Ent. Tidskr. 143 (2022)

Revision of the Scandinavian species of *Xorides* Latreille, 1809 (Hymenoptera: Ichneumonidae: Xoridinae), with an illustrated key to the species of Northern Europe

NIKLAS JOHANSSON, JACEK HILSZCZAŃSKI & FRODE ØDEGAARD

Johansson, N., Hilszczański, J. & Ødegaard, F.: Revision of the Scandinavian species of *Xorides* Latreille, 1809 (Hymenoptera: Ichneumonidae: Xoridinae), with an illustrated key to the species of Northern Europe. [**Revision av de skandinaviska arterna av *Xorides* Latreille, 1809 (Hymenoptera: Ichneumonidae; Xoridinae.) med en illustrerad nyckel till de nordeuropeiska arterna.**] – Entomologisk Tidskrift 143(4): 183–222. Björnlunda, Sweden 2022. ISSN 0013-886x.

The Scandinavian species of *Xorides* Latereille, 1809 are revised and the study recognizes 13 species occurring in Sweden and 11 in Norway. One species, *Xorides hilszczanskii* Johansson **sp. nov.**, a parasitoid of the cerambycid *Saperda perforata* (Pallas, 1773) is described as new to science. The following taxonomic updates are proposed: *Xorides hedwigi* Clément, 1938 **syn. nov.** of *Xorides sapporensis* (Uchida, 1928); *Xorides niger* (Pfeffer, 1913) **syn. nov.** of *Xorides fuligator* (Thunberg, 1824); *Xorides minutus* (Clément, 1938) **syn. nov.** of *Xorides praecatorius* (Fabricius, 1793); *Xorides berlandi* (Clément, 1938) **syn. nov.**, *Xorides asiasius* Sheng & Hilszczański 2009 **syn. nov.** and *Xorides cinnabarinus* Sheng & Hilszczański 2009 **syn. nov.** of *Xorides indicatorius* (Latreille, 1806). *Xorides sordator* (Thunberg, 1824) **stat. rev.** is the valid name for the species previously treated under the name *Xorides fuligator*. Barcodes for 12 species have been obtained and are stored in BOLD. An illustrated key to the 17 species occurring in Northern Europe and adjacent regions is provided. All *Xorides*-species are parasitizing xylophagous Coleoptera, primarily Cerambycidae and Buprestidae and a short discussion is given on their potential role as indicators of sustainable forestry and biodiversity in boreal forest ecosystems.

Niklas Johansson, Baskarp Fredriksberg 1, 566 92 Habo, Sweden. E-mail: chrysis32@yahoo.se urn:lsid:zoobank.org:author:B0031F47-99F7-4FEE-B545-B6F1E79E1A4E

Jacek Hilszczański, Department of Forest Protection, Forest Research Institute, Sękocin Stary 05-090, Poland. E-mail: hilszczj@ibles.waw.pl

Frode Ødegaard, Norwegian University of Science and Technology (NTNU), Department of Natural History, NO-7491 Trondheim, Norway. E-mail: frode.odegaard@ntnu.no

Zoobank publication id: urn:lsid:zoobank.org:pub:ECD6CC2A-FE08-414C-8736-D80F0108075C

Xorides Latreille, 1809 is a relatively species-poor genus with about 170 described species worldwide, of which about 40 species occur in the Western Palaearctic (Yu et al. 2016). The members of the genus are slender Darwin wasps, distinguished from other genera of the subfamily Xoridinae by the unidentate mandibles and the peg-like setae projecting from the subapical flagellomeres of the females. *Xorides* larvae are idiobiont ectoparasitoids of xylophagous beetles (Broad et al. 2018, Hilszczański 2002) where they attack the host larvae, but occasionally also pupae and pharate adults (Broad et al. 2018).

Historically, the European species of the genus has been treated by several authors adding new species and partly revising known species (Thunberg 1824; Gravenhorst 1829; Curtis 1831; Holmgren 1860; Thomson 1877; Kriechbaumer 1879, 1889; Szépligeti 1899; Kiss 1924). The first thorough revision of the Western Palaearctic fauna was conducted by Clément (1938). Hilszczański (2000) revised the species of the subgenus *Moerophora* Förster, 1869, introducing two new species for science from Poland, while Hilszczański (Hilszczański & Plewa 2011) described two new species of *Xorides* from Crete. Mainly faunistic reviews, treating the national fauna of Britain (Gauld & Fitton 1981), the European part of Russia (Kasparyan 1981), Bulgaria (Kolarov 1997) and Ukraine (Varga 2014) have also contributed to our knowledge of European *Xorides*. The *Xorides* of the Northern and Central parts of the Eastern Palaearctic have been revised in several papers (Uchida 1928, Wang & Gupta 1995, Liu & Sheng 1998, Sheng & Wen 2008, Sheng & Hilszczański 2009), while Townes et al. (1960) revised the species of North America. Varga (2019, 2020) revised the Afrotropical members of the genus.

Hedström (1988) presented a checklist of the Swedish species of *Xorides*, including provincial records, recognizing 12 species, with *Xorides fuligator* (Thunberg, 1824) (as *X. niger* Pfeffer, 1913) as a potentially Swedish species. This study presents diagnostics and distributional records for the 13 known Scandinavian species of *Xorides*. An illustrated key to the *Xorides* of Northern Europe, which includes an additional four species occurring in adjacent regions, is presented. Finally a short discussion on the conservation status of *Xorides* in Sweden and the potential role of parasitoids on saproxylic insects as indicators of biodiversity and ecosystem stability is given.

Material and methods

Specimens of *Xorides* from public collections in Sweden and Norway and larger private collections housing specimens from Sweden were studied (see list of depositories below). The material of *Xorides*, collected by the SMTP, (seven species/12 specimens, M. Riedel, Bad Fallingbostel, det.) has been examined only in part, but any additional provincial records have been added. Available and relevant types were checked, either in person by the authors or by studying high-resolution photos. Some focus has also been on the types collected in the eastern Palaearctic. Original idea, morphological analysis, study design, data collection and manuscript preparation by the first author. The second author contributed with data collection and the third author assisted with the barcoding procedure and data collection.

For some species, primarily targeting complexes containing taxa of uncertain taxonomic status, the CO1 barcode region was sequenced. DNA extraction was made from a single mid leg, PCR amplification and sequencing of a majority of the samples were conducted at the Canadian Centre for DNA Barcoding (CCDB) using standardized high throughput protocols (Ivanova et al. 2006). The first pass primer pair in all plates was LepF1 and Lepr1 (ATTCAACCAATCATAAAGATATTGG and TAAACTTCTGGATGTCCAAAAAATCA) and they all produced PCR products. The sequences were aligned using MUSCLE (Edgar 2004) provided through the software MEGA X (Tumar et al. 2021). All data are available through the public dataset Scandinavian *Xorides* (DS-XORIDES) in the Barcode of Life Data Systems 4.0 (BOLD, Ratnasingham & Hebert 2007). The phylogeny of the barcoded specimens was then inferred by constructing a maximum likelihood (ML) phylogenetic tree (Fig. 4) using MEGA X. The analysis is based on 150 bootstrap iterations using the general time reversible model. The DNA extracts and the specimen data are stored at the CCDB. Specimen id numbers for barcoded specimens are listed for each species under the heading *DNA barcode* and in Fig 4.

Morphological terminology follows Broad et al. (2018). Fore wing length (FWL) is measured as the greatest distance from the apex of the tegula to the wing tip. Known faunistic province records for Sweden and Norway respectively is listed for each species according to the abbreviations given by Fig. 2. Pictures, if not stated otherwise, were taken by the first author with a Canon 6D either with a Canon 35 mm f/2.8 Macrophoto lens or a Nikon 10x M-Plan microscopic objective mounted on bellows. Pictures were then stacked in Zerene stacker and post processed in Photoshop.

Figure 1. Female *Xorides sepulchralis* (Holmgren, 1860) ovipositing into a trunk of an aspen *Populus tremula* L. containing larvae of the host *Xylotrechus rusticus* (Linnaeus, 1758). Photo: Henrik Larsson.

Figur 1. Hona av *Xorides sepulchralis* (Holmgren, 1860) äggläggandes på en asp *Populus tremula* L. innehållande larver av grå getingbock *Xylotrechus rusticus* (Linnaeus, 1758). Foto: Henrik Larsson.

Abbreviations

Depositories

BMNHUK = Natural History Museum; London, United Kingdom
CSA = Collections of Stift Admont; Admont, Austria
FDG = Private collection of Filippo di Giovanni; Italy
GSFPM = Insect Museum, General Station of Forest Pest Management, State Forestry Administration; Shenyang, P. R. China
HNHM = Hungarian Natural History Museum; Budapest, Hungary
HUM = Hokkaido University Museum; Sapporo, Japan.
JH = Private collection of Jacek Hilszczański; Łoziska, Poland
LW = Private collection of Lars-Ove Wikars; Borlänge, Sweden
MNHN = Muséum National d'Histoire Naturelle; Paris, France
MNHW = Museum of Natural History, University of Wrocław; Wrocław, Poland
MZH = Finnish Museum of Natural History; Helsinki, Finland
MZLU = Zoologiska Museet, Lunds Universitet; Lund, Sweden
NHM.UIO = Natural History Museum, University of Oslo; Norway
NHMW = Natural History Museum; Vienna, Austria
NHRS = Swedish Museum of Natural History; Stockholm, Sweden
NJ = Private collection of Niklas Johansson; Baskarp, Sweden
NMS = National Museums of Scotland; Edinburgh, United Kingdom
NMV = Museums Victoria; Melbourne, Australia

NTNU = University Museum, Norwegian University of Science and Technology; Trondheim, Norway
SGN = Senckenberg Gesellschaft für Naturforschung; Frankfurt, Germany
SMNS = Staatliches Museum für Naturkunde; Stuttgart, Germany
SMTP = Swedish Malaise Trap Project, Station Linné; Skogsby, Sweden
UPSZ = Evolutionsmuseet, Uppsala University; Uppsala, Sweden
USUC = The collection of the Utah State University; Logan, USA
WP = Private collection of William Penigot; Saint-Juéry, France
ZFMK = Zoologisches Forschungsmuseum Alexander Koenig; Bonn, Germany
ZIN = Zoological Institute, Russian Academy of Sciences; St Petersburg, Russia
ZMHB = Museum für Naturkunde; Berlin, Germany
ZMUC = Zoological Museum, University of Copenhagen; Copenhagen, Denmark
ZSM = Zoologishe Staatsammlung München; Munich, Germany

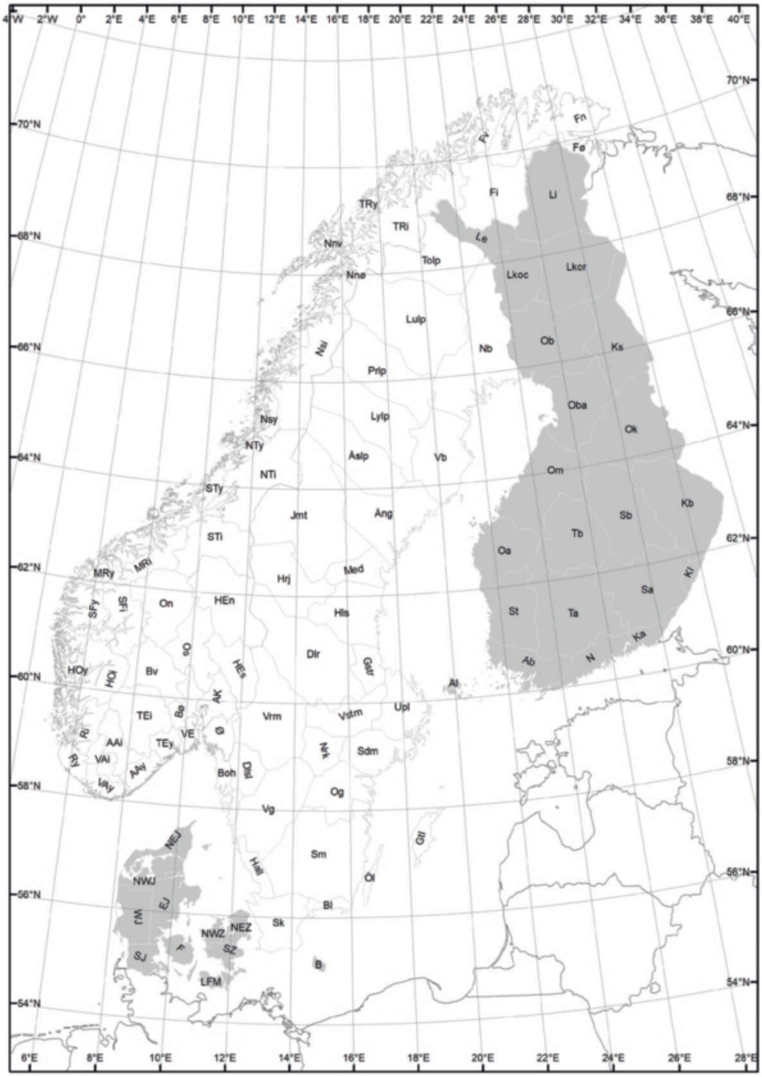

Figure 2. Map of Scandinavia with borders and used abbreviations for the faunistic provinces.

Figur 2. Karta över Skandinavien med inrikes gränser och använda förkortningar för faunaprovinser.

Faunistic provinces

Sk (Skåne), Bl (Blekinge), Hall (Halland), Sm (Småland), Öl (Öland), Gtl (Gotland), Ög (Östergötland), Vg (Västergötland), Bo (Bohuslän), Dlsl (Dalsland), Nrk (Närke), Sdm (Södermanland), Upl (Uppland), Vstm (Västmanland), Vrm (Värmland), Dlr (Dalarna), Gstr (Gästrikland), Hls (Hälsingland), Med (Medelpad), Hrj (Härjedalen), Jmt (Jämtland), Ång (Ångermanland), Vb (Västerbotten), Nb (Norrbotten), Åslp (Åsele lappmark), Lylp (Lycksele lappmark), Pilp (Pite lappmark), Lulp (Lule lappmark), Tolp (Torne lappmark). Faunistic provinces of Norway follow Endrestøl (2021): Ø – Østfold; AK – Akershus; HES - Hedmark, southern; HEN - Hedmark, northern; OS - Oppland, southern; ON - Oppland, northern; BØ - Buskerud, eastern; BV - Buskerud, western; VE – Vestfold, TEY - Telemark, outer; TEI - Telemark, inner; AAY - Aust-Agder, outer; AAI - Aust-Agder, inner; VAY - Vest-Agder, outer; VAI - Vest-Agder, inner; RY - Rogaland, outer; RI - Rogaland, inner; HOY - Hordaland, outer; HOI - Hordaland, inner; SFY - Sogn og Fjordane, outer; SFI - Sogn og Fjordane, inner; MRY - Møre og Romsdal, outer; MRI - Møre og Romsdal, inner; STY - Sør-Trøndelag, outer; STI - Sør-Trøndelag, inner;; NTY - Nord-Trøndelag, outer; NTI - Nord-Trøndelag, inner; NSY - Nordland, southern, outer; NSI - Nordland, southern, inner; NNØ - Nordland, northeastern; NNV - Nordland, northwestern; TRY - Troms, outer; TRI - Troms, inner; FV - Finnmark, western; FI - Finnmark, inner; FN - Finnmark, northern; FØ - Finnmark, eastern (Fig. 2).

Figure 3. Female of *Xorides ater* (Gravenhorst, 1829) ovipositing into a trunk of Norway spruce *Picea abies* (L.) H. Karst. Photo: Henrik Larsson.

Figure 3. Hona av *Xorides ater* (Gravenhorst, 1829) äggläggande på en stående granstam *Picea abies* (L.) H. Karst. Foto: Henrik Larsson.

Morphological characters useful in distinguishing species

Traditionally relatively few characters, mainly based on coloration, shape of the tibiae of females, the pubescence of the male flagellomeres and sculpture have been used in species identification of *Xorides*. The body size in most species is extremely variable, most likely as a result of using multiple hosts, and often abnormally small males occur. In general, it is these small males, less distinct in characters useful in species separation such as sculpture and coloration, which cause most problems during identification and thereby usually needs to be addressed using a combination of characters.

Head. The sculpture of the head has been used in a few cases to morphologically define species (e.g. *Xorides gravenhorstii*). In fact, the shape and sculpture of the head, primarily in dorsal view, is usually diagnostic and even morphologically similar species seem to differ in this respect. The shape of the apical and basal flagellomeres in the female and the length of the pubescence of the male antennae is very useful, especially in the latter case.

Mesosoma. In some species the mesosoma is strongly dorsoventrally depressed giving the species a very characteristic habitus. The sculpture of the mesoscutum occasionally can be important when separating otherwise similar species.

Metasoma. The metasoma hold several useful characters. The shape of the first tergite, usually expressed by the absence/presence of a diagonal groove laterally and the length/width ratio is useful for determination. Also the sculpture of the

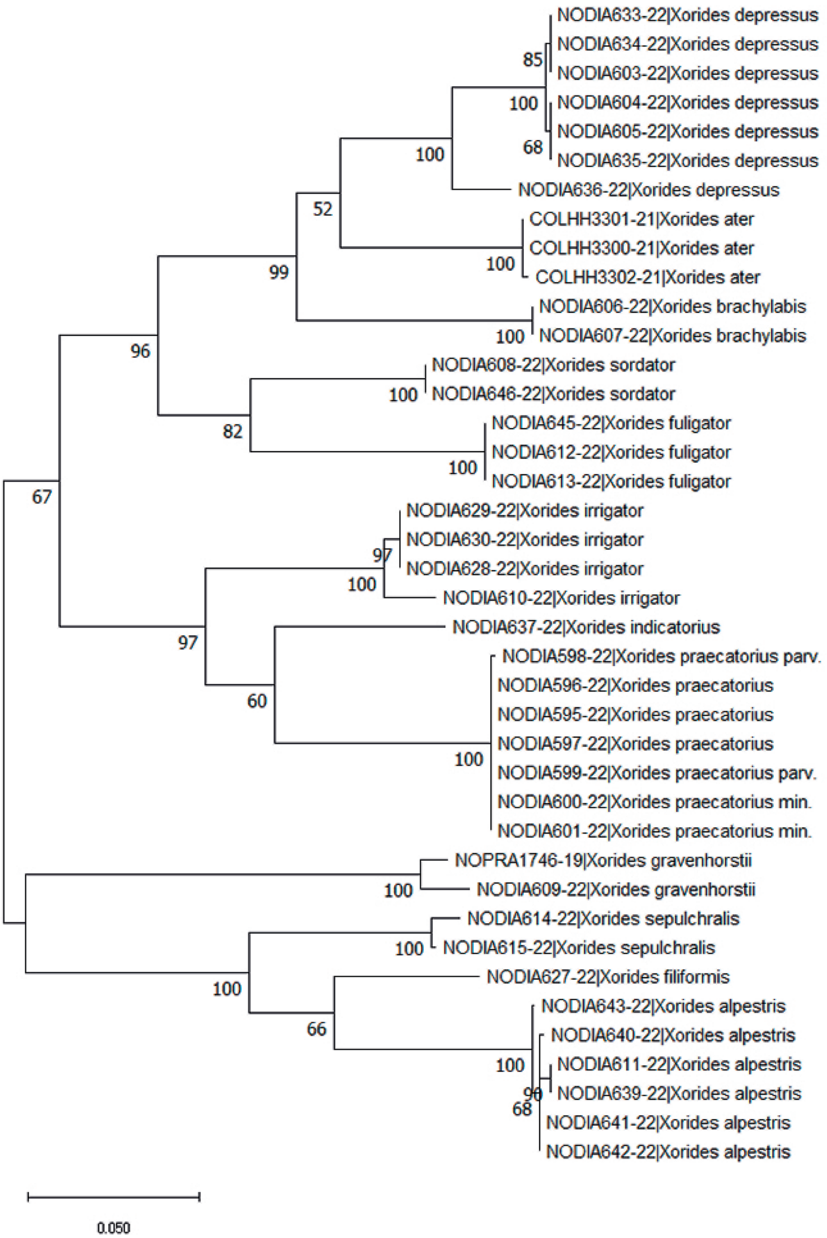

Figure 4. Phylogeny of Northern European *Xorides* as obtained from cytochrome oxidase 1 (COI) sequences. Maximum likelihood tree is shown with clade support based on 150 bootstrap iterations using the General Time Reversible model and analysed with MEGA-X. The sample ids refer to the BOLD database. Note that *Xorides rufipes* (Gravenhorst, 1829) is missing.

Figur 4. Fylogeni för de nordeuropeaiska arterna av *Xorides* utifrån CO1 sekvenser. Maximum likelihood tree visas med ett grenstöd baserat på 150 bootstrap-upprepningar med hjälp av General Time Reversible model och analyserat i MEGA-X. Individkoderna referar till BOLD databasen. Notera att *Xorides rufipes* (Gravenhorst, 1829) saknas.

remaining tergites seem to be diagnostic to some extent. The relative length of the ovipositor or the shape of the male genitalia are not used in this study, but may prove to be useful in separating closely related species.

Legs. The shape of the female fore and mid tibia has been used by several authors and is a character very useful in distinguishing several species as is the sculpture of the hind coxa. The colour of the legs is usually quite stable and most species have a “typical” coloration, but some variation occurs and especially smaller specimens are more prone to having aberrant leg colours.

Coloration. The extension of the reddish and whitish markings on the meta- and mesosoma is quite variable, often with specimens from more southerly latitudes having more extensive pale/ reddish markings. Several species also show a considerable intraspecific variation in the coloration of the metasoma ranging from red to black in one species. The extensions of the whitish markings is also variable to some extent, but usually at least partly diagnostic. The pale markings along the inner orbits of the female, is quite variable and in some case its usefulness when identifying species has been overestimated. However, used in combination with other characters such as sculpture, it may facilitate identification. The colour of the coxae is more variable and can range from entirely red to black in one species. The absence/presence of a white spot basally on the tibae is usually very useful and only a few smaller specimens may deviate from the general conception of the species, needing additional characters to be used for reliable identification.

Results

Xorides alpestris Habermehl, 1903

Xylonomus alpestris Habermehl, 1903: 224, holotype female and paratype male in SGN, examined.
Sichelia korotnevi Kokujev, 1927: 71, holotype male in ZIN, not examined.

Fig. 5F

Non type material examined
16♀♀, 35 ♂♂ (Sweden) (LW, NJ, UPSZ, MZLU, NHRS); 3♀♀ Norway (NTNU, NHM.UIO); 2♂♂, France (WP).

Diagnosis
Xorides alpestris is usually easily identified on the size, the female often more than 25 mm long (excluding the ovipositor) and the very slender first tergite, which is about three times as long as wide in the female (Fig. 5F) and four times as long as wide in the male in dorsal view. Specimens potentially parasitizing *Anastrangalia* Casey, 1924 in coniferous forests appear to be distinctly smaller. The body is black and lacks pale markings, but sometimes has rufous spots on the sides of the mesosoma. The legs are entirely red, apart from the hind tibia and tarsi, which are infuscate, the former with a whitish spot basally. The pubescence on the male flagellomeres is short, about 0.25 times the width of the flagellomere. *Xorides alpestris* is most likely to be confused with *Xorides rufipes* (Gravenhorst, 1829), but lacks the tooth on the fore trochantelli and has the dorsal part of the head more densely and distinctly punctate.

Ecology
Xorides alpestris is active from early June to early August, in one prolonged, or two generations. The species has been reared from *Necydalis major* (Linnaeus, 1758) (Šedivý 1958), but also from larvae of cerambycids living in dead wood of birch *Betula* sp. and black alder *Alnus glutinosa* (L.) Gaertn. The following hosts have been recorded from Poland: *Leptura quadrifasciata* Linnaeus, 1758 in hazel *Corylus avellana* L.; *Leptura aethiops* (Poda, 1761) in mountain ash *Sorbus aucuparia* L. and *Anastrangalia dubia* (Scopoli, 1763) in common fir *Abies alba* Mill. (Hilszczański 2002). Collected in numbers on high stumps of scots pine *Pinus sylvestris* L. infested by *Anastrangalia* sp. in a sandy open forest in Sweden and collected in window traps and observed on high stumps of aspen containing larvae of *N. major* (first author pers. obs.).

Distribution in Sweden
Widespread and not uncommon in the woodlands of Southern and Central Sweden: Hall, Sm, Ög, Vg, Gtl, Dlsl, Sdm, Upl, Dlr, Vstm, Jmt, Ång.

Distribution in Norway
A quite rare species in Norway with a few records from the southeastern part of the country: Ø, BØ and TEY. First reported from Norway by Riedel (2019).

Figure 5. A–D) *Xorides sapporensis* (Uchida, 1928), type female; – A) habitus lateral view; – B) pronotum, lateral view; – C) head, anterior view; – D) labels; – E) *Xorides praecatorius* (Fabricius, 1793), metasoma of female, lateral view; – F) *Xorides alpestris* (Habermehl, 1903), first tergite of female, dorsal view; – G) *Xorides rufipes* (Gravenhorst, 1829), fore trochanter and trochantellus. Photos: A–D: Namiki Kikuchi.

Figur 5. A–D) *Xorides sapporensis* (Uchida, 1928), typ hona; – A) habitus från sidan; – B) pronotum, från sidan; – C) huvud framifrån; – D) etiketter; – E) *Xorides praecatorius* (Fabricius, 1793), bakkropp hona, från sidan; – F) *Xorides alpestris* (Habermehl, 1903), första tergiten hos hona, ovanifrån; – G) *Xorides rufipes* (Gravenhorst, 1829), främre trochanter och trochantellus. Foton: A–D: Namiki Kikuchi.

Remarks
The eastern Palaearctic taxon *Xorides longicaudus* Sheng & Wen, 2008 is morphologically very similar to *X. alpestris*. High resolution pictures of the holotype of *X. longicaudus* have been studied and apart from the obvious differences in colour (*X. longicaudus* has the coxae all black and the hind tarsi white), *X. longicaudus* seem to have slightly longer ovipositor and the sculpture of the propodeum and mesoscutum appear to be slightly coarser. However, if possible, the status of the species in relation to *X. alpestris* should be the subject of integrative methods. Specimens of *X. alpestris* of different sizes and collected in various habitats, both deciduous and coniferous forests (presumably from different hosts) have been barcoded and the results show that they are conspecific (Fig. 4). *Xorides alpestris* is currently red listed in Finland as NT (Hyvärinen et al. 2019).

DNA barcode
The DNA sequences of six specimens of *Xorides alpestris* are stored in BOLD: NODIA611–22, NODIA639–22, NODIA640–22, NODIA641–22, NODIA642–22, NODIA643–22.

***Xorides ater* (Gravenhorst, 1829)**
Xylonomus ater Gravenhorst, 1829: 827, lectotype female in MNHW, examined.

Figs 3, 8B–C, 9A, 17A–B

Non type material examined
26♀♀, 21 ♂♂ Sweden (LW, NJ, UPSZ, NHRS, JH, MZLU); 2♂♂ Norway (NHM.UIO); 1♀ Poland (JH); 1♂ Finland (MZLU).

Diagnosis
As in *Xorides brachylabis* (Kriechbaumer, 1889) and *X. depressus*, which, together with *X. ater* form the subgenus *Rhadinopimpla* Schulz, 1911, the female lacks a white ring on the antennae and diagonal grooves on the sides of the first tergite. The weak or entirely absent dorsal carinae of the first tergite makes it appear relatively smooth. The body is entirely black and the legs mainly reddish yellow, with the hind tibia and tarsi infuscate without any basal white spot or ring. Occasionally the hind tibia can be more or less infuscate. The inner orbits have narrow white lines in both sexes (Figs 17A–B). In the female, the orbital line above the antennal incision is narrowed dorsally. The male is readily distinguished from other species by the short pubescence on the flagellomeres (Fig. 9A) in combination with the smooth first tergite, the black body and the black face with two short white stripes or spots along the inner orbits (Fig. 17B). The female is easily confused with *X. brachylabis* and traditionally the two species have been separated by the wider and longer white lines along the inner orbits in *X. brachylabis* (Kasparyan 1981, Kolarov 1997, Varga 2014) which indeed seem to be the case in most specimens. However, several studied females of *X. brachylabis* from northern localities have the white line strongly reduced, only present above the antennal incision, in this respect almost identical to the typical coloration of *X. ater*. In cases of doubt, the polished sculpture of the upper part temples and the slightly less swollen mid tibia in *X. ater* will support identification. Notably, *X. ater*, at least in specimens from Northern Europe (Fig. 3), never have any reddish marks on the temple or meso-/metapleuron as is often the case in *X. brachylabis*. Hedström (1988) mentions that there are (in the paper unspecified) differences in the sculpture of the mesoscutum and propodeum. However, there appear to be no reliable differences regarding those features in the here examined material.

Ecology
Known records from Sweden indicate that *Xorides ater* is active mainly during June and July and Shaw et al. (2021) conclude that the species is univoltine in the Swiss alps, where it only occurs above 980 m.a.s.l. with one generation active from late June to early August. The ecology of the species is partly unknown and there are no known authenticated rearing records available. It has been reared from a cocoon collected together with the remains of a lepturine larvae, possibly *Stictoleptura rubra* (Linnaeus, 1758), (Hilszczański 2002), which is a very common species in Scandinavia. Also observed in large numbers, including mating pairs, on logs of Norway spruce together with *Callidium aeneum* (De Geer, 1775), *C. coriaceum* (Paykull, 1800), and *C. violaceum* (Linnaeus, 1758), which were the only potential hosts of suitable size occuring at the locality (Shaw et al. 2021). While these latter observations hold no direct evidence of any host association, the Swedish records all comes from more or less pristine forests

where the otherwise quite rare and local *C. aeneum* and *C. coriaceum* are abundant, indicating that these indeed may be the main hosts.

Distribution in Sweden

Quite rare, with most records from Central Sweden. Only a few, primarily older records known from Southern Sweden: Sdm, Ög, Vg, Sö, Dlr, Vstm, Upl, Jmt, Hls, Vb, Åslp, Lylp.

Distribution in Norway

Probably a rare species in Norway. A few records known from the southeastern parts of the country: AK, BØ and TEI.

Remarks

The coloration of the hind coxa and femur is variable in this species, ranging from red to black as displayed by the two aberrations described by Hellén (1915),

Figure 6. A–E) *Xorides hilszczanskii* **sp. nov.;** – A) habitus of female holotype, lateral view; – B) central flagellomeres in male paratype; – C) head of female holotype, dorsal view; – D) head of female holotype, lateral view; – E) metasoma of female holotype, dorsolateral view; F–H) *Xorides indicatorius* (Latreille, 1806) female; – F) head, dorsal view; – G) head, lateral view; – H) metasoma, dorsolateral view.

Figur 6. A–E) *Xorides hilszczanskii* **sp. nov.**; – A) habitus av hona, holotyp, från sidan; – B) centrala antennleder hos hane, paratyp; – C) huvud hos hona, holotyp ovanifrån; – D) huvud hos hona, holotyp från sidan – E) bakkropp hos hona, holotyp, snett ovanifrån; F–H) *Xorides indicatorius* (Latreille, 1806) hona. – F) Huvud ovanifrån; – G) huvud från sidan; – H) bakkropp, snett ovanifrån.

Xorides ater nigripes and *X. ater nigrofemorata*. Red-listed in Finland as NT (Hyvärinen et al. 2019).

DNA barcode
The CO1 sequences of three specimens of *Xorides ater* are stored in BOLD: COLHH3300-21, COLHH3301-21, COLHH3302-21.

Xorides brachylabis Kriechbaumer, 1889

Xylonomus brachylabis Kriechbaumer, 1889: 75, male paralectotype in ZSM, examined.
Xylonomus sachalinensis Uchida, 1928: 20, female type in HUM, examined.

Figs 8A, 8D, 9E, 17C–D

Non type material examined
15♀♀, 7♂♂ Sweden (LW, NJ, UPSZ, JH, NHRS); 2♀♀, 1 ♂ Norway (NTNU, NHM.UIO); 1♂ France (WP); 4♀♀, 1♂ Poland (JH); 1♂ Finland (MZLU).

Diagnosis
As in the other members of the subgenus *Rhadinopimpla* Schulz, the antenna in the female lacks white ring, the first tergite lacks diagonal grooves laterally (Fig. 9E) and the dorsal carinae of the first tergite are weak, almost absent. The male is easily identified by the entirely whitish face (Fig. 17B), which is a unique feature in Northern European *Xorides*. Males frequently have a large red spot covering most of the temple. The female is very similar to *X. ater*, but usually has the white stripes along the inner obits more extensive (Fig. 17C), the mid and fore tibiae more strongly swollen (Fig. 8D) and the upper part of the temple with striate microsculpture (Fig. 8A). If the white lines along the inner orbits are reduced or absent below the antennal incisions, the upper part appear to be wider and not as distinctly narrowed dorsally as in *X. ater*. Studied specimens from Central and Southern Europe frequently have more abundant pale markings in the form of more extensive reddish markings and yellowish stripes on the mesoscutum.

Ecology
The species is active from early June to early August, in one prolonged, or two generations. *Xorides brachylabis* is associated with cerambycids of the genus *Tetropium* Kirby, 1837 and reared from cocoons found in larval galleries of *T. castaneum* (Linnaeus, 1758) on Norway spruce and scots pine *Pinus sylvestris* L. and from *T. gabrieli* Wiese, 1905 on larch *Larix* sp. (Kolarov 1997, Hilszczański 2002).

Distribution in Sweden
Quite rarely recorded despite the common hosts and most records comes from Central Sweden: Sdm, Vg, Ög, Vstm, Sö, Upl, Dlr, Vb, Lulp.

Distribution in Norway
New to Norway: Ø, Fredrikstad: Hankø, Bloksberg, Malaise trap June-Oct.-2019, 2♀♀, leg. F. Ødegaard. An older record (♂) also from BØ, Modum (NHM.UIO).

Remarks
Presented as new to Sweden by Hedström (1988), but since then recorded from most of Central and Northern Sweden. While the Fennoscandian specimens are quite uniform in shape and colouration, studied material from Central Europe is more variable in size and colour. We have studied several abnormally large specimens from continental Europe (JH), which indicate that other host genera than *Tetropium* are used. Red listed in Finland as VU (Hyvärinen et al. 2019).

DNA barcode
The DNA sequences of two female specimens of *Xorides brachylabis* are stored in BOLD: NODIA606-22, NODIA607-22.

Xorides depressus (Holmgren, 1860)

Xylonomus depressus Holmgren, 1860: 70, holotype female in NHRS, examined.
Rhadinopimpla baueri Clément, 1938: 563, female paratype in ZSM, temporarily (?) lost (Stefan Schmidt ZSM pers. comm.), paralectotype female in MNHN, examined.
Rhadinopimpla linearis Clément, 1938: 566, female paralectotype in ZSM and female lectotype in MNHW, examined.

Fig. 13A, 15A–D, 16A–C

Non type material examined
16♀♀, 15♂♂ Sweden (LW, NJ, NHRS); 4♀♀ Norway (NTNU, NHM.UIO), 1♀ Hungary (HNHW), 3♀♀, Poland (JH); 1♀ Italy (FDG).

Diagnosis

Xorides depressus is easily distinguished from other species of the genus in Europe by the absence of a white ring on the antennae and grooves laterally on the first tergite in combination with the partly red metasoma and the entirely black head.

Ecology

All evidence indicates that this species parasitizes *Nothorhina muricata* (Dalman, 1817) (Cerambycidae) (Šedivý 1958) and *Phaenops cyaneus* (Fabricius, 1775) (Herve 1937) (Buprestidae). During studies of *P. cyaneus* in Poland, rearing thousands of specimens of the buprestid, only two specimens of *X. depressus* were reared (Hilszczański 2002). During a study in Northern Sweden, where ichneumonids from areas with *Nothorhina* Redtenbacher, 1845 were compared to that of pristine forest areas lacking the species, *X. depressus* was only present in samples from areas with abundant populations of the cerambycid, and all

Figure 7. – A) *Xorides indicatorius* (Latreille, 1806) male, anterior part of mesoscutum, laterodorsal view; – B) *Xorides praecatorius* (Fabricius, 1793) male, anterior part of mesoscutum, laterodorsal view; – C) *Xorides indicatorius* male, second tergite, dorsal view; – D) *Xorides praecatorius* (Fabricius, 1793) male, second tergite, dorsal view.

Figur 7. – A) *Xorides indicatorius* (Latreille, 1806), hane, främre delen av mellankroppen snett ovanifrån; – B) *Xorides praecatorius* (Fabricius, 1793), främre delen av mellankroppen snett ovanifrån; – C) *Xorides indicatorius*, hane, andra tergiten ovanifrån – D) *Xorides praecatorius* (Fabricius, 1793) hane, andra tergiten ovanifrån.

but one of the specimens (n = 14) were collected in window traps mounted on scots pine with *Nothorhina* (Roger Mugerwa Pettersson in prep.). At several occasions collected in window traps on *Nothorhina* infested pines. Notably, several specimens of the *Phaenops* form (see below) were collected in recently burned forests. The relatively scarce records indicate that *X. depressus* is active in one generation from early June to July.

Distribution in Sweden
Quite rarely recorded in scots pine forest, but the records indicate a wide distribution, primarily in Central and Northern Sweden. Sk, Gtl, Öl, Ög, Vstm, Åslp, Upl, "Lpl". Pilp. No recent records from Sk, Ög or Öl. The type in NHRS was collected in Östergötland by Peter F. Wahlberg around 1850. The *Phaenops* form (see below): Sm, Ög, Upl.

Distribution in Norway
Scattered records (*Nothorhina* form, see below) from Southeastern and Northern Norway: VE, BØ, BV, TEY and NSI. First reported from Norway by Riedel et al. (2005).

Remarks
This taxon is still partly enigmatic as it seems to represent two quite distinct forms that may potentially represent two different taxa, one connected to the cerambycid *N. muricata* (“var. *linearis* Clément”) and the nominate form, which is reared from and potentially at least partly connected to the buprestid *Phaenops cyanea*. Though a couple of intermediate males have been studied, the *Nothorhina* form (specimens collected on *Nothorhina* infested pines) appear to have more slender flagellomeres, the hind coxae more slender and the metasoma more strongly compressed dorsoventrally (Figs 15A, 15C, 16B) and longer tergites. The species also occur in one additional “variety” with slender flagellomeres (as in var. *linearis*) and even more depressed metasoma, frequently partly deformed (Figs 13A, 16C), most likely due to having the cuticula still soft when exiting through the shallow galleries of the host. The *Nothorhina* form from Sweden and the form with the abnormally depressed metasoma are only weakly separated in the CO1 marker (Fig. 4) most likely indicating conspecificity. Notably, one sampled male from a burned forest (NODIA636) in Småland (Hultsfred) Sweden is more strongly deviating molecularly. However, though apperaring in a very typical *Phaenops* habitat (untypical of *Nothorhina*) the specimen is intermediate regarding morphology and cannot be assigned with certainty to either form based on the morphological characters that appear to be useful in separating females (Figs 15, 16). If further observations and molecular analysis (achieved by acquiring and sequencing fresh material of females of the *Phaenops* form) would support the existence of two valid species, the correct name for the *Nothorhina* form would be *Xorides linearis* (Clément, 1938), while the holotype of *X. depressus* in NHRS represents the stouter *Phaenops* form. Notably the species epithet *linearis* given by Clément was adopted from the label of the lectotype female in coll. Tschek in NHMW, unpublished at the time of the description. Apart from the more slender habitus indicated by the scientific name, studies of the holotype in NHMW and the paratype in ZSM shows that the pale colours used in the definition of *X. linearis* by the author are due to the specimen being newly hatched or chemically faded. With the kind help of Dr. Stefan Schmidt in ZSM, we have tried to locate the holotype of *Rhadinopimpla baueri* (Clément, 1938), but it seems to have been misplaced since it was studied by Horstmann (Horstmann 1983, 1992) (Stefan Schmidt ZSM pers. comm.). The other known specimen assigned to this species, the paratype in Paris mentioned by Clément (1938) was located with the kind help of Dr Bernardo Santos at the MNHN. The specimen is quite large, but in other respects conspecific with the type of *X. depressus* in NHRS. Red-listed in Sweden as NT and in Finland as EN (SLU Artdatabanken 2020, Hyvärinen et al. 2019).

Barcode
The DNA sequences of seven specimens of *Xorides depressus* is stored in BOLD: NODIA603-22, NODIA633-22, NODIA634-22 (females *Nothorhina* form). NODIA604-22, NODIA605-22, NODIA635-22 (females deformed *Nothorhina* form). NODIA636 (male *Phaenops* form?).

***Xorides filiformis* (Gravenhorst, 1829)**

Xylonomus filiformis Gravenhorst, 1829: 830, two female and 21 male syntypes in NMHW, examined.

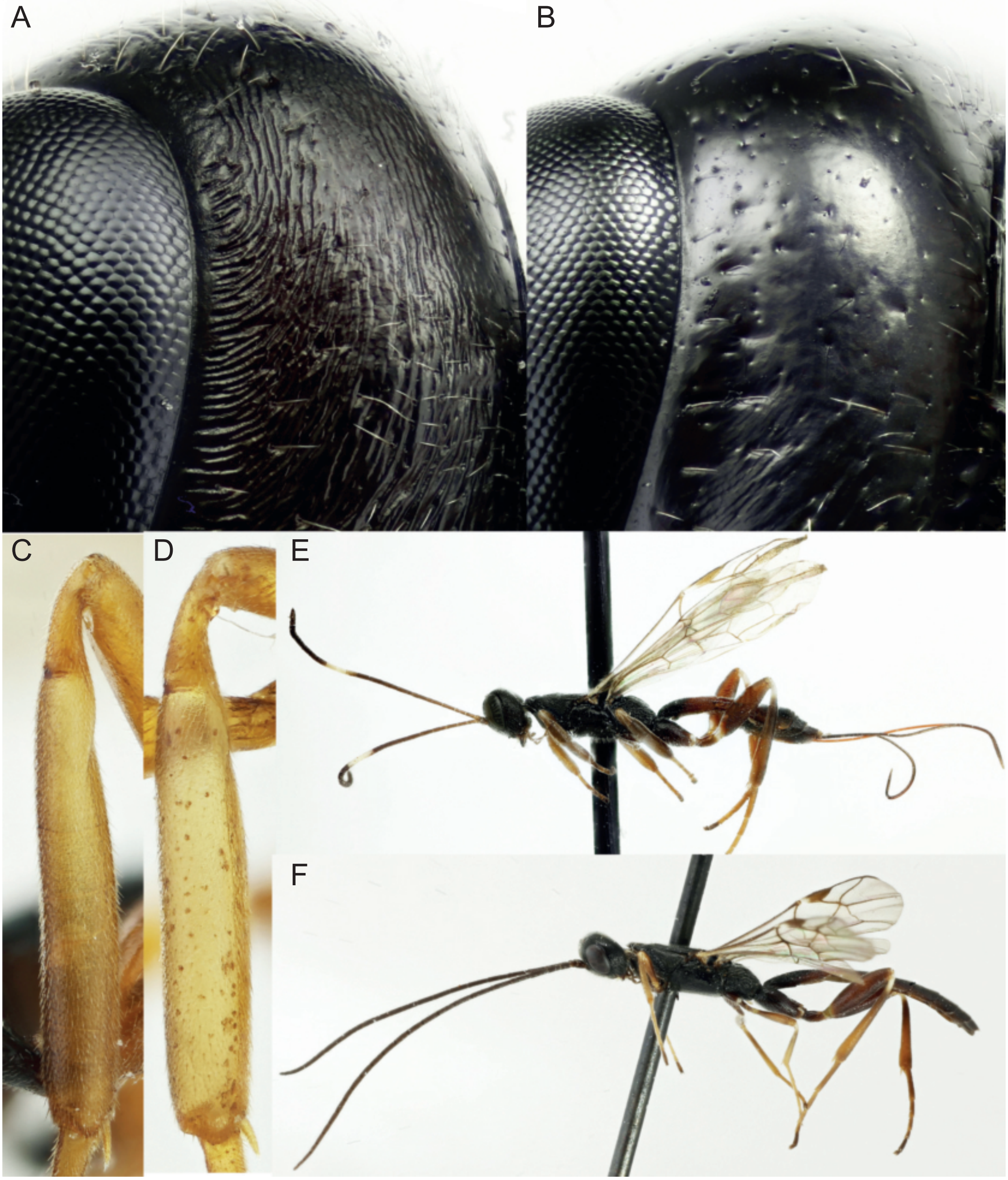

Figure 8. A–B) Upper part of temple in female, lateral view; – A) *Xorides brachylabis* (Kriechbaumer, 1889); – B) *Xorides ater* (Gravenhorst, 1829); C–D) mid tibia of female; – C) *Xorides ater*; – D) *Xorides brachylabis*; E–F) *Xorides gracilicornis* (Gravenhorst, 1829), habitus, lateral view; – E) female; – F) male.

Figur 8. A–B) Övre delen av tinningen på hona från sidan; – A) *Xorides brachylabis* (Kriechbaumer, 1889); – B) *Xorides ater* (Gravenhorst, 1829); C–D) mellanskenben hos hona; – C) *Xorides ater*; – D) *Xorides brachylabis*; E–F) *Xorides gracilicornis* (Gravenhorst, 1829), habitus, sidovy; – E) hona; – F) hane.

Xylonomus habermehli Kiss, 1926: 102 f, holotype female in HNHM, not examined.
Xylonomus obscuripes Kiss, 1926: 128 f, lectotype male in HNHM, not examined.

Figs 10A, 10C

Non type material examined
12♀♀, 14♂♂ Sweden (NJ, MZLU, NHRS); 2♀♀, 8♂♂ France (WP); 1♂ Norway (NTNU).

Diagnosis
With the usually entirely bright red metasoma and white spots basally on the hind tibia, one of the more characteristic species of the genus in Northern Europe. The hind tarsus in the male has a white ring. Potentially the species could be confused with paler specimens of *Xorides sepulchralis*, but distinguished by the smoother surface of the apical tergites (Figs 10A, 10C). Females and especially males frequently occur in a variety with the metasoma entirely black (var. *habermehli* Kiss).

Ecology
Xorides filiformis is active from early June to late August, in one prolonged, or two generations. Associated with cerambycids on oak *Quercus* sp., primarily *Phymatodes testaceus* (Linnaeus, 1758), but in Central Europe recorded also from other species of cerambycids connected to oak, among them *Plagionotus detritus* (Linnaeus, 1758).

Distribution in Sweden
Xorides filiformis is quite common in areas with oak in Southern Sweden: Sk, Bl, Öl, Hall, Sm, Sdm, Upl.

Distribution in Norway
Only known from Ø, VE and TEY. First reported from Norway by Riedel (2019).

Remarks
The varieties described by Kiss (1926) were revised and synonymized with *X. filiformis* by Horstmann (2009).

DNA barcode
The DNA sequences of one specimen of *Xorides filiformis* is stored in BOLD: NODIA627-22.

***Xorides fuligator* (Thunberg, 1824)**
Ichneumon fuligator Thunberg, 1824: 258, type female in UPSZ, examined
Xylonomus niger Pfeffer, 1913: 351 syn. nov., type in SMNS, lost?
Xylonomus bicolor Clement, 1938:535 paralectotype female in ZSM, examined

Figs 11C, 12B, 12D

Non type material examined
11♀♀, 4♂♂ Sweden (NJ, UPSZ, NHRS); 3♀♀, 1 ♂ Norway (NTNU, NHM.UIO); 1♂, 1♀ Poland (JH).

Diagnosis
A midsized species reminiscent of several other *Xorides* species, but distinguished by the combination of the absent white basal spots on the hind tibiae, the relatively narrow temples (Fig. 11C), (slightly more buccate in males) and the dorsally coriaceous hind coxae (Fig. 12D). The male has long pubescence on the flagellomeres (as in Fig. 9C). *Xorides fuligator* is most easily confused with *Xorides sordator* Thunberg stat rev. (*X. fuligator* by previous authors), but has the hind coxae distinctly coriaceous and the head wider in dorsal view (Fig. 11B, C). Usually the metasoma in both sexes is mainly infuscate, while the basal tergites in *X. sordator* are red. Males are similar to *X. gravenhorstii*, which have the hind coxae polished dorsally and the head more densely striate. The female is also similar to the common *Xorides irrigator*, but with the fore and mid tibiae less swollen (Fig. 12B).

Ecology
The few records of *Xorides fuligator* leave few clues to the period of activity in Sweden, which takes part somewhere from late May to late August. Associated with cerambycids on conifers. Most frequently reared from *Molorchus minor* (Linnaeus, 1758) on scots pine *Pinus sylvestris* and common fir *Abies alba*. One specimen was reared from a cocoon found in a larval gallery of *Acanthocinus griseus* (Fabricius, 1792) (Cerambycidae) on scots pine (Hilszczański 2002). Also reared from thin *Salix* sp. twig infested with cerambycids.

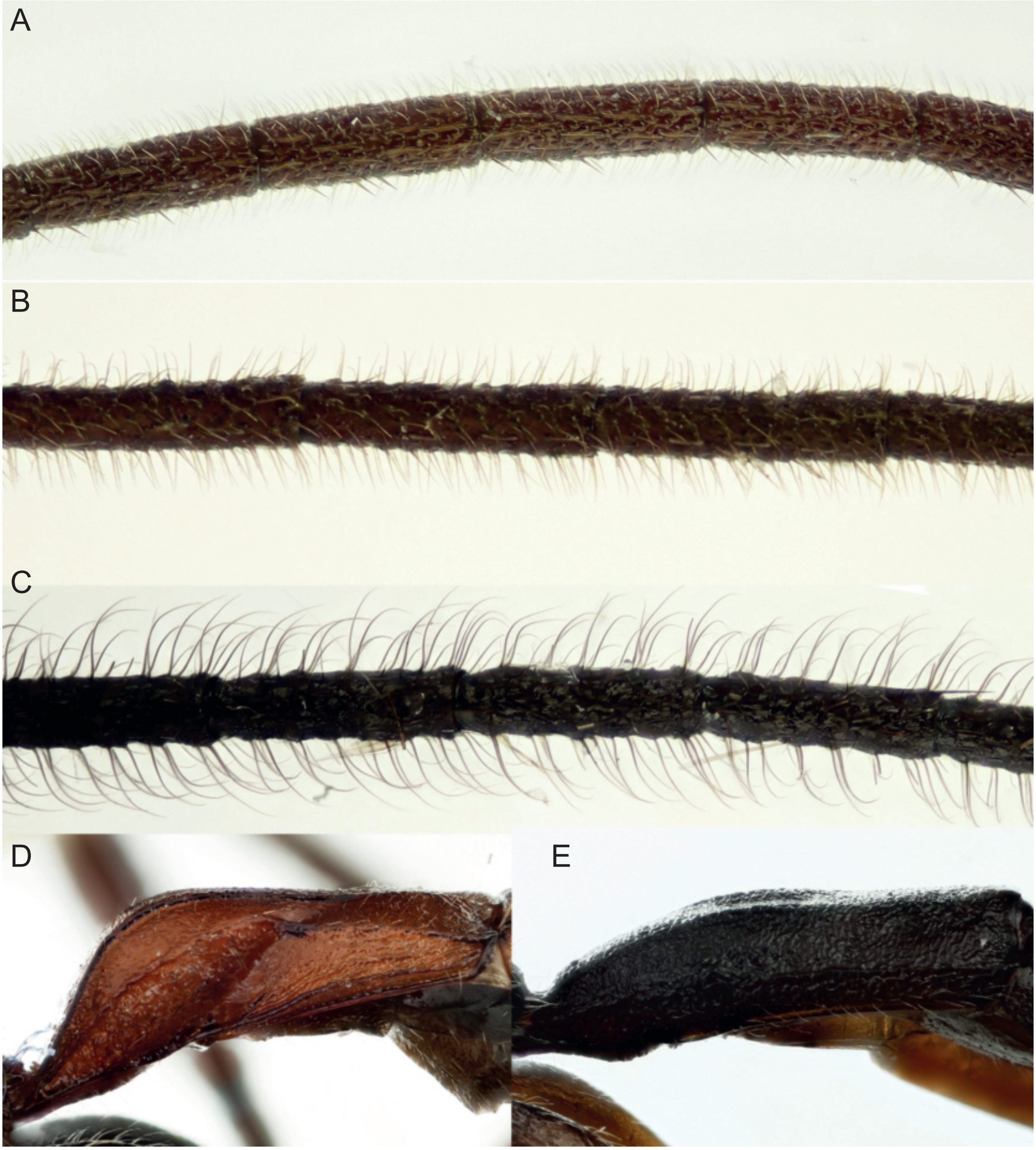

Figure 9. A–C) Central flagellomeres; – A) *Xorides ater* (Gravenhorst, 1829); – B) *Xorides irrigator* (Fabricius, 1793); – C) *Xorides sordator* (Thunberg, 1824); D–E) first tergite of female, lateral view; – D) *Xorides irrigator*; – E) *Xorides brachylabis* (Kriechbaumer, 1889).

Figur 9. A–C) Centrala antennleder; – A) *Xorides ater* (Gravenhorst, 1829); – B) *Xorides irrigator* (Fabricius, 1793); – C) *Xorides sordator* (Thunberg, 1824); D–E) *Första tergiten hos hona från sidan*; – D) *Xorides irrigator*; – E) *Xorides brachylabis* (Kriechbaumer, 1889).

Distribution in Sweden
Widely distributed, but obviously quite rare. There are a couple of males and females in the collections of Gyllenhaal and Märklin in UPSZ, which probably originate from Västergötland (Vg). Several specimens collected during the second half of the 19th century in Sdm, Ög, Vg and Upl. A couple of recent records from pristine coniferous forests in Sm and Vb.

Distribution in Norway
A rare species with a few records known from the southeastern part of the country: Ø, AK and BØ. First reported from Norway by Riedel et al. (2000).

Remarks
The type of *Xorides niger* Pfeffer, 1913, should be housed in the SMNS (Clément 1938, p. 535), but could not be located (Patricia Peters SMNS pers. comm.) and the here presented interpretation relies on the description by Clément (1938, p. 530) who studied and redescribed the type in detail. Notably, the single female type of *X. fuligator* in the Thunberg collection in UPSZ, studied and synonymized with *X. pilicornis* Gravenhorst, 1829 by Roman (1912), represents the species commonly treated under the name *X. niger*, and accordingly *Xorides niger* (Pfeffer, 1913) syn. nov. is to be regarded as a junior synonym of *X. fuligator* (Thunberg, 1824). This also means that the correct name for the species previously known as *Xorides fuligator* is *Xorides sordator* stat. rev. (male holotype in UPSZ examined). Recorded as potentially Swedish by Hedström (1988) based on specimens in UPSZ in the Gyllenhaal and Märklin collections. However, there are also several specimens (5 females and 3 males) from the second half of the 19th century, together with two newer males of *Xorides sordator* under the label "*X. fuligator*" in NHRS, possibly indicating that the species was correctly interpreted before the study by Roman. Red-listed in Sweden as NT and in Finland as RE (as *X. niger*) (Artdatabanken 2020, Hyvärinen et al. 2019).

DNA barcode
The DNA sequences of three specimens of *Xorides fuligator* are stored in BOLD: NODIA612-22, NODIA613-22, NODIA645-22.

***Xorides gravenhorstii* (Curtis, 1831)**

Xylonomus gravenhorstii, Curtis, 1831, vol. 3: 353, type female in NMV, examined.
Xylonomus securicornis Holmgren, 1860, type female in NHRS, examined.
Xylonomus glyptus Thomson, 1877: 776, lectotype male in MZLU, examined.
Xylonomus clavicornis Kriechbaumer, 1879: 167–169, lectotype female in ZSM, not examined.
Xylonomus distinguendus Magretti, 1884: 111, type lost?
Sichelia hungaricus Szepligeti, 1899: 20, type lost? (see Clément 1938 p. 559).
Xylonomus seticornis Strobl, 1902: 45f, holotype in CSA (?), not examined.
Xylonomus rufoscutellata Habermehl, 1918: 8, lost? (Not in SMNS).
Xylonomus kokujevi Meyer, 1922: 137, type female in ZIN, not examined.
Xylonomus caucasicus (Shestakov, 1925: 11), type female in ZIN, not examined.
Xorides romani Clement, 1938: 535, holotype female in NHRS, examined.

Figs 11D, 13B–C, 14D

Non type material examined
5♀♀, 3♂♂ Sweden (NJ, SMTP, NHRS); 6♀♀, 8♂♂ France (WP); 1♀, 1♂ Poland (JH); 7♀♀, 6♂♂ Norway (NTNU, NHM.UIO).

Diagnosis
The clavate antennae (Fig. 13C) and the dorsally striate head of the female (Fig. 11D) are unique features among Fennoscandian *Xorides* (but see *X. csikii*). The female has the metasoma entirely red, at most the posterior tergites weakly infuscate, which is a feature shared only with *Xorides filiformis* among Northern European *Xorides*. Potentially confused with *X. csikii* Clément, 1938 (Fig. 14A) in which the female also has the antennae distinctly clavate, but usually larger, having the metasoma more elongate, lacking the infuscate first tergite typical of *X. csikii* (Fig. 14B) and having the flagellomeres more slender (Fig. 14D). The male of *X. gravenhorstii* is identified by the dorsally striate head (as in Fig. 11D) in combination with the long pubescence on the flagellomeres (as in Fig. 8C). Usually the male has two arcuate grooves centrally on the second tergite (Fig. 13B), which

Figure 10. A–B) Fourth and fifth tergite of male, dorsal view; – A) *Xorides filiformis* (Gravenhorst, 1829); – B) *Xorides sepulchralis* (Holmgren, 1860); C–D) apical part of first and second tergite in female; – C) *Xorides filiformis*; – D) *Xorides sepulchralis*.

Figur 10. A–B) Fjärde och femte tergiten hos hane ovanifrån; – A) *Xorides filiformis* (Gravenhorst, 1829); – B) *Xorides sepulchralis* (Holmgren, 1860); C–D) bakre delen av första tergiten och andra tergiten hos hona, snett ovanifrån; – C) *Xorides filiformis*; – D) *Xorides sepulchralis*.

may be vague or absent in dwarf specimens. The male is most similar to the male of *X. csikii*, which has short pubescence on the flagellomeres. The male is also potentially confused with small specimens of *X. sordator* stat. rev., which also have the flagellomeres with very long pubescence, but the dorsal sculpture and proportions of the head separates the two species (Fig. 11B, D). Note that specimens from Central and Southern Europe occasionally have the mesosoma partly or almost entirely red.

Ecology

The period of activity appear to be June and July based on the few known specimens. *Xorides gravenhorstii* has been reared from the cerambycid *Molorchus umbellatarum* (Schreber, 1759) on apple *Malus* sp. Also reared from Elm *Ulmus* sp. infested with *Magdalis* sp. (Curculionidae) and *Scolytus multistriatus* (Marsham, 1802) (Scolytinae), but without any indication of host (Hilszczański, 2002). Also reared from *Pogonocherus hispidulus* (Piller & Mitterpacher, 1783) on *Prunus* sp. twigs and from *Xylotrechus antilope* (Schönherr, 1817) on oak branches.

Distribution in Sweden

Rare, only a few records from Southern and Central Sweden: Sk, Sm, Öl, Sdm, Upl.

Distribution in Norway

A few records known from southern and western parts of Norway: Ø, AK, BØ, BV, TEY and SFI. First reported from Norway by Riedel et al. (2000).

Remarks

Notably the barcoded specimens of this species in the BOLD database forms three distinct clades representing three rather distinct haplotypes. One from Corsica, not studied here, and two occuring at least in Northern and Central Europe. A number of barcoded specimens housed in the ZFMK from Germany, Rhineland Palatinate and one male in NHM.UIO form a clade separated from other specimens from the same region. The Norwegian male in NHM.UIO from Sogn og Fjordane, Luster, Solvorn, was collected together with another male and three females from the same locality. Our examination was unable to find any reliable morphological distinguishing characters to distinguish these haplotypes and they are here treated as conspecific, although they may very well reflect the existence of three different host-races. Only a few of the numerous types synonymized with this species have been examined in this study as most of the original descriptions clearly emphasize the clavate antennae of the female and/or the partially or almost entirely red mesosoma frequently occurring in specimens from Southern Europe (*X. romani, X. caucasicus, X. kokujevi, X. rufoscutellata, X. seticornis, X. clavicornis*). *Xorides gravenhorstii* is Red-listed in Finland as VU (Hyvärinen et al. 2019).

DNA barcode

The DNA sequences of one specimen of *Xorides gravenhorstii* is stored in BOLD: NODIA609–22. The specimen from NHM.UIO has the BOLD id: NOPRA1746–19. The specimens from ZFMK have the BOLD ids: GMGMB683–14; GMGMJ1410–14; GMGMM1099–14; GMGMI1414–14; GMGMI1362–14; GMGMM482–14; GMGMI639–14; GMGMB1399–14; GMGMB1391–14; GMGMH899–14; GMGMN1513–14.

Xorides hilszczanskii Johansson sp. nov.

Zoobank species id: urn:lsid:zoobank.org:act:74F00504–0396–46D5-BC63-A11687C25D56

Figs 6A–E

Type material 9♀♀, 4♂♂

Holotype

Poland: 1♀, Sękocin Stary dist. Pruszków, 7 May 2000.

Paratypes

Poland: 1♂, 2 May 1996; 5♀♀ 1♂ 6–7 May 2000; 3♀♀ 2♂♂ 20–22 April 2001, same locality as holotype.

Additional material

Germany: 1♂ "Hessen" ZMHB.

The holotype and one male paratype is housed in NHRS, one paratype in NMS and remaining paratypes in JH.

Etymology

The name *hilszczanskii* (masculine name in genitive case) is in honour of the Polish hymenopterist and forest ecologist Jacek Hilszczański for his contribution to the systematics of Xoridinae.

Diagnosis

The female of *Xorides hilszczanskii* sp. nov. is distinguished from other species of *Xorides* primarily with the white marked 4th and 5th tergite in combination with the wide temples. It is most similar to *Xorides indicatorius* var. *quadrimaculatus* (= *X. berlandi* Clément) but has wider temples and lacks white markings on the head. The male is harder to characterize and is primarily confused with larger males of *Xorides praecatorius* and males of *Xorides indicatorius*, but distinguished by the shorter pubescence on the flagellomeres and the wider temples.

Description

Fore wing length 7–9 mm. Female with 19–21 flagellomeres, male with 23–24. First to fourth flagellomere about 4.5 times as long as wide in female, 4.0 times in males. Central flagellomeres stout, about 1.5–1.7 times as long as wide in female, 2.5 times in male. Subapical part of antennae in female filiform with peg-like setae on the subapical flagellomeres. Subapical flagellomeres in male about 2.0 times as long as wide. Flagellomere in male with short dense pubescence, which is about 0.5 times as long as the width of the flagellomere (Fig 6B). Temple strongly buccate in dorsal view, with the lower part striate and the upper part polished with weak punctures (Figs 6C–D). Temple in lateral view centrally about as wide as compound eye (Fig. 6D). Frons about two times as wide as compound eye in anterior view. Lower part of frons with irregular punctures

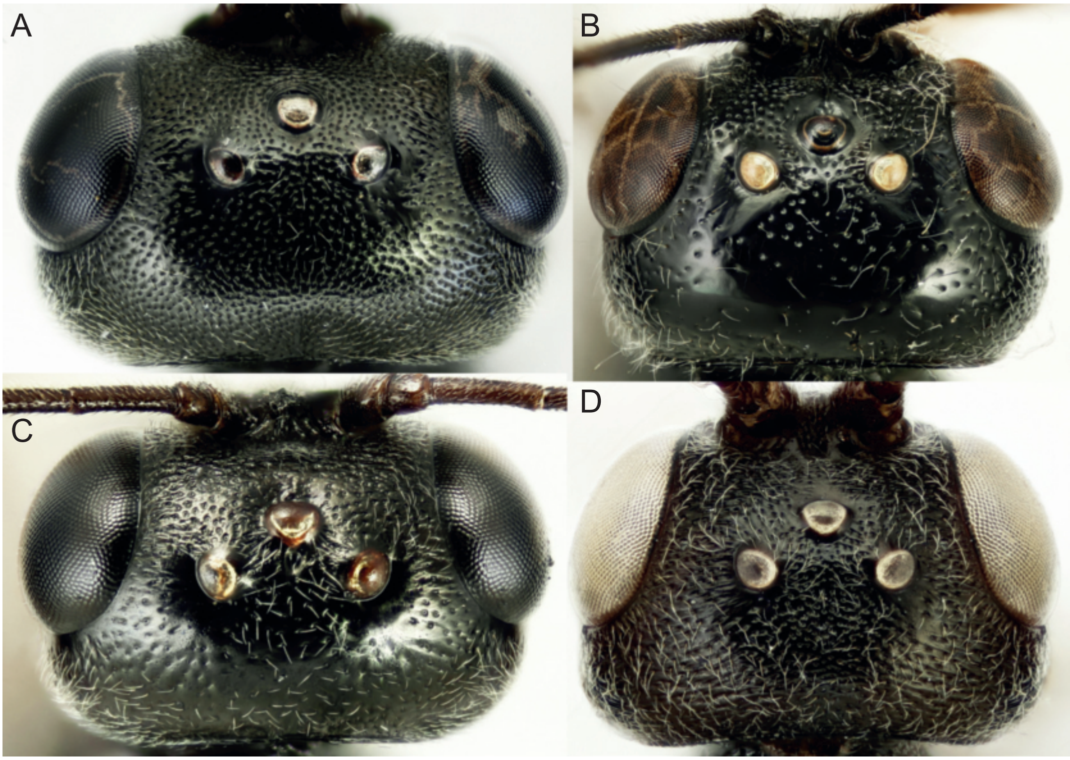

Figure 11. A–D) Head of female in dorsal view; – A) *Xorides irrigator* (Fabricius, 1793); – B) *Xorides sordator* (Thunberg, 1824); – C) *Xorides fuligator* (Thunberg, 1824); – D) *Xorides gravenhorstii* (Curtis, 1831).

Figur 11. A–D) Huvud av hona ovanifrån; – A) *Xorides irrigator* (Fabricius, 1793); – B) *Xorides sordator* (Thunberg, 1824); – C) *Xorides fuligator* (Thunberg, 1824); – D) *Xorides gravenhorstii* (Curtis, 1831).

on a weakly shagreened background, centrally with weak transverse striation. Upper part of frons polished with rather dense punctures, the diameter between punctures about equal to their diameter. Face rugulose, laterally with transverse striation. Head dorsally polished with rather indistinct scarce punctures, the interstices between punctures about two to three times their diameter (Fig. 6C). Inner orbits parallel. Mandible unidentate, chisel-shaped. Malar space long, about equal to the mandibular base. Occipital carina indistinct. Sides of pronotum polished with irregular punctures, the interstices between punctures about equal to their diameter. Mesosternum and mesopleuron polished with quite dense and clearly discernible punctures, slightly denser and larger ventrally. Metapleuron rugulose. Mesoscutum polished with dense irregular punctures, centrally in posterior part transversely strigose. Notauli deeply impressed, weakly crenulate, dividing the mesoscutum into three lobes. Scutellum polished with very dense punctures, which makes the posterior part appear almost rugulose. Propodeum polished with strong irregularly reticulate sculpture with all the carinae, including costulae, strong. Submetapleural carinae complete. First sternite fused with the first tergite for about 0.3–0.4 of its length, in female about 1.5 times as long as wide, in male about two times as long as wide in dorsal view. The dorsal lateral carinae of the first tergite strong in both sexes. First tergite laterally with distinct diagonal groove. Scultpure of the tergites 1–3 rugulose, remaining tergites gradually becoming smoother, in female with weak transverse microsculpture (Fig. 6E). Ovipositor of female about 0.6 times the length of metasoma (Fig. 6A). Fore and mid tibiae of female moderately swollen, the latter about four times as long as wide with a ventral groove basally.

Colouration

Body black or dark brownish (Fig. 6A). Female with lateral white spots on the fourth and fifth tergite. Metasoma in male without spots. Legs red. Fore and mid coxae infuscate in female, almost black in males. Trochanter and trochantelli infuscate. All tibiae with distinct white basal ring. Hind tibiae and tarsi infuscate. Fifth segment of fore and mid tarsi infuscate. Scapus and antennae dark brown, in female with segments 9–12 partially or entirely white. Wing membrane clear. Wing veins dark brown. Pterostigma dark brownish with the basal 0.2 white.

Ecology

Reared from the cerambycid *Saperda perforata* (Pallas, 1773) which is associated with aspen *Populus tremula* L. All type specimens have been collected as pupae in cocoons found under the bark in larval galleries of the host. Adults are most probably active from the second half of May.

Remarks

This species has initially been confused with and treated as a variety of *Xorides indicatorius* (Hilszczański 2002). The male *Xorides* from Hessen in ZMHB mentioned by Clément (1938 p. 534) as *Xorides* cf. *indicatorius* has been studied and is a male of the species here described.

***Xorides indicatorius* (Latreille, 1806)**

Ichneumon indicatorius Latreille, 1806, Plate XII, Fig 3. type lost.

Xorides ferrugatus (Gravenhorst, 1829: 840, two female syntypes in MNHW, examined.

Xorides berlandi Clément, 1938: 532 syn. nov., holotype male in MNHN, examined.

Xorides quadrimaculatus Clément, 1938: 534, type in ZSM not possible to locate (Stefan Schmidt ZSM pers. comm.).

Xorides cinnabarinus Sheng & Hilszczański, 2009, syn. nov., paratype males and females in JH, examined.

Xorides asiasius Sheng & Hilszczański, 2009 syn. nov. holotype female in GSFPM, examined.

Figs 6F–H, 7A, 7C

Non type material examined

6♀♀ Sweden (NJ); 1♀, Greece (JH); 3♂♂, France (WP).

Diagnosis

The female is easily identified by the partially red metasoma with white spots on the tergites 4–5 (var. *quadrimaculatus*) or 4–6 (Fig. 6H). The inner and outer orbits in both sexes usually have white markings (Fig. 6G). The male is similar to larger males of *Xorides praecatorius* in having the metasoma black and the hind tibiae with a whitish ring basally, but usually have vague white spots laterally on the 4th and 5th tergite and the outer orbits with a large white spot. If the white markings are absent, the morphological delimitation towards the male of *X. praecatorius* becomes more difficult. All three studied males of *X. indicatorius* have the antennal incision at the middle of the relatively short white line along the inner orbit while studied males of *X. praecatorius* have the orbital markings of different constitution. Furthermore, the male of *X. indicatorius* have the sculpture of the mesoscutum and the second tergite more strongly rugulose (Figs 7A, 7C) and the pubescence of the flagellomeres longer and less regular. The male of *X. indicatorius* is also easily confused with *Xorides hilszczanskii* sp. nov. but distinguished by the narrower temples (Fig. 6F) and the usually typical coloration.

Ecology

A rare species for which the hosts in Europe are still unknown. However, several observations have been made in Sweden from high stumps of Birch *Betula* sp. On one occasion the rare cerambycid *Aegomorphus clavipes* (Schranck, 1781) which is

Figure 12. A–B) Fore and mid tibia of female, anterior view; – A) *Xorides irrigator* (Fabricius, 1793); – B) *Xorides fuligator* (Thunberg, 1824); C–D) hind coxa of female, dorsal view; – C) *Xorides sordator* (Thunberg, 1824); – D) *Xorides fuligator*.

Figur 12. A–B) Fram- och mellanskenben framifrån – A) *Xorides irrigator* (Fabricius, 1793); – B) *Xorides fuligator* (Thunberg, 1824); C–D) ovansidan av bakhöften; – C) *Xorides sordator* (Thunberg, 1824); – D) *Xorides fuligator*.

common at the locality, was observed at the same trunk as one female and one presumed male of *X. indicatorius*. Reputedly reared from *Saperda perforata* (Hilszczański 2002), but these records refer to the here described *Xorides hilszczanskii* sp. nov. Sheng & Hilszczański (2009) refer to rearings in China from *Asias halodendri* (Pallas, 1776) on hawthorn and *Saperda balsamifera* Motschulsky, 1860 on silver poplar.

Distribution in Sweden
Rare, only a few recent records from the southern and central parts of the country: Sm, Vstm, Ög. Older records (NHRS) from Ög and Vg (?).

Remarks
The apparent rarity of this species, in combination with the partly variable coloration has led to several different interpretations. Clément (1938) concluded that it is an extremely rare species and described the closely related and very similar *Xorides berlandi* Clément, 1938, as well as a variety of *X. indicatorius*, var. *quadrimaculatus*, with the posterior pair of the white spots on the abdomen absent. Study of the male holotype of *X. berlandi* syn. nov. in MNHN as well as a female of *X. indicatorius* var. *quadrimaculatus* from Greece (JH) shows that they represent specimens of *X. indicatorius* with slightly aberrant coloration. The absence of setae (which is a generic characteristic) on the apical flagellomeres of the female of *Xorides berlandi*, which is mentioned in the description, is most likely due to wearing. The female paratype in NHMW could not be located (Dominique Zimmerman pers. comm.). While males are so rarely collected that any comment regarding the variation in colour cannot be made at present, females seem to occur in two main varieties in the Western Palaearctic, both mentioned already by Gravenhorst (1829). One with the hind coxa dorsally red and the third tergite and second mostly infuscate, and the nominate form with the hind coxae mostly black and the third tergite red (Latreille 1806). Sheng & Hilszczański (2009) described two species belonging to the *X. indicatorius* group of species from Northern China. Unfortunately these descriptions were based on an erroneous perception of *Xorides indicatorius* (see remarks under *X. hilszczanskii* Johansson sp. nov.) and did not account for the variation in colour present in this species. Examination of the types show that *Xorides cinnabarinus* Sheng & Hilszczański, 2009, represents a form with the propodeum and parts of mesopleuron and propleuron reddish (as common in several other species of Palaearctic *Xorides*). Therefore, *Xorides cinnabarinus* Sheng & Hilszczański 2009 syn. nov. is a junior synonym of *Xorides indicatorius* (Latreille, 1806). The other species, *X. asiasius* Sheng & Hilszczański 2009, is identical to the nominate form, and therefore *Xorides asiasius* Sheng & Hilszczański 2009 syn. nov. is also a synonym of *X. indicatorius*. *Xorides hedwigi* Clément, 1938 is a continental species similar to and possibly closely related to *X. indicatorius*. The holotype male and one paratype female of *X. hedwigi* housed in ZMHB have been studied. Notably, the paratypes reputedly housed in ZSM and NMHW (Clément, 1938) could not be located. The study of the available types of *X. hedwigi* (http://coll.mfn-berlin.de_u_c06c63 and coll.mfn-berlin.de_u_84c91e) and European material stored in JH and the type of *X. sapporensis* (Uchida, 1928) (type in HUM, Fig. 5A–D, examined) show that the two taxa are conspecific. Therefore, *Xorides hedwigi* syn. nov. is a junior synonym of *X. sapporensis*. *Xorides indicatorius* is red-listed in Sweden as NT, in Finland as VU (Hyvärinen et al. 2019).

DNA barcode
The DNA sequences of one female specimen of *Xorides indicatorius* is stored in BOLD: NODIA637-22.

***Xorides irrigator* Fabricius, 1793**
Ichneumon irrigator Fabricius, 1793: 152, female lectotype in ZMUC, examined.
Xylonomus planus Šedivý, 1958 (ambigous synonym).

Figs 9B, 9D, 11A, 12A

Non type material examined
65♀♀, 34♂♂ Sweden (NJ, UPSZ, LW, MZLU, NHRS); 11♀♀, 5♂♂ Norway (NTNU, NHM.UIO); 2♀♀, France (WP).

Diagnosis
Xorides irrigator is very variable in body size, most likely as a result of a wide range of hosts. The species is quite easily identified by the strongly swollen fore and mid tibia in the female (Fig. 12A) in combination

with the diagonal groove laterally on the first tergite (Fig. 9D), the lack of basal white spots on the hind tibia and the, in dorsal view, densely and regularly punctate head (Fig. 11A). The male may be trickier to identify, but has similar head-characteristics as the female, the head entirely black and the antennae with quite short pubescence, which is about as long as the width of the flagellomere (Fig. 9B), distinguishing it from the similar *X. fuligator* and *X. sordator*, which have very long antennal pubescence (as in Fig. 9C). Probably most likely to be confused with *Xorides fuligator*, but with more strongly swollen fore and mid legs in the female, the head wider and more densely punctate in dorsal view and the male with shorter pubescence on the flagellomeres.

Ecology

An inhabitant of coniferous forests, mainly dominated by scots pine. Reared as a parasitoid of *Rhagium inquisitor* Linnaeus, 1758 and *Tetropium castaneum*

Figure 13. A) *Xorides depressus* (Holmgren, 1860), female habitus in lateral view; – B) *Xorides gravenhorstii* (Curtis, 1831), first and second tergite of male in dorsal view; – C) *Xorides gravenhorstii*, apical flagellomeres of female.

Figur 13. A) *Xorides depressus*, hona från sidan; – B) *Xorides gravenhorstii* (Curtis, 1831), första och andra tergiten hos hanen ovanifrån; – C) *Xorides gravenhorstii*, yttre antennleder hos hona.

(Linnaeus, 1758) on scots pine and *Obrium brunneum* (Fabricius, 1793) on common fir (Hilszczański 2002). Also reared from *Acanthocinus griseus* (Fabricius, 1792) on scots pine in Finland (Martikainen 2002).

Distribution in Sweden
Quite common in coniferous and mixed forests all over the country: Sk, Bl, Sm, Öl, Gtl, Gstr, Hall, Ög, Vg, Vstm, Sdm, Upl, Vrm, Dlr, Hls, Vb, Åslp.

Distribution in Norway
Probably quite common in southestern part of the country. Known from AK, BØ, BV, TEY and TEI. First reported from Norway by Riedel et al (2000).

Remarks
One barcoded specimen (NODIA610–22) deviates genetically, but appear to be morphologically identical, possibly indicating some kind of distortion in the sequencing or incomplete sampling. Red-listed in Finland as VU (Hyvärinen et al. 2019).

DNA barcode
The DNA sequences of four female specimens of *Xorides irrigator* are stored in BOLD: NODIA610–22, NODIA628–22, NODIA629–22, NODIA630–22.

***Xorides praecatorius* (Fabricius, 1793)**
Ichneumon praecatorius Fabricius, 1793: 139, female lectotype in ZMUC, examined.
Ichneumon articulatus Geoffroy, 1785: 408, type lost. Nomen oblitum (see Horstmann 2001: 32).
Ichneumon falsatorius Olivier, 1792: 169, type lost. Nomen oblitum (see Horstmann 2001: 32).
Xylonomus parvulus Gravenhorst, 1829: 825f, five syntype males in MNHW, examined.
Xylonomus precatorius Marshall, 1872. emendation for *praecatorius*.
Xylonomus funebris Kiss, 1929: 128 syn. nov., holotype female in HNHM, examined.
Xorides rufopictus Kiss, 1926: 106, holotype male in HNHM, examined.
Xylonomus ruficoxis Kiss, 1929: 129, lectotype male in HNHM, examined.
Xylonomus temporalis Kiss, 1929: 129, lectotype male in HNHM, examined.
Xorides minutus Clément, 1938: 534f, holotype female in MNHN and paralectotype male in ZSM, examined.
Xorides holsaticus Heinrich, 1951, holotype female in USUC, examined.

Figs 5E, 7B, 7D

Non type material examined
34♀♀, 38♂♂ Sweden (NJ, UPSZ, LW, MZLU, NHRS); 11♀♀, 22♂♂ France (WP); 1♂ Poland (JH); 11♀♀, 2♂♂ Norway (NTNU, NHM.UIO); 1♂ Hungary (JH); Turkey 1♂ (JH); 1♀ Denmark (NTNU).

Diagnosis
The female is easily indentified by the whitish markings on the metasoma (Fig. 5E) and usually also the numerous white and reddish markings on the mesosoma. The male is harder to characterize, but usually has white spots or lines along the inner orbits and the hind tibiae with white bases. The male may be confused with the male of the here described *Xorides hilszczanskii*, but has the temples narrower. The male is also potentially confused with small males of *Xorides indicatorius*, which lack a white spot along the outer orbits. The male of *X. praecatorius* always have at spot or line along the inner orbits reaching distinctly below the antennal scrobes while *X. indicatorius* have most of the line over the antennal incision. Furthermore, the male of *X. praecatorius* have the sculpture of the mesoscutum and the second tergite less strongly rugulose (Fig. 7A–D) and the pubescence of the flagellomeres shorter and more regular.

Ecology
Active from early June to late August. Recorded from a number of different hosts and tree species, most likely explaining the variation in size and coloration. Reared from the following cerambycid species: *Phymatodes testaceus*, *P. alni* (Linnaeus, 1767), *Anaesthetis testacea* (Fabricius, 1781) and *P. pusillus* (Fabricius, 1787) on oak *Quercus* sp.; *Leiopus nebulosus* (Linnaeus, 1758) on oak and alder; *Obrium cantharinum* (Linnaeus, 1767) on aspen; *Leioderes kollari* Redtenbacher, 1849 on sycamore *Acer pseudoplatanus* and the buprestid *Agrilus viridis* (Linnaeus, 1758) on willow *Salix* sp.

Figure 14. A–C) *Xorides csikii* (Clément, 1938), female; – A) habitus, lateral view; – B) first and second tergite, dorsal view; – C) basal flagellomeres; – D) *Xorides gravenhorstii* (Curtis, 1831), basal flagellomeres of female.

Figur 14. A–C) *Xorides csikii* (Clément, 1938), female; – A) habitus från sidan; – B) första och andra tergiten ovanifrån; – C) basala antennleder; – D) *Xorides gravenhorstii* (Curtis, 1831), basala antennleder hos hona.

Also reared from *Molorchus minor* (Linnaeus, 1758) on Norway spruce.

Distribution in Sweden
A quite common species occurring primarily in Southern and Central Sweden: Sk, Bl, Öl, Hall, Sm, Ög, Vg, Vstm, Sdm, Upl.

Distribution in Norway
New to Norway and known from AK, BØ, VE, TEY, VAY. The new records: AK, Oslo, Hovedøya, Malaise trap June-Oct. 2006, 1♀, 1♂,leg. A. Endrestøl & S. Olberg; BØ, Øvre Eiker: Lilleby, Malaise trap June-Sept. 2021, 6 ♀♀, leg. F. Ødegaard; TEY, Skien, Kilebygd, Bolvik Malaise trap Aug-Oct. 2017, 1♀, leg. F. Ødegaard; Drangedal, Lillehøydalen, Malaise trap June-Aug. 2018, leg. F. Ødegaard; Sannes, Malaise trap Aug.-Sept.-2021, 1♀, leg. F. Ødegaard, Liaråsen, Malaise trap Aug.-Sept.-2021, 1♀, leg. F. Ødegaard; Hurum, Ramvikholmen, Malaise trap June-July 2010, 1♀, leg. L.O. Hansen; Mølen, Malaise trap July-Aug. 2010, 1♂, leg. L.O. Hansen; VE, Borre, Veggefjellet, Malaise trap July 1997, 1♀, leg. L.O. Hansen; VAY, Kristiansand, Nedre Timenes, light trap July 2002, 1♀, leg. K. Berggren.

Remarks
The varieties described by Kiss were revised and synonymized with *X. praecatorius* by Horstmann (2009) and synonymy between *X. praecatorius* and *X. parvulus* (Gravenhorst, 1829) was established by Clément (1938, p. 535). Apparently the three forms, the smaller *Xorides minutus* with its more polished frons, the darker *X. parvulus* (*X. holsaticus* Heinrich) and the nominate form are genetically identical in the COI marker according to the barcoding effort and they obviously all represent size and colour forms of the same species. The barcoded specimens belonging to the different non-nominate forms are referred to as "*praecatorius parv*." and "*praecatorius min*." in Fig. 4. *Xorides minutus*, which here is considered to be a synonym of *X. praecatorius* was recorded as new to Sweden and Fennscandia by Jussila et al. (2003). *Xorides praecatorius* is red-listed in Finland as VU (Hyvärinen et al. 2019).

DNA barcode
The DNA sequences of seven specimens of *Xorides praecatorius* are stored in BOLD: NODIA595-22–NODIA601-22.

Xorides rufipes **(Gravenhorst, 1829)**

Xylonomus rufipes Gravenhorst, 1829: 823, two female syntypes in MNHW, examined.

Fig. 5G

Non type material examined
1♀, 2♂ Sweden (NJ, NHRS); 1♀, 3♂♂ France (WP); 1♀, Poland (JH).

Diagnosis
Xorides rufipes is the only known species of the subgenus *Moerophora* Förster, 1869 recorded from Scandinavia. The subgenus is distinguished by the presence of a distinct apical tooth on the fore and middle trochantellus (Fig 5G). The body is black and the legs, including the coxae are entirely red. The elongate first tergite in combination with the colouration makes *Xorides rufipes* resemble *Xorides alpestris*, a species which always lacks the tooth on the fore trochantelli. Furthermore, the head is dorsally densely punctate in *X. alpestris* while it is polished with scarce punctures in *X. rufipes*. Of the other species of subgenus *Moerophora* which potentially could occur in Scandinavia, *X. rufipes* is distinguished by the short hairs on the flagellomeres, while *X. ephialtoides* (Kriechbaumer, 1882), *X. rusticus* (Desvignes, 1856) and *X. flavotibialis* Hilszczański, 2000 have very long, apically curved hairs. *Xorides ilignus* Hilszczański, 2000 which also have short hairs on the flagellomeres, have the hind legs, including the trochanter and trochantellus, entirely black and the hind tibia with a white spot basally. The female of *Xorides rufipes* is distinguished from the similar species listed above by the distinctly white banded antennae. In similar species the antennal ring is absent or vaguely defined.

Ecology
Brischke (1880) mentions a rearing from *Rhagium inquisitor* (Linnaeus, 1758). Given the abundance of the host and the presumably

very rare parasitoid, this record should be regarded with caution or implies that the species have other, more demanding habitat requirements. In Poland two females were collected while searching for host on dying, well insolated tree form of hawthorn *Crataegus* sp. heavily infested with cerambycid *Xylotrechus arvicola* (Olivier, 1795).

Distribution in Sweden
Very rare. Two modern records, one male and one female both from the Baltic island of Gotland (NJ). One male probably late 19th century in NHRS with the label "Suecia" in NHRS (misidentified as *X. alpestris*). We have not been able to find neither the specimen from Upl, referred to by Hedström (1988) in UPSZ, nor the one recorded from Ög (Eldefors 2009) in NHRS.

Xorides sepulchralis **(Holmgren, 1860)**
Xylonomus sepulchralis Holmgren, 1860: 71, female lectotype and male allotype in NHRS, examined.
Xylonomus moiwasanus Matsumura, 1912, female holotype in HUM, not examined.
Xorides schmiedeknechti Clément, 1938: 559f. Female lectotype in ZMHB and female paralectotype in ZSM, examined.

Figs 1, 10B, 10D

Non type material examined
35♀♀, 20♂♂ Sweden (NJ, UPSZ, LW, MZLU, NHRS); 7♀♀, 1♂ Norway (NTNU, NHM.UIO); 4♀♀, France (WP); 1♀ Finland (MZLU).

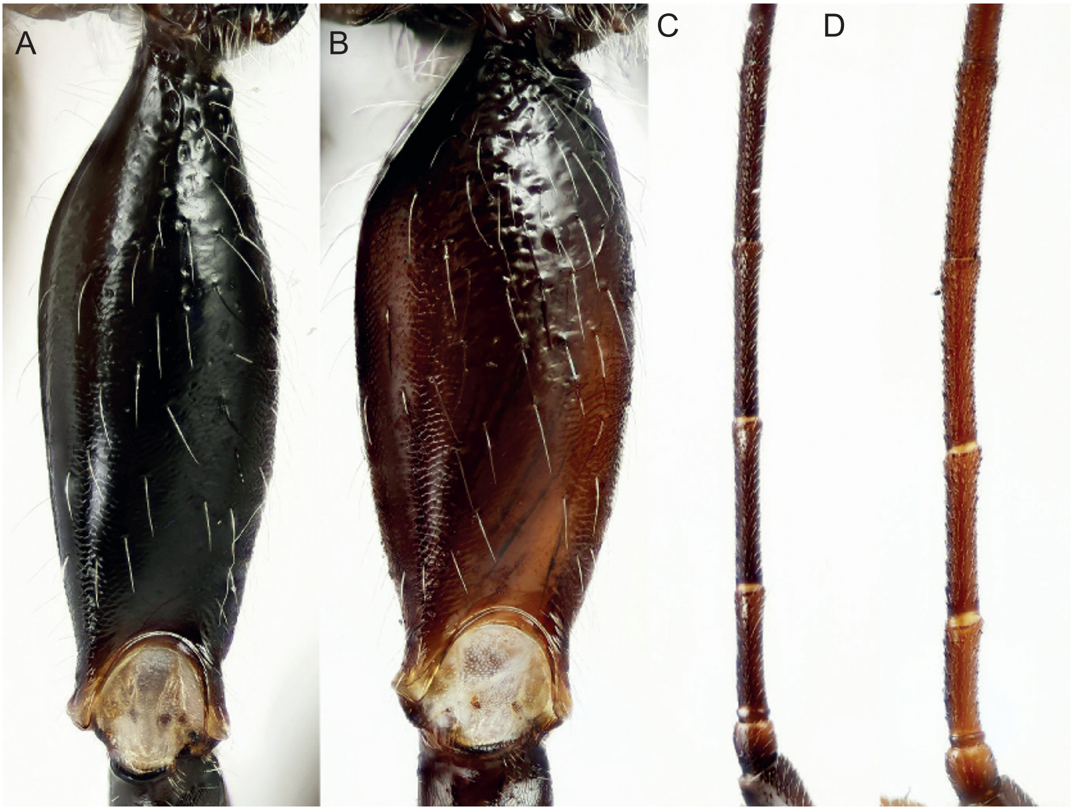

Figure 15. *Xorides depressus* (Holmgren, 1860), female; A–B) hind coxa, dorsal view; – A) *Nothorhina* form; – B) *Phaenops* form; C–E) basal flagellomeres, lateral view; – C) *Nothorhina* form; – D) *Phaenops* form.

Figur 15. *Xorides depressus* (Holmgren, 1860), hona; A–B) bakhöft ovanifrån; – A) *Nothorhina* form; – B) *Phaenops* form; C–E) basala antennleder från sidan; – C) *Nothorhina* form; – D) *Phaenops* form.

Diagnosis
Xorides sepulchralis is quite easily distinguished from other species on the basally white tibiae in combination with the usually partly red metasoma in the female (Fig. 1). Both the female and the male have white antennal rings. Most similar to *Xorides filiformis*, but distinguished by the more distinct microsculpture of the tergites (Figs 10B, 10D). The female is variable regarding the colouration of the metasoma which ranges from entirely black, to having the basal tergites red (var. *schmiedknechti* Clément, 1938). Females with dark, almost black metasoma could potentially be confused with *X. sapporensis*, but is distinguished by the sculpture of the propleuron and the absence of white marks on the apical tergites.

Ecology
Associated with cerambycids of the genus *Xylotrechus* Chevrolat, 1860 (*Rusticoclytus* Vives, 1977), in Sweden mainly or solely *X. rusticus* (Linnaeus, 1758) on aspen *Populus tremula* L. One female in MZLU according to the label reared from *X. rusticus*. Often observed on recently dead trunks of aspen and birch together with its main host (first and second author pers. obs). Exceptionally reared also from oak in Poland.

Distribution in Sweden
A quite common species all over the country: Hall, Sm, Öl, Vstm, Ög, Vg, Dlr, Vs, Sdm, Upl, Hls, Ång, Åslp.

Distribution in Norway
Probably quite common in southeastern parts of Norway. Recorded from Ø, AK, BØ, BV, TEY and AAY.

Remarks
While the lectotype female of *Xorides sepulchralis* var. *schmiedknechti* Clément, 1938 in ZMHB is indeed *Xorides sepulchralis*, the paralectotype in ZSM (designated by Horstmann) is actually a very pale (newly hatched?) female of *Xorides filiformis*. Red-listed in Finland as NT (Hyvärinen et al. 2019).

DNA barcode
The DNA sequences of two specimens of *Xorides sepulchralis* are stored in BOLD: NODIA614–22, NODIA615–22.

Xorides sordator **(Thunberg, 1824) stat. rev.**

Ichneumon sordator Thunberg, 1824: 269, holotype male in UPSZ, examined.
Xylonomus pilicornis Gravenhorst, 1829: 833, three female and three male syntypes in NMHW, examined.
Xorides fuligator auct. nec Thunberg, 1824

Figs 9C, 11B, 12C

Non type material examined
22♀♀, 9♂♂ Sweden (NJ, UPSZ, MZLU, NHRS); 5♀♀ France (WP); 1♀ Denmark (MZLU); 3♀♀ Norway (NHM.UIO).

Diagnosis
With its partly red metasoma, white antennal ring and the absence of white spots or rings basally on the hind tibia, the female of *Xorides sordator* is most similar to *X. irrigator,* but lacks the strongly swollen fore and mid tibia (as in Fig. 12B). The male has long prominent and partly bent hairs on the flagellomeres (Fig. 9C), a feature only shared with the male of *Xorides gravenhorstii* and *X. fuligator*, from which it is distinguished by the polished hind coxae (Fig. 12C) in combination with the, in dorsal view longer and more buccate temples and the more polished and punctate head (Fig. 11B).

Ecology
Most likely mainly connected to host on oak. Reared from oak without indication of host (1♀, 2♂♂, M. Jonsell, Sm, Tingsås N. Svensjön). Several times collected on oak timber (first author pers. obs.). In Poland reared from *Anaesthetis testacea* on oak twigs and from American maple twigs *Acer negundo* Linnaeus, without indication of the host.

Distribution in Sweden
Relatively rare and mainly occurring in Southern and Central Sweden: Sk, Hall, Öl, Sm, Vg, Ög, Upl.

Distribution in Norway
A few records from Southern and Western Norway: BØ, AAY and SFI.

Remarks
As the type of *Xorides fuligator* in the Thunberg collection in UPSZ is a female of the species

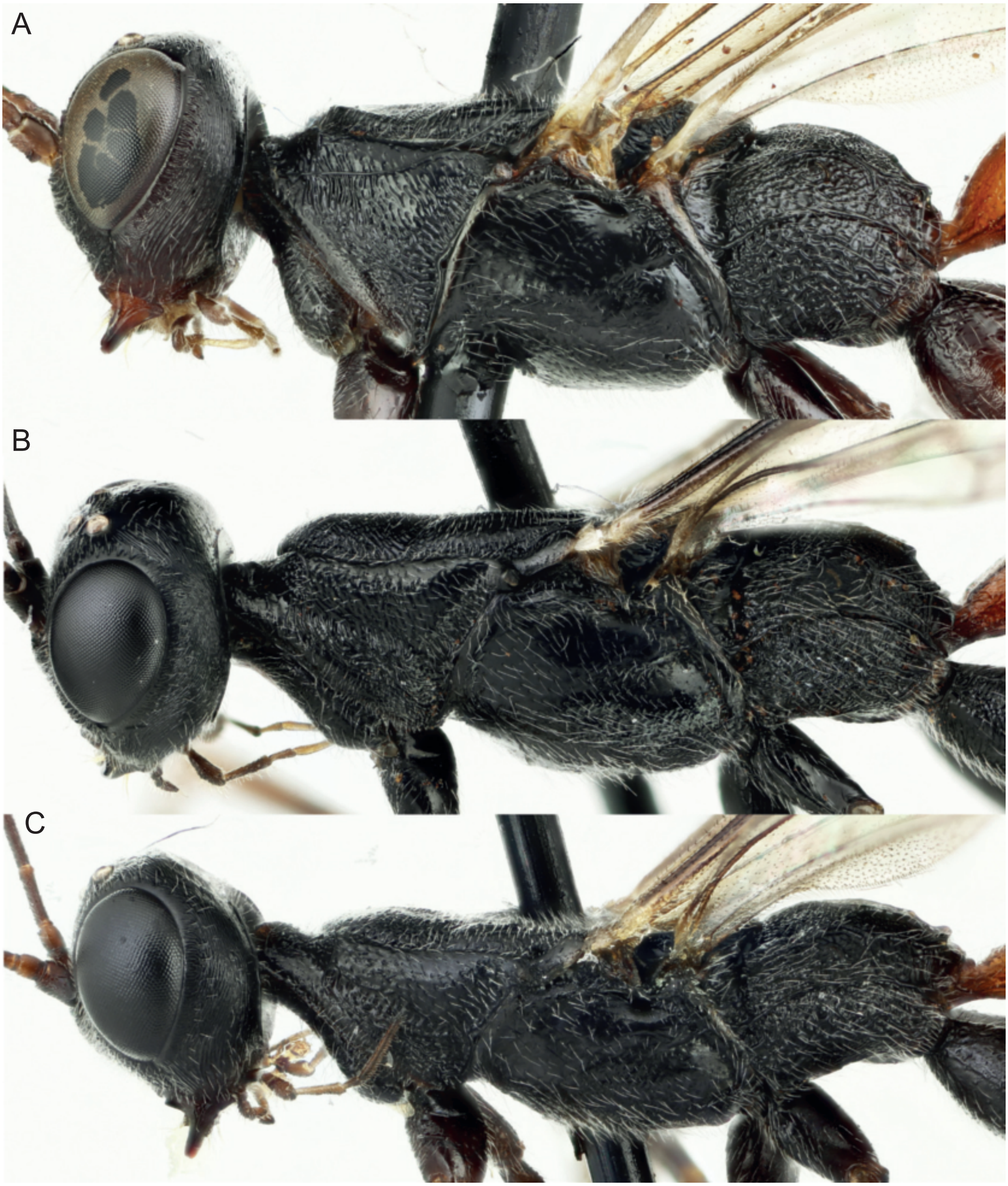

Figure 16. A–C) Head and mesosoma of female *Xorides depressus* (Holmgren, 1860), lateral view; – A) *Phaenops cyanea* form; – B) *Nothorhina muricata* form; – C) *Nothorhina muricata* form deformed.

Figur 16. A–C) Huvud och mellankropp, hona *Xorides depressus* (Holmgren, 1860) från sidan; – A) *Phaenops cyanea* form; – B) *Nothorhina muricata* form; – C) *Nothorhina muricata* form - deformerad.

commonly treated under the name *Xorides niger* (Pfeffer) (see Remarks above under *X. fuligator*), the oldest available name for this species is *Ichneumon sordator* Thunberg, 1824. The male type in the Thunberg collection in UPSZ was examined and is in accordance with the perception of the species here treated. The valid name is therefore *Xorides sordator* (Thunberg, 1824) stat. rev.

DNA barcode

The DNA sequences of two specimens of *Xorides sordator* are stored in BOLD: NODIA608-22, NODIA646-22.

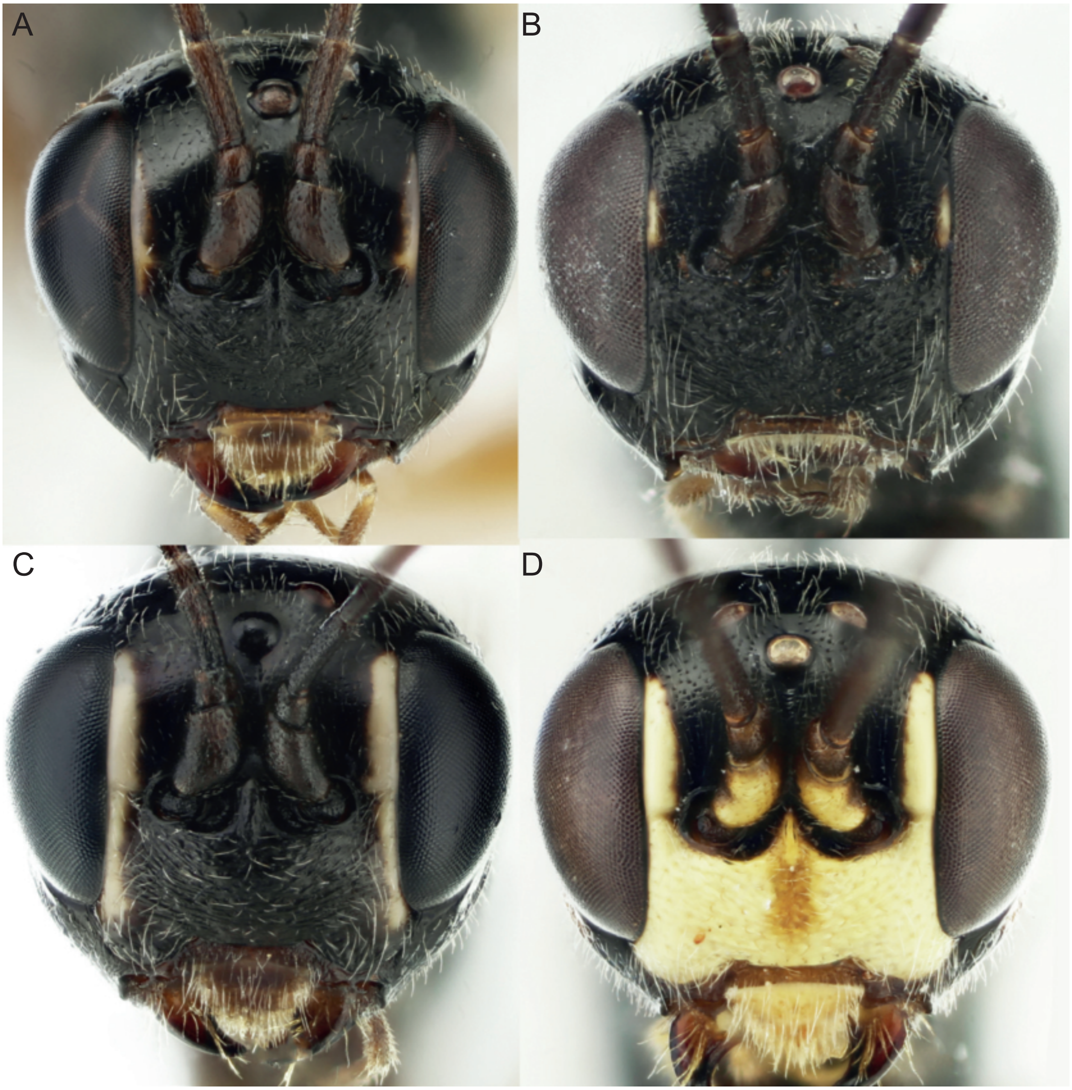

Figure 17. A–D) Head, anterior view; – A) *Xorides ater* (Gravenhorst, 1829), female; – B) *Xorides ater*, male; – C) *Xorides brachylabis* (Kriechbaumer, 1889), female; – D) *Xorides brachylabis*, male.

Figur 17. A–D) Huvud framifrån; – A) *Xorides ater* (Gravenhorst, 1829), hona; – B) *Xorides ater*, hane; – C) *Xorides brachylabis* (Kriechbaumer, 1889), hona; – D) *Xorides brachylabis*, hane.

Identification key to the Northern European species of *Xorides*

Xorides is readily separated from other Darwin wasps of similar constitution by the strongly buccate temples in combination with the very deep and distinct notauli, which divides the mesoscutum into three separate parts, the nervellus broken in the middle by the discoidella in the hind wing, the lack of projections on the hind femur and frons and the peg-like setae projecting from the apical flagellomeres in the female. Even if size may be useful to some extent when identifying species, one should be aware that most species are extremely variable in size. Smaller specimens may have some characters, such as the sculpture of the head and metasoma less distinct. Four species occurring in adjacent areas, which can be expected to occur also in Northern Europe and Fennoscandia are included in the key.

1. Fore trochantellus with a prominent tooth (Fig. 5G); body and head entirely black with red or yellowish legs; first tergite in female and male very elongate (at least as in Fig. 5F); head in dorsal view narrower, polished with scarce punctures (as in Fig. 11B); hind tibia usually uniformly red, never with white base. Very rare in Fennoscandia. (If the female antenna lacks a distinct white ring and the male flagellomeres have long pubescence, then see the revision of the European species of the subgenus *Moerophora*, Hilszczański (2000))..........................*Xorides rufipes* (Gravenhorst, 1829)

- Fore trochantellus unmodified. If the body and head is black and the first tergite strongly elongate (*X. alpestris*), then head in dorsal view wider, densely punctate/striate (as in Fig. 11A), and hind tibia usually infuscate, always with white spot basally..2

2. Hind tibia basally with white spot or ring; female frequently with white spots on the metasoma (Figs 5A, 5E, 6E, 6H); if female without white spots on the metasoma, then antenna with white ring and the pterostigma more than four times as long as wide or mesosoma strongly compressed (Fig. 8E–F); male antennae usually with relatively short pubescence (only longer in the rare *X. indicatorius*) (Fig. 9A–B)..3

- Base of hind tibia sometimes paler, yellow, but never white; female never with white spots on the metasoma; if female with white antennal ring, then pterostigma less than three times as long as wide; male antennae with short to long pubescence (Fig. 9A–C)...10

3. Metasoma strongly elongate, first tergite about three times as long as wide in dorsal view in females (Fig. 5F) and four times as long as wide in males; body and head entirely black and all coxae and femora red. Usually a large to very large species............................*X. alpestris* (Habermehl, 1903)

- Metasoma less elongate, first tergite about two times longer than wide in females, three times in male 4

4. Mesosoma in male and female strongly compressed dorsoventrally (Fig. 8E–F); metasoma in female partly red; male without white antennal ring and usually partly red metasoma. A small species, fore wing length about 5–6 mm. Reared from *Anthaxia* Eschscholtz, 1829. Not yet recorded from Northern Europe...*X. gracilicornis* (Gravenhorst, 1829)

- Mesosoma in male and female not strongly compressed dorsoventrally (as in Figs 1, 3, 5A, 6A).....5

5. Female metasoma with white spots (Figs 5A, 5E, 6E, 6H); antennae in male without white ring.......6

- Female metasoma without white spots; antennae in male with white ring..9

6. Hind femora and abdomen, apart from four whitish spots in the female, black or dark brown (Fig. 5A); upper part of pronotum laterally distinctly longitudinally striate (Fig. 5B). Not yet recorded from Northern Europe, but known from Poland. Known host *Mesosa curculionoides* (Linnaeus, 1761) ....*X. sapporensis* (Uchida, 1928) (= *X. hedwigi* Clément **syn. nov.**)

- Femora at least partly red...7

7. Head in dorsal view almost square (Fig. 6C), in female without pale markings along the inner and outer orbits; temple in both sexes wide in lateral view (Fig. 6D); metasoma in female relatively smooth with four whitish spots (Fig. 6A, 6E). Very rare, not yet recorded from Northern Europe. Known host *Saperda perforata* (Pallas, 1773)..*X. hilszczanskii* Johansson **sp. nov.**
- Head in dorsal view wider (as in Fig. 6F), usually with extensive white or red markings on the inner and/or outer orbits; temple in lateral view narrower (as in Fig. 6G); metasoma in female usually with six or more whitish spots (Figs 5A, 6H)..8

8. Usually larger species, fore wing length 8–15 mm; sculpture of mesoscutum and mesosoma in both sexes coarser (Figs 6H, 7A, 7C); at most metasomal segments 4–6 in female with white spots (Fig. 6H); temples in lateral view polished with distinct punctures, usually with a white spot. A rare species. Hosts mainly on birch (*Betula* spp.), possibly *Aegomorphus clavipes* (Schrank, 1781) ....*X. indicatorius* (Latreille, 1906)
- Usually smaller species, fore wing length 4–9 mm; sculpture of the mesoscutum and mesosoma smoother (Fig. 7B, 7D); female usually with spots on tergites 2–7 (Fig. 5E); temples in lateral view densely striate/punctate, usually with red or red and white markings. (Small males of *X. irrigator* may run out here, but always have the inner orbits entirely black and the metasoma partly reddish) ....*X. praecatorius* (Fabricus, 1793)

9. Metasoma usually entirely red (very rarely black = var. *habermehli* Kiss); posterior metasomal segments in male polished with scarce punctures (Fig. 10A); second tergite in female shagreened (Fig. 10C); hind tarsus in female without white ring. Hosts on oak...........*X. filiformis* (Gravenhorst, 1829)
- Metasoma usually partly or entirely black (Fig. 1); posterior metasomal segments in male with distinct microsculpture (Fig. 10B); second tergite in female weakly rugulose (Fig. 10D); hind tarsus in female with distinct white ring. Associated with *Xylotrechus*, mainly *X. rusticus* on aspen (*Populus*) and birch (*Betula*)..*X. sepulchralis* (Holmgren, 1860)

10. First tergite with a diagonal groove laterally (Fig. 9D); flagellomeres in male with more or less conspicuous pubescence (Figs 9B, C) (the only species with short pubescence, as in Fig. 9A, is the very small *X. csikii*); antennae in female with white ring (Note that the diagonal groove in *X. fuligator* can be vague, but the white ring on the antennae distinguishes it from the species without groove); metasoma usually partly red...11
- First tergite without diagonal groove laterally (Fig. 9E), flagellomeres in male without conspicuous pubescence (Fig. 9A); antennae in female black; metasoma often entirely black (Subgenus *Rhadinopimpla* Schulz). Hosts on conifers..15

11. Head in dorsal view polished with small dense punctures (Fig. 11A); mid and fore tibia in female strongly swollen, distinctly thicker than the femur (Fig. 12A), male antennae with relatively short pubescence (Fig. 9B)..*X. irrigator* (Fabricius, 1793)
- Head in dorsal view partly striate or with scarce, larger punctures (Fig. 11B–D); mid- and fore tibia in female less swollen (Fig. 12B); male antennae with very long pubescence (Fig. 9C). If the antennae has short pubescence in the male (the very small *X. csikii*, as in Fig. 9A), then the head dorsally striate (as in Fig. 11D)..12

12. Antennae in female clavate (Figs 13C, 14A); head in dorsal view in both sexes densely striate (Fig. 11D); metasoma in female entirely red or with only the first tergite black; male flagellomeres with short or long pilosity; if pilosity long (as in Fig. 9C), then second tergite usually with two arcuate grooves centrally (Fig. 13B) and hind coxae polished dorsally..13

- Antennae in female filiform; head in dorsal view in both sexes more or less polished with punctures (Fig. 11B, 11C); metasoma in female with at least apical segments black; male flagellomeres with long pilosity (Fig. 9C) and second tergite with more regular sculpture..14

13. Larger species 8–11 mm; first tergite in female red; basal flagellomeres in female more slender (Fig. 14D); male flagellomere with conspicuous bristles (as in Fig. 9C); second tergite in male usually with two arcuate grooves centrally (Fig. 13B)..................................*X. gravenhorstii* (Curtis, 1831)
- Smaller species 5–6 mm; first tergite in female largely black (Fig. 14B); basal flagellomeres in female stout (Fig. 14C); flagellomere in male without conspicuous bristles (as in Fig. 9A); second tergite in male with more regular sculpture. Hosts mainly on oak. Not yet recorded from Fennoscandia, present in Great Britain and Poland...*X. csikii* Clément, 1938

14. Hind coxae polished dorsally with scarce punctures (Fig. 12C); temple wider, head in dorsal view more square (Fig. 11B)......................*X. sordator* Thunberg, 1824 stat. rev. (= *X. fuligator* sensu auct.)
- Hind coxae dorsally shagreened with scarce indistinct punctures (Fig. 12D); temple narrower, head shorter and less polished in dorsal view (Fig. 11C)................*X. fuligator* Thunberg, 1824 (= *X. niger* sensu auct.)

15. Head black; tergites 1–2 (3) red, without dorsal carinae; mesosoma often compressed dorsoventrally (Figs 13A, 16B–C). Hosts on pine. Note that this species appears to occur in two forms that possibly represent valid taxa (see Figs 15A–D, 16A–C)....................*X. depressus* Holmgren, 1860
- Head with white markings (Fig. 17A–D); first tergite with weak dorsal carinae; metasoma entirely black (Fig. 3) (specimens from Central and Southern Europe may have red spots on the first tergite); hosts mainly on spruce...16

16. Mid tibia in female more strongly swollen (Fig. 8D); upper part of temple in female with striate microsculpture (Fig. 8A); head of female usually with wider and longer white line along inner orbit (Fig. 17C); face in male entirely whitish (Fig. 17D). At least in Northern Europe associated with the genus *Tetropium*...*X. brachylabis* (Kriechbaumer, 1889)
- Mid tibia in female less strongly swollen (Fig. 8C); upper part of temple in female polished without microsculpture (Figs 3, 8B); head in female with inner orbits only narrowly white (Fig. 17A); face in male black with white lines or spots along the inner orbits (Fig. 17B). Possibly associated with the genus *Callidium*..*X. ater* (Gravenhorst, 1829)

Discussion

This revision treats the 13 species of *Xorides* occurring in Scandinavia. Additionally, there are several species in the northern part of Central Europe which potentially could occur in Fennoscandia, given their known host preferences. These are: *Xorides gracilicornis*, which parasitizes *Anthaxia* Eschscholtz, 1829 species (Yu et al. 2016); *Xorides sapporensis*, which has been reared from *Mesosa curculionoides* (Linnaeus, 1761) and *Xorides* (*Moerophora*) *ephialtoides* Kriechbaumer, 1882, which parasitize buprestids of genus *Dicerca* Eschscholtz, 1829 in deciduous trees; *Xorides* (*Moerophora*) *flavotibialis* Hilszczański, 2000, known from Northern Poland where it has been reared as parasitoid of cerambycid *Chlorophorus herbsti* (Brahm, 1790) on hazel *Corylus avellana* L; the here described *Xorides hilszczanskii* Johansson sp. nov. a parasitoid of *Saperda perforata* and *Xorides csikii*, which is associated with oak (reared from oak twigs, Mark Shaw pers. comm.) and elm *Ulmus* sp. where it was reared from twigs infested with cerambycid *Exocentrus punctipennis* Mulsant & Guillebeau, 1856. *Xorides csikii* is probably easily overlooked due to its small size. It is recorded as far north as Great Britain and Poland, where it is considered to be a very rare species. Notably, *Xorides gracilicornis* was reported from Sweden by Holmgren (1860) and from Finland by Hellén (1937, p. 9). We have unsuccessfully tried to locate these specimens in the Holmgren and Hellén collections in NHRS and MZH respectively.

Xorides as indicators of sustainable forestry

Xorides species are often encountered in window traps or when rearing saproxylic Coleoptera and hopefully this revision, together with similar studies (Johansson 2020, Johansson & Klopfstein 2020) will inspire and facilitate future ecological studies of parasitic wasps and their role in boreal forest ecosystems. Despite the fact that literature lists a variety of hosts for several species of *Xorides* (Yu et al. 2016), there are relatively few authenticated rearing records, and some host associations are derived from older, partly unreliable ecological information. The new observations here presented indicate that some species actually appear to be quite specialized when it comes to host and preferred habitat and thereby more sensitive when the constitution of the boreal forests changes by the hand of modern forestry.

In the Red list of Swedish species 2020 (SLU Artdatabanken 2020), the genus *Xorides* was treated for the first time. Four (*X. indicatorius*, *X. depressus*, *X. fuligator* and *X. rufipes*) out of 13 species (31%) met at least one of the criteria for red listing (see details at www.iucnredlist.org). When looking at other groups of parasitoid Hymenoptera assessed for the Swedish red list (e.g. Evanioidea, Chrysididae, parasitic bees) the result shows that about 25–30% of the species qualify for the red-list. This relatively high proportion of decreasing and threatened species is due to their positioning at a high trophic level (Komonen et al. 2000, Shaw & Hochberg 2001, Roslin et al. 2013), which makes them more sensitive to changes in the ecosystem dynamics. The majority of the red-listed parasitoid species also show a relatively high degree of host specialization by utilizing one single or a limited number of declining or rare hosts (Artdatabanken 2020). This is a well-known pattern where specialists among parasitoid wasps have been shown to be more vulnerable to changes in their environment than generalists (Santos 2012, Paukkunen et al. 2018). Paukkunen et al. (2018) also showed that specialist parasitoids, exemplified by chrysidid wasp, dependent on sun exposed dead wood, are more vulnerable to habitat destruction than species connected to open sandy habitats due to the lack of secondary habitats. This indicates that additional *Xorides* species may qualify for the Swedish red list as our knowledge of their ecological requirements increase. This may concern species such as *Xorides ater*, which is mainly recorded from pristine coniferous forests in Central Sweden (the possible connection to *Callidium* was not known at the time of the red list assessment) and the possibly rare and locally occurring *X. gravenhorstii*.

The main role of the red list is to act as an early warning system, identifying species which may risk extinction if appropriate measures are not taken to reverse their negative population trends. Related to this subject there have been several studies and papers dealing with the potential usefulness of parasitic Hymenoptera as indicators of biodiversity and ecosystem stability (Hilszczański et al. 2005, Hedgren 2007, Fraser et al. 2007, Gibb et al. 2008, Stenbacka et al. 2010, Hilszczański 2018, Johansson & Larsson 2020). Practically all of these studies confirm that parasitoid wasps are indeed potentially useful as biodiversity indicators and that their placement on a high level in the trophic chain could provide a new dimension when it comes to ecological studies of saproxylic insects in boreal forests. However, most of these studies also conclude that ecological research dealing with the parasitoid level depend upon correct species concepts and identification keys, which in turn are provided by basic taxonomic research of the kind here presented.

Modern forestry, threats and possibilities

In the northern parts of the Palaearctic, xoridines and other parasitoid wasps with similar ecology, have evolved in and adapted to forest structures created and maintained by large scale disturbance regimes such as forest fires, periodical flooding, grazing and recurrent storms. This becomes particularly evident when studying the composition of saproxylic insects in burned forests, where many *Xorides* species and their hosts rapidly can establish very large populations. Even if some species, mostly generalists, have managed to find their niches in the modern forest landscape, many are most likely disfavoured by modern large-scale industrial forestry and its profound impact on the constitution of the forests. In Scandinavia, the totally dominating forestry method is clearcutting, where all the trees in an area are cut down at once. More than 60 % of the forests have been clearcut since the 1950s (Larsson et al. 2011, Nilsson et al. 2020) and mainly turned into monocultures consisting of dense coniferous plantations (Kempe & Dahlgren 2015). Today 93% of the Swedish forests, this figure also includes protected areas, does not contain large enough volumes of dead wood to meet the minimum threshold values (at least 20 m^3/hectare) to support viable populations of many insects depending on dead wood (Ranius & Fahrig 2006, Müller & Bütler 2010, Nilsson et al. 2020). In Norway, 75% of the old forests have been substituted with plantations, and the area of forests that never have been clear-cut was reduced by 28% from 1990 to 2016 (Storaunet & Rolstad 2020). The Scandinavian forests are also becoming denser, darker and colder in absence of natural disturbance regimes such as fire and forest grazing (Claesson et al. 2015), which disfavors many insects. Today, the two major disturbance factors, fires and grazing, no longer have a major impact on forest structure in Sweden (Niklasson & Nilsson 2005, Niklasson 2011, Westin et al. 2022). Fires are effectively suppressed and forest grazing was practically forbidden with the forest legislation of 1923 (Ekelund & Hamilton 2001) due to its negative impact on tree plantations (Westin et al. 2022). Out of about 750 000 hectares of grazed forest in 1930 only about 15 000–30 000 hectares remain today (Swedish Board of Agriculture 2011, Westin et al. 2022). Another possible threat to the parasitods of saproxylic insects is the increased demand for bioenergy from logging residues. Branches and logs unfit for sawtimber are gathered in large piles where they attract a large variety of saproxylic insects (Jonsell 2008, Jonsell 2019) and subsequently also their parasitoids. The partly delayed development of the parasitoids and the continous removing of these residues may have a still understudied effect on the local parasitoid community.

Modern industrial forestry is undoubtedly responsible for this fundamental change in the ecological prerequisites for biodiversity of boreal forests, but may also hold the key to future conservation of forest species depending on frequent large-scale disturbances. In the absence of fire, flooding and grazing, the only remaining large scale disturbance in boreal forests in Western Europe, apart from rare wildfires and reindeer grazing in the northern parts, is caused by logging. Today, as seen above, the present considerations by the forest industry regarding crucial structures such as dead wood and old growth forests are unable to meet the levels needed to maintain viable populations of many saproxylic insects. However, with measures adapted to biodiversity conservation, e.g. smaller clearcuts, leaving and creating larger amounts of sun-exposed dead wood, continuous cover forestry and ecological planning, such as found in Swedish ecoparks, modern industrial forestry could become a necessary resource in the conservation of disturbance dependent saproxylic insects and potentially the savior instead of the perpetrator (Larsson Ekström et al. 2021).

In summary, more detailed ecological and biodiversity research involving the parasitoid level could shed new light on the ecological status of boreal forest ecosystems and how they are affected by modern forestry. If indeed one third to one fourth of the parasitoid species qualify for the red-list as strongly diminishing or threatened, the situation is far more worrying than previously assumed, hereby questioning the methods of the commonly promoted sustainable Swedish and Norwegian forestry. However, more research on ecology and population dynamics is urgently needed to support this hypothesis, for example by studying the differences in the composition of parasitoid Hymenoptera between plantations, semi-natural and pristine natural forests and the effect of artificial conservation measures mimicking natural disturbance regimes. Notably, none of this crucial research can be conducted without basic taxonomic research, providing correct species concepts, ecological information and identification keys to species, as exemplified by this study.

Acknowledgements

We are grateful for the help and contributions of the following persons: Patricia Peters at SGN for detecting and depicting the types of Habermehl, Simon Hinkley at the NMV for providing pictures of the type of *Xorides gravenhorstii*, Mark Shaw NMS for lending British specimens of *Xorides csikii* for study and sharing rearing records, William Penigot for lending his *Xorides* collection for study, Marek Wanat at the MNHW for depicting the Gravenhorst types, David Wahl at the USUC for the photos of *Xorides holsaticus*, Hege Vårdal NHRS for depicting specimens and giving access to the collections, Hans Mejlon UPSZ for access to the Thunberg types and the collection, Rune Bygebjerg, Christoffer Fägerström MZLU for access to the collections, Stefanie Krause at the ZMHB for giving access to specimens in the museum. Lars-Ove Wikars, Roger Mugerwa Pettersson and Håkan Andersson for lending or donating their material of *Xorides* from window traps. Håkon Haraldseide kindly gave access to some of his barcoded material. Stefan Schmidt ZSM for sending and depicting type material, Zoltán Vas HMHN for depicting the types of Kiss, Henrik Larsson for the beautiful live photos. Dave Karlsson at the SMTP provided a list of their *Xorides*. Namiki Kikuchi kindly assisted in depicting the types of Uchida in HUM. Dominique Zimmerman at the NHMW for depicting the *Xorides* types in the collection, Filippo Di Giovanni for sharing rearing records and pictures of *Xorides*, Markus Franzén at the Linnean University for assisting with the barcoding of some specimens. Mao-Ling Sheng for sending photos of the types stored in GSFPM. Paul Hoekstra for giving feedback on an early draft of the key. Lars Ove Hansen at the NHM.UIO for lending the material of *Xorides* and last but not least Bernardo Santos at MNHN for depicting some types housed in their collection and locating the type of *Xorides baueri*. DNA barcode data was generated in collaboration with the Norwegian Barcode of Life Network (NorBOL), funded by the Research Council of Norway and the Norwegian Biodiversity Information Centre. Thanks to the staff at the Canadian Centre for DNA barcoding for help with sequencing and databasing. Reviewers Olexandr Varga (SIZK) and Alexandra Viertler (NHMB) gave suggestions that improved the quality of the manuscript.

References

Broad, G.R., Shaw M.R. & Fitton M.G. 2018. Ichneumonid wasps (Hymenoptera:Ichneumonidae): their classification and biology. – Handbooks for the identification of British Insects 7 (12): 1–480.

Claesson, S., Duvemo, K., Lundström, A. & Wikberg, P.-E. 2015. Skogliga konsekvensanalyser 2015, SKA 15. Skogsstyrelsen och SLU, Rapport 10: 2015: 1–110.

Clément, E. 1938. Opuscula Hymenopterologica IV. Die palaarktischen Arten der Pimplinentribus Ischnocerini, Odontomerini, Neoxoridini und Xylomini (Xoridini Schm.). – Festschrift für 60 Geburtstag Prof. Embrik Strand 4: 502–569.

Curtis, J. 1831. British Entomology; being illustrations and descriptions of the genera of insects found in Great Britain and Ireland. – 8: 353–383.

Edgar, R.C. 2004. MUSCLE: a multiple sequence alignment method with reduced time and space complexity. BMC Bioinformatics 5: 113. https://doi.org/10.1186/1471–2105–5–113

Ekelund, H & Hamilton, G. 2001. Skogspolitisk historia. Rapport 8A: 2001. – Skogsstyrelsen, 252pp.

Eldefors, L 2009. Parasitsteklar i eklandskapet 2. Parasitsteklar från eklandskapet inom och söder om Linköping. – Rapport till Eklandskapsfonden 2009. 1–15.

Endrestøl, A. 2021. Strand-systemet 4.0. Insekt-Nytt 46 (1): 43–72.

Fraser, S.E.M., Dytham, C. & Mayhew, P.J. 2007. Determinants of parasitoid abundance and diversity in woodland habitats. – Journal of Applied Ecology, 44, 352–361.

Gauld, I.D. & Fitton, M.G. 1981. Keys to the British xoridine parasitoids of woodboring beetles (Hymenoptera: Ichneumonidae). – Entomologist's Gazette 32: 259–267.

Gibb, H., Hilszczański, J., Hjältén, J., Danell, K., Ball, J.P.,Pettersson, R.B. & Alinvi, O. 2008. Responses of parasitoids to saproxylic hosts and habitat: a multi-scale study using experimental logs. – Oecologia, 155: 63–74.

Gravenhorst, J.L.C. 1829. Ichneumonologia Europaea. Pars III., Vratislaviae. 1097 pp.

Hedgren, P.O. 2007. Early arriving saproxylic beetles (Coleoptera) and parasitoids (Hymenoptera) in low and high stumps of Norway spruce. – Forest Ecololgy Managment 241(1–3): 155–161.

Hedström, L. 1988. Svenska insektfynd - rapport 4. [Swedish insect records - report 4]. – Entomologisk Tidskrift 109: 139–149. Umeå.

Hellén, W. 1915. Beitrage zur Kenntnis der Ichneumoniden Finlands I. Subfamily Pimplinae. – Acta Societatis pro Fauna et Flora Fennica. 40(6): 1–89.

Hellén, W. 1937. Für die Fauna Finnlands neue Ichneumoniden II. Cryptinae, Pimplinae: Notulae Entomologicae 17: 5–13.

Hervé, P. 1937. Note sur le parasite de *Phaenops cyanea* F.: *Rhadinopimpla depressa* Holm. – Miscellaneous Entomology. 38: 93–94.

Hilszczański, J. 2000. European species of subgenus *Moerophora* Foerster of Xorides Latreille (Hymenoptera: Ichneumonidae: Xoridinae), with descriptions of two new species. – Insect Systematics & Evolution. 31: 247–255.

Hilszczański, J. 2002. Polish xoridines and their host associations (Hymenoptera, Ichneumonidae: Xoridinae). – Parasitic Wasps: evolution, systematics, biodiversity and biological control. Proceedings of Symposium Koszeg, Hungary, May 2001. Melika G. and Thuroczy C. (eds): 294–298.

Hilszczański, J., Gibb, H., Hjältén, J., Atlegrim, O., Johansson, T., Pettersson, R., Ball, J.P. & Danell, K. 2005. Parasitoids (Hymenoptera, Ichneumonoidea) of saproxylic beetles are affected by forest successional stage and dead wood characteristics in boreal spruce forest. – Biological Conservation 126: 456–464.

Hilszczański, J. & Plewa, R. 2011. Two new species of *Xorides* Latreille from Crete with a checklist of Greek Xoridinae Shuckard (Hymenoptera: Ichneumonidae). – Annales Zoologici 2011 Vol. 61 No. 3, 513–517.

Hilszczański, J. 2018. Ecology, Diversity and Conservation of Saproxylic Hymenopteran Parasitoids. In: Ulyshen M. (eds) Saproxylic Insects. – Zoological Monographs, vol 1. Springer, Cham. https://doi.org/10.1007/978-3-319-75937-1_6

Holmgren, A.E. 1860. Försök till uppställning och beskrifning af Sveriges Ichneumonider. Tredje Serien. Fam. Pimplariae. (Monographia Pimplariarum Sueciae). – Kongliga Svenska Vetenskapsakademiens Handlingar. (B) 3(10): 1–76.

Horstmann, K. 1983. Die Ichneumoniden-Sammlung Erich Bauers in der Zoologischen Staatssammlung in München (Hymenoptera). Spixiana 6: 281–290.

Horstmann, K. 1992. Typenverzeichnis der von Ernst Clément beschriebenen paläarktischen Ichneumonidae (Hymenoptera). – Zeitschrift der Arbeitsgemeinschaft Österreichischer Entomologen, 44. Jahrgang 1,2: 49–55.

Horstmann, K. 2001. Revision der von Johann Christian Fabricius beschriebenen Ichneumonidae (Hymenoptera). – Beiträge zur Entomologie 51 (1): 7–50.

Horstmann, K. 2009. Typenrevisionen der von Kiss beschriebenen Taxa der Ichneumonidae III. Verschiedene Unterfamilien (Hymenoptera, Ichneumonidae). – Linzer biologische Beiträge, 0041_1, 673–689.

Hyvärinen, E., Juslén, AK., Kemppainen, E., Uddström, A., & Liukko, U-M. (Eds.) 2019. Suomen lajien uhanalaisuus 2019 - Punainen kirja: The 2019 Red List of Finnish Species. – Ympäristöministeriö & Suomen ympäristökeskus. http://hdl.handle.net/10138/299501

Ivanova, N.V., deWaard, J.R. & Hebert, P.D.N. 2006. An inexpensive, automation-friendly protocol for recovering high-quality DNA. – Molecular Ecology Notes 6: 998–1002 https://doi.org/10.1111/j.1471-8286.2006.01428.x

Johansson N. & Larsson, A. 2019. *Xiphydria betulae* (Enslin, 1911) new to Sweden and new records of *Xiphydria picta* Konow, 1897 (Hymenoptera: Xiphydriidae) with additional notes on two rare ichneumonid parasitoids associated with xiphydriid wood wasps. – Entomologisk Tidskrift, 140(3–4): 145–155.

Johansson, N. 2020. Revision of the Swedish Species of *Odontocolon* Cushman, 1942 (Ichneumonidae: Xoridinae) with the description of a new species and an illustrated key to species. – Entomologisk Tidskrift 141 (1–2): 23–42.

Johansson, N., & Klopfstein, S. 2020. Revision of the Swedish species of *Neoxorides* Clément, 1938 (Ichneumonidae: Poemeniinae) with the description of a new species and an illustrated key to species. – European Journal of Taxonomy, (680). https://doi.org/10.5852/ejt.2020.680

Jonsell, M. 2008. Saproxylic beetle species in logging residues: which are they and which residues do they use? Norwegian Journal of Entomology 55, 109–122.

Jonsell, M. 2019. Insects reared out from logging residues on clear cuts in southern Sweden, Dryad, Dataset, https://doi.org/10.5061/dryad.m905qftx9

Jussila, R., Sääksjärvi, I.E., Halme, P. & Vihervaara, P. 2003. *Scambus signatus* (Pfeffer), *Xorides minutus* Clément, *X. praecatorius* (Fabricius) and *Lethades laricis* Hinz new to the Finnish and Swedish faunas (Hymenoptera, Ichneumonidae). Sahlbergia 8: 21–23.

Kasparyan, D.R. 1981 [A guide to the insects of the European part of the USSR. Hymenoptera, Ichneumonidae. Subfamily Xoridinae] (in Russian). – Opredeliteli Faune SSSR 129(III): 168–174.

Kempe, G. & Dahlgren, J. 2015. Uppföljning av miljötillståndet i skogslandskapet baserat på Riksskogstaxeringen. – SLU, institutionen för skoglig resurshushållning och Länsstyrelserna.

Kiss, von Zilah A. 1924. Beitrag zur Kenntnis der ungarischen und siebenburgischen Ichneumoniden-(Schlupfwespen-) Fauna., Verhandlungen und Mitteilungen des Siebenburgischen Vereins fur Naturwissenschaften in Hermannstadt. 72/74: 32–146.

Kokujev, N.R. 1927. [Hymenoptera recueillies par V. Sovinskij sur les bords du lac Bajkal en 1902.] (in Russian with Latin descriptions). – Travaux de la Commission pour l'etude du lac Bajkal. 2: 63–76

Kolarov, J.A. 1997: *Fauna Bulgarica vol. 25*. Hymenoptera, Ichneumonidae. Part I. Pimplinae, Xoridinae, Acaenitinae, Collyriinae, Pensoft Publishers, Sofia, 222–238.

Komonen, A., Penttila, R., Lindgren, M. & Hanski, I. 2000. Forest fragmentation truncates a food chain based on an old-growth forest bracket fungus. – Oikos, 90: 119–126.

Kriechbaumer, J. 1879. Ein neuer *Xylonomus* nebst Bemerkung uber den *X. securicornis* Hlmg. – Correspondenz-Blatt des Zoologische-Mineralogischen Vereines in Regensburg. 33: 167–169.

Kriechbaumer, J. 1889. Pimpliden-Studien. 22–26. – Entomologische Nachrichten. 15(5): 73–78.

Latreille, P.A. 1806. Genera Crustaceorum et Insectorum secundum ordinem naturalem in familias disposita iconibus exemplisque plurimis explicata. Tomus primus. Parisiis & Argentorati. 303 pp.

Larsson Ekström, A., Bergmark, P., & Hekkala, A.-M. 2021. Can multifunctional forest landscapes sustain a high diversity of saproxylic beetles? – Forest Ecology and Management, 490, 119107.

Liu, T. & Sheng, M.-L. 1998. Studies on the genus *Xorides* (Xorides) from Northeast China. – Entomologica Sinica 5(1): 35–41.

Martikainen, P. 2002. Ecology and conservation ststus of Acanthocinus griseus (Fabricius, 1792) (Coleoptera: Cerambycidae) in Finland. Entomologica Fennica 13: 41–50.

Müller, J. & Bütler, R. 2010. A review of habitat thresholds for dead wood: a baseline for management recommendations in European forests. – European Journal of Forest Research 129: 981–992. https://doi.org/10.1007/s10342–010–0400–5

Niklasson, M. & Nilsson, S. 2005. Skogsdynamik och arters bevarande: bevarandebiologi, skogshistoria, skogsekologi och deras tillämpning i Sydsveriges landskap. Studentlitteratur AB.

Niklasson, N. 2011. Brandhistorik i sydöstra Sverige. Länsstyrelserna rapport 2011:14. 30 pp.

Nilsson, P., Roberge, C, & Fridman, J. 2020. Forest statistics 2020, Official Statistics of Sweden Swedish University of Agricultural Sciences Umeå 2020, 1–154pp.

Paukkunen, J, Pöyry, J & Kuussaari, M. 2018. Species traits explain long-term population trends of Finnish cuckoo wasps (Hymenoptera: Chrysididae). Insect Conservation and Diversity 11: 58–71. https://doi.org/10.1111/icad.12241

Ranius, T. & Fahrig, L. 2006. Targets for maintenance of dead wood for biodiversity conservation based on extinction thresholds. Scandinavian Journal of Forest Research 21: 201–208. https://doi.org/10.1080/02827580600688269

Ratnasingham, S. & Hebert, P. D. N. 2007. BOLD: The Barcode of Life Data System (www.barcodinglife.org). *Molecular Ecology Notes* 7: 355–364.

Riedel, M. 2019. Ichneumonidae (Hymenoptera) new for the fauna of Norway, Part 8. Norwegian Journal of Entomology 66: 65–70.

Riedel, M., Hansen, L.O. & Berg, Ø. 2000. Ichneumonidae (Hymenoptera) new for the fauna of Norway. Norwegian Journal of Entomology 47: 163–176.

Riedel, M., Hansen, L.O. & Berg, Ø. 2005. Ichneumonidae (Hymenoptera) new for the fauna of Norway, Part 2. Norwegian Journal of Entomology 52: 151–162.

Roman, A. 1912. Die Ichneumonidentypen C.P. Thunbergs. Zoologiska Bidrag från Uppsala 1, 229–293.

Roslin, T., Varkonyi, G., Koponen, M., Vikberg, V. & Nieminen, M. 2013. Species-area relationships across four trophic levels – decreasing island size truncates food chains. – Ecography, 37: 443–453.

Santos, A.M.C. 2012. Thesis abstract: Ecology and biogeography of island parasitoid faunas Journal Article published 3 May 2012 in Frontiers of Biogeography volume 4 (1). https://doi.org/10.21425/f5fbg12551

Šedivý, J. 1958. Faunistische and taxonomische Bemerkungen zu den Ichneumoniden der Tschechoslowakei. Pimplinae I. – Acta Faunistica Entomologica Musei Nationalis Pragae, 3: 97–108.

Shaw, M.R. & Hochberg, M.E. 2001. The neglect of parasitic Hymenoptera in insect conservation strategies: the British fauna as a prime example. – Journal of Insect Conservation, 5: 253–263.

Sheng, M-L. & Hilszczański, J. 2009. Two New Species of Genus *Xorides* (Hymenoptera: Ichneumonidae) Parasitizing *Saperda balsamifera* Motschulsky and *Asias halodendri* (Pallas) (Coleoptera: Cerambycidae) in China. – Annales Zoologici, 59(2): 165–170.

Sheng, M-L. & Wen, J-B. 2008. Species of *Xorides* (*Xorides*) (Hymenoptera: Ichneumonidae: Xoridinae) parasitizing wood-boring insects in the Palaearctic part of China. – Entomologica Fennica. 19: 86–93.

SLU Artdatabanken 2020. Rödlistade arter i Sverige 2020. SLU, Uppsala.

Shaw, M.R.,Giannotta, M., Herrera-Flórez, A.F. & Klopfstein, S. 2021. Two males, one female: triplet-style mating behaviour in the Darwin wasp *Xorides ater* (Gravenhorst, 1829) (Hymenoptera, Ichneumonidae, Xoridinae) in the Swiss Alps. – Alpine Entomology, vol. 5: 15–22.

Stenbacka, F., Hjältén, J., Hilszczański J., Ball J.P., Gibb H., Johansson T., Pettersson R.B. & Danell K. 2010. Saproxylic parasitoid (Hymenoptera, Ichneumonoidea) communities in managed boreal forest landscapes. – Insect Conservation and Diversity 3: 114–123. doi: 10.1111/j.1752–4598.2010.00082.x

Storaunet, K.O. & Rolstad, J. 2020. Naturskog i Norge. En arealberegning basert på bestandsalder i Landsskogtakseringens takstomdrev fra 1990 til 2016. NIBIO Rapport: 6(44).

Swedish Board of Agriculture, Statens Jordbruksverk. 2011. Jordbruket i siffror åren 1866–2007. Serie: Sveriges officiella statistik. Jordbruksverket, Jönköping.

Szépligeti, G. 1899. Beitrage zur Kenntnis der ungarischen Ichneumoniden. II., Termeszetrajzi Fuzetek. 23(1900): 1–38.

Tamura, K., Stecher, G. & Kumar, S. 2021. MEGA 11: Molecular Evolutionary Genetics Analysis Version 11. Molecular Biology and Evolution https://doi.org/10.1093/molbev/msab120.

Thomson, C.G. 1877. XXVII. Bidrag till kännedom om Sveriges Pimpler. – Opuscula Entomologica. Lund. VIII, 732–777.

Thunberg, C.P. 1822. Ichneumonidea, Insecta Hymenoptera illustrata, Memoires de l'Academie Imperiale des Sciences de Saint Petersbourg. 8: 249–281.

Townes, H.K., Townes, M., Walley, G.S. & Townes, G. 1960. Ichneumon-flies of American north of Mexico: 2 Subfamily Ephialtinae, Xoridinae, Acaenitinae. – United States National Museum Bulletin. 216(2): 1– 676.

Uchida, T. 1928. Dritter Beitrag zur Ichneumoniden-Fauna Japans. – Journal of the Faculty of Agriculture, Hokkaido University. 25: 1–115.

Varga, O. 2014. A review of the genus *Xorides* Latreille, 1809 (Hymenoptera, Ichneumonidae, Xoridinae) in the Ukrainian Carpathians. – Journal of Insect Biodiversity, 2(7) Available at: http://dx.doi.org/10.12976/jib/2014.2.7

Varga, O. 2019. Revision of the Afrotropical *Xorides* Latréille, 1809 (Hymenoptera, Ichneumonidae, Xoridinae), with description of three new species. Zootaxa. 4638(1): 057–080.

Varga, O. 2020. New species of the genus *Xorides* Latréille, 1809 (Hymenoptera, Ichneumonidae, Xoridinae) from Kenya. Journal of Insect Biodiversity, 15 (2): 40–43.

Wang, S. F. & Gupta, V. K. 1995. Studies on the xoridine ichneumonids of China (Hymenoptera: Ichneumonidae: Xoridinae). Oriental Insects 29: 1–21.

Westin, A., Lennartsson, T. & Ljung, T. 2022. Skogsbeten och Bondeskogar, Historia, ekologi, natur- och kulturmiljövård. Riksantikvarieämbetet, SLU Centrum för biologisk mångfald, Naturvårdsverket, Skogsstyrelsen. 360 pp.

Yu, D.S.K., van Achterberg, C. & Horstmann, K. 2016. Taxapad 2016, Ichneumonoidea 2015 (Biological and taxonomical information), Taxapad Interactive Catalogue Database on flash-drive. – Nepean, Ottawa.

Sammanfattning

De skandinaviska arterna av brokparasitsläktet *Xorides* Latreille, 1809 revideras och studien identifierar 13 arter som förekommande i Sverige och 11 i Norge. Samtliga nordeuropeiska arter parasiterar vedlevande långhorningar och praktbaggar. En art, *Xorides hilszczanskii* Johansson **sp. nov.**, parasit på grön aspvedbock *Saperda perforata* bekrivs som ny för vetenskapen utifrån material insamlat i Polen. Sex nya synonymer etableras: *Xorides minutus* (Clément, 1938) **syn. nov.** till *Xorides praecatorius* (Fabricius, 1793), *Xorides niger* (Pfeffer, 1913) **syn. nov.** till *Xorides fuligator* (Thunberg, 1824), *Xorides hedwigi* Clément, 1938 **syn. nov.** till *Xorides sapporensis* (Uchida, 1928). *Xorides berlandi* (Clément, 1938) **syn. nov.**, *X. asiasius* Sheng & Hilszczański 2009 **syn. nov.** och *Xorides cinnabarinus* Sheng & Hilszczański 2009 **syn. nov.** synonymiseras med *X. indicatorius* (Latreille, 1806). *Xorides sordator* (Thunberg, 1824) **stat. rev.** är det giltiga namnet på den art som tidigare behandlats under namnet *Xorides fuligator* (Thunberg, 1824). En illustrerad bestämningsnyckel till Nordeuropas arter presenteras. Avslutningsvis diskuteras parasitsteklarnas potentiellt revolutionerande roll i studier av boreala skogsekosystem och deras funktion som mångfaldsindikatorer och signalarter för hållbart brukade skogar.