densely pointed. Gastrocoeli and thyridiae small, but clearly marked. Hypopygium long, it exceeds the hind part of the gaster. Gaster large. Face with no red colour. Flagella with white ring. Hind femora predominantly or completely red ..... *Neotypus melanocephalus* (GMELIN)

Males

1 (2) Hind femora predominantly or completely red. Temporal orbits with narrow white marks that almost cover its full length. Thorax black with some white marks, never with red marks. Thyridiae narrower than the distance between them (Fig. 5). Basal middle part of the gastral tergit 2 densely pointed ..... *Neotypus melanocephalus* (GMELIN)

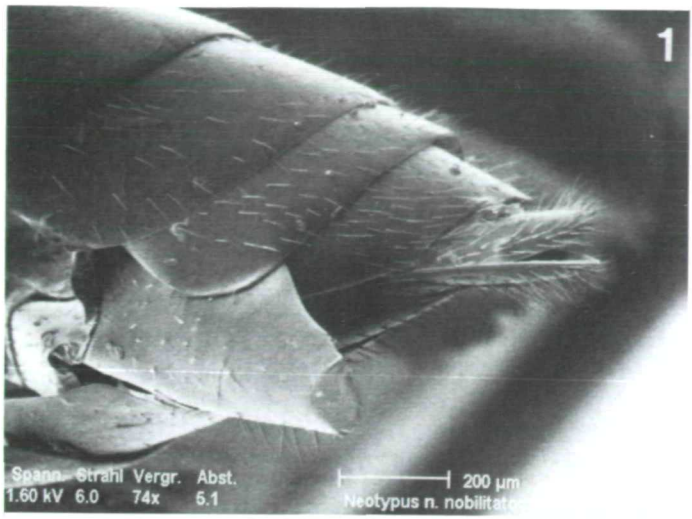
2 (1) Hind femora predominantly or completely black or blackish-brown. Temporal orbits with white marks (wide or narrow) covering less than half of its length. Other characters 3

3 (4) Clypeus with a middle tooth on its apical edge. Gastrocoeli and thyridiae weakly marked (Fig. 6). Basal middle part of the gastral tergit 2 almost smooth and shining. Gaster oval and short. Temporal orbits with widened white marks. Thorax predominantly red. Coxae with white marks ..... *Neotypus intermedius intermedius* MOCSÁRY

4 (3) Clypeus without middle tooth on its apical edge. Gastrocoeli and thyridiae clearly marked. Gaster large. Temporal orbits with narrow white marks. Thorax predominantly or completely black. Coxae without white marks 5

5 (6) Thyridiae wider than the distance between them (Fig. 7). Temples not widened (head in dorsal view). Thorax often with white marks ..... *Neotypus nobilitator nobilitator* (GRAVENHORST)

6 (5) Thyridiae narrower than the distance between them (Fig. 8). Temples widened (head in dorsal view). Thorax often with no white marks ..... *Neotypus coreensis* UCHIDA



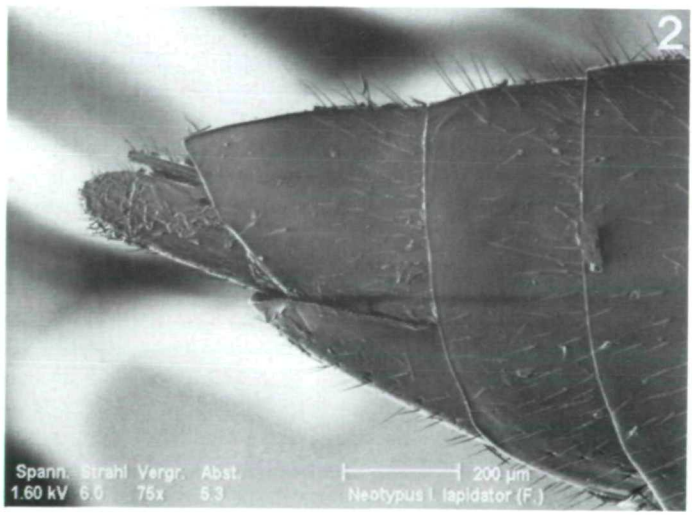
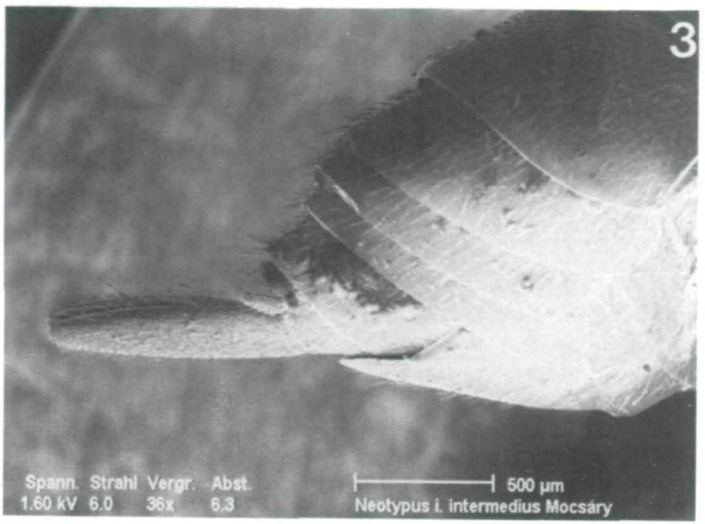


Fig. 1: *Neotypus nobilitator nobilitator* (GRAVENHORST) - ♀, ovipositor and hypopygium.
Fig. 2: *Neotypus coreensis* UCHIDA - ♀, ovipositor and hypopygium.



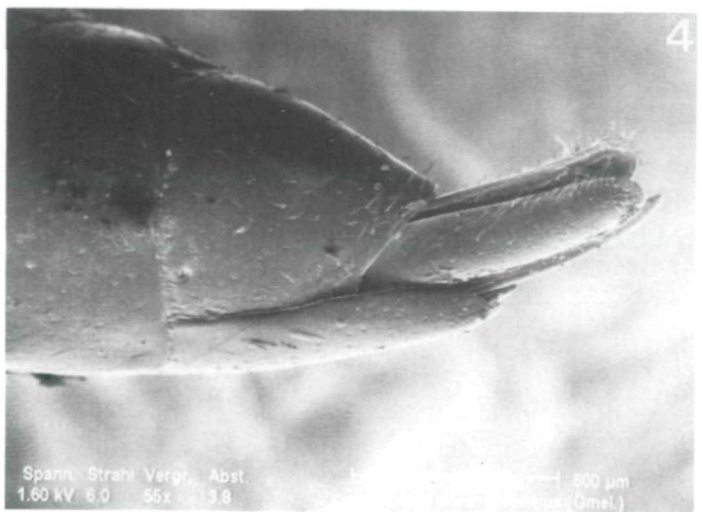
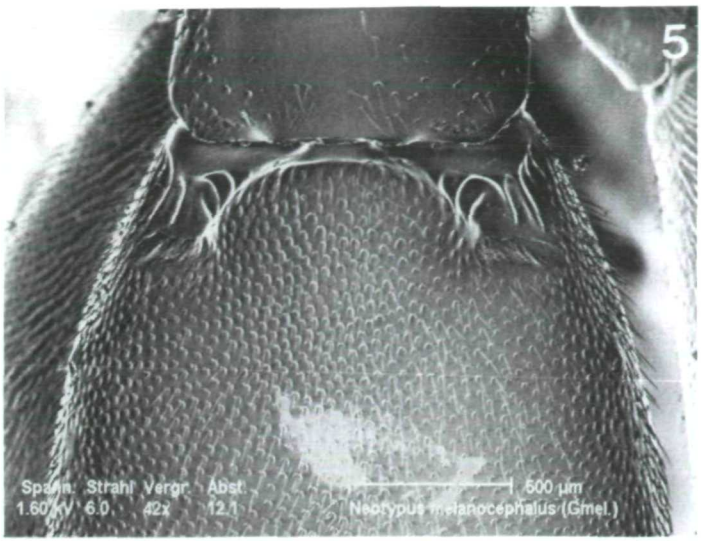


Fig. 3: *Neotypus intermedius intermedius* MOCSÁRY - ♀. ovipositor and hypopygium.
Fig. 4: *Neotypus melanocephalus* (GMELIN) - ♀, ovipositor and hypopygium.



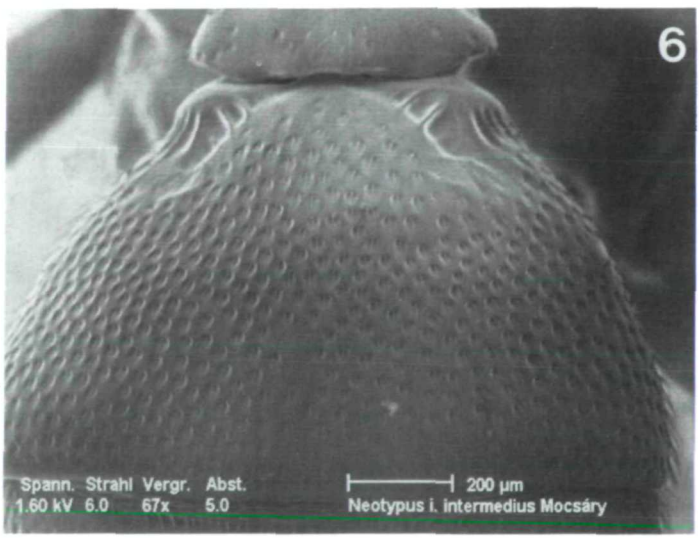
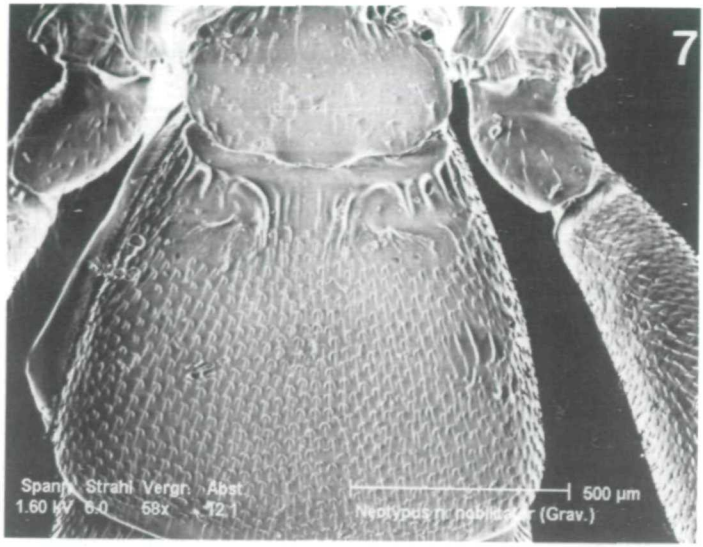


Fig. 5: *Neotypus melanocephalus* (GMELIN) - ♂, basal part of gastral tergit 2.
Fig. 6: *Neotypus intermedius intermedius* MOCSÁRY - ♂, basal part of gastral tergit 2.



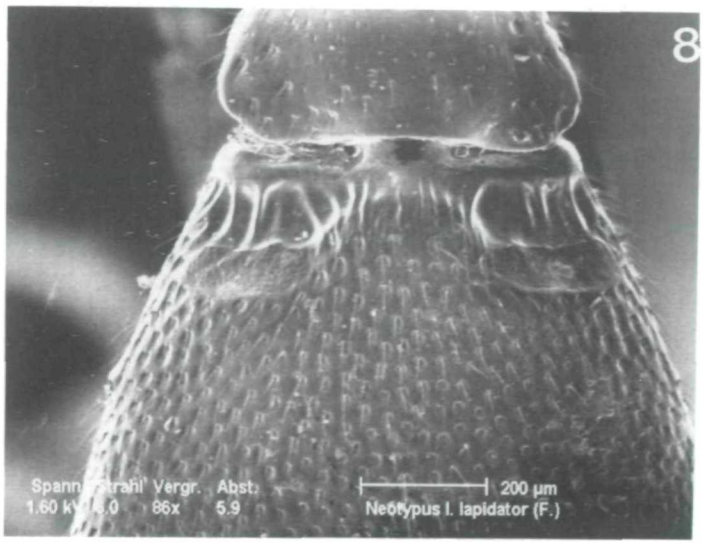


Fig. 7: *Neotypus nobilitator nobilitator* (GRAVENHORST) - ♂, basal part of gastral tergit 2.
Fig. 8: *Neotypus coreensis* UCHIDA - ♂, basal part of gastral tergit 2.

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