

# The first European records of the pantropical genus *Bambara* VUILLET, and a review of the immigrant featherwing beetles in Europe (Coleoptera: Ptiliidae)

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## Abstract

The Nearctic featherwing beetle *Bambara fusca* (DYBAS, 1966) and the pantropical *B. contorta* (DYBAS, 1966) are reported from north-western Germany, being the first European records of the genus *Bambara* VUILLET, 1911 (Coleoptera: Ptiliidae). They are regarded as recent immigrants, possibly introduced by the import of sawmill products. Diagnostic characters are briefly described, illustrated and keyed, and an extension of the key to the Central European genera of Ptiliidae by BESUCHET (1971) is given. The 14 *Bambara* species of the world are tabulated with their distribution known so far. Previous introductions of 11 further ptiliid species into Europe are summarized and discussed and the oldest known records, or the references referring to such, are accounted for. Parthenogenesis by European species of Ptiliidae is shown to be statistically highly correlated with immigration ( $P < 0.001$ ) and, thus, a powerful tool for dispersal. *Ptinella johnsoni* RUTANEN is reported from Norway, *Baeocrara japonica* (MATTHEWS) from Belarus and Slovakia, and *Acrotrichis insularis* (MÄKLIN) from the Czech Republic for the first time.

**Key words:** Coleoptera, immigrant, introduction, dispersal, checklist, Ptiliidae, key, *Bambara*, Dybas, Europe, sawmill, parthenogenesis, *Acrotrichis*, *Ptinella*, *Baeocrara*.

## Introduction

Improved communications on a worldwide scale has been postulated to account for accelerated rates of dispersal and man-induced introductions of new groups of organisms in recent years. Organisms with high dispersal abilities and/or with ecological tendencies of association to man's activities are the main targets of this process. Featherwing beetles (Ptiliidae) provide good examples of such organisms. The comparatively high incidence of thelytoky, high generation turn over, small size and specific alar structures promoting highly effective flight ability are qualities shared by many ptiliid species. When these are at hand in species associated with ephemeral, man-made or man-induced habitats such as compost heaps, stable manure, saw dust piles, grass cuttings and plantations the conditions are favourable for "artificial" dispersal via trans- and intercontinental communications.

The European fauna of Ptiliidae is a mixture of autochthonous, original elements and foreign elements, some of the latter probably having invaded Europe during the last millenium of expanding interterritorial human communications. There is practically no scientific proof for those species having appeared during early stages of human history and we can only guess at what species are likely candidates in that scenario. However, for those species which invaded Europe rather recently (about the last hundred years) proofs are accumulating and, perhaps, of more convincing nature. Thus, there are several examples of recently introduced species among the Ptiliidae in the European fauna some of which were certainly caused by man, others possibly of more dubious origin (SÖRENSON 2003). The examples encompass several genera and below

are listed those species introduced in Europe during this century (Table 2). The fact that several species were introduced very recently suggests that this process is far from ended and that most likely we will be able to observe this phenomenon over and over again in the future.

This paper presents a new example of a recent introduction of foreign ptiliid species in Europe. Through the courtesy of Mr. Heinrich Meybohm (Stelle) the first author was able to study six specimens of two featherwing beetle species recently caught by Mr. Meybohm at various sites near Hamburg in north-western Germany. Closer examination revealed that they belonged to *Bambara* VUILLET - a pantropical genus with some 14 species known. Surprisingly, two different species were involved: three specimens belonged to *Bambara fusca* (DYBAS, 1966), previously only known from the south-eastern USA, while the three remaining specimens proved identical to the pantropical relative *B. contorta* (DYBAS, 1966). The odd incidence of a simultaneous appearance outside Hamburg, north-western Germany, suggests a possible common source of dissemination.

#### ACRONYMS

NISK Norsk Institutt for Skogforskning (Norway), coll. E. Sundt

ZMLM Zoological Museum of the Lomonosov University of Moscow

ZMUL Zoological Museum of the University of Lund

### *Bambara* VUILLET

*Bambara* VUILLET, 1911: 159

*Eurygyne* DYBAS, 1966: 15 (syn. in JOHNSON 1968: 76)

TYPE SPECIES: *Bambara joannis* VUILLET, 1911 (SENEGAL) by original monotypy.

TAXONOMIC HISTORY: The genus *Bambara* was described by VUILLET (1911) for the single species *B. joannis*. DYBAS (1966) erected *Eurygyne* as a new genus with eight new species and simultaneously transferred five other species previously described in other genera to *Eurygyne*, among them *Acrotrichis elongatula* MOTSCHULSKY, 1869 and *Throscidium nidicola* PAULIAN, 1952. JOHNSON (1968) synonymized *Eurygyne* with *Bambara* and *Eurygyne lutea* DYBAS, 1966 with *Bambara testacea* (BRITTEN, 1926), the latter species originally described as *Throscidium testaceum* BRITTEN. JOHNSON (1971) added *Bambara sublutea* as a new species. DYBAS (1971) confirmed *Trichopteryx invisibilis* NIETNER, 1857 as belonging to *Bambara*, while JOHNSON (1982) confirmed *Throscidium brunneum* BRITTEN, 1926 as belonging to *Bambara* giving it precedence over the younger synonym *Bambara suteri* (DYBAS, 1966). JOHNSON (1985) added *Bambara dybasi* as a new species. DYBAS & DYBAS (1981) figured and illustrated sperms of six undescribed species.

Currently, there are altogether fourteen valid species known of *Bambara* in the world. In addition, syntypes of *Myrmicotrachis subvittata* MOTSCHULSKY, 1869 apparently also belong to *Bambara* (SÖRENSSON unpubl.) but the species identity has not been further investigated and it was excluded from the checklist presented below (Table 1). Evidently, *Bambara* is a genus prolific in species, at least in the New World tropics. DYBAS (1978: 93) stated that he knew of 40 species from the New World, most of them undescribed from the Neotropical zone. About half of them seemed to be parthenogenetic. Hence, numerous species still await description, mainly from tropical areas.

DIAGNOSIS: A compact, somewhat broad and flat, finely and densely pubescent genus, often of more or less paler colour with rather short elytra and an anteriorly tapering pronotum being widest across base, thereby reminding externally of smaller species of acrotrichine Ptiliidae (cf. Fig. 2). It may be easily distinguished from these and other ptiliid genera on the basis of contiguous, laminate metacoxae (Fig. 1, mtx) in combination with separate abdominal tergites IX and X (Fig. 7), eleven-segmented antennae, posterior emargination of eyes (Fig. 1, em), very

short prothoracal venter (Fig. 1), simple median keel anterior to mesocoxae (Fig. 1, mk), short unidental intermetacoxal condyle (Fig. 1, cd), and rounded, non-dental pygidial apex (Figs. 1, 7, py). Males rarely collected.

SYSTEMATICS: *Bambara* is a genus of uncertain relationships to other ptiliid genera. It is currently placed in the heterogenous subfamily Ptiliinae but seems to take a rather isolated position.

Table 1: Checklist of the world species of *Bambara* with their known distribution. F = only females known, probably parthenogenetic. MF = both males/females known. Data on distribution from DYBAS (1966, 1971), DYBAS & DYBAS (1981), JOHNSON (1968, 1971, 1982, 1985, 1989, 1993, 2003).

| Species name                                                           | World distribution                                                                                | Status |
|------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------|--------|
| <i>B. brunnea</i> (BRITTEN, 1926)<br>(= <i>B. suteri</i> (DYBAS, 1966) | Florida, Panama, Galapagos Is., Trinidad, Cap Verde Is., Mascarenes, Seychelles                   | F      |
| <i>B. contorta</i> (DYBAS, 1966)                                       | Florida, Trinidad, Galapagos Is., Nigeria, North Yemen, South Yemen, Germany                      | F      |
| <i>B. dybasi</i> JOHNSON, 1985                                         | Mascarenes, Madagascar                                                                            | F      |
| <i>B. elongatula</i> (MOTSCHULSKY, 1869)                               | Panama                                                                                            | ?      |
| <i>B. frosti</i> (DYBAS, 1966)                                         | Florida, Bahamas, Galapagos Is., Mascarenes, Madagascar, Yemen, Jordan                            | F      |
| <i>B. fusca</i> (DYBAS, 1966)                                          | Eastern-south-eastern USA, Germany                                                                | F      |
| <i>B. intricata</i> (DYBAS, 1966)                                      | Bahamas                                                                                           | MF     |
| <i>B. invisibilis</i> (NIETNER, 1857)                                  | Sri Lanka (Ceylon), Nepal, Mascarenes                                                             | MF     |
| <i>B. joannis</i> VUILLET, 1911                                        | Senegal                                                                                           | F      |
| <i>B. nidicola</i> (PAULIAN, 1952)                                     | Ivory coast                                                                                       | ?      |
| <i>B. steevesi</i> (DYBAS, 1966)                                       | Florida, Galapagos Is.                                                                            | F      |
| <i>B. sublutea</i> JOHNSON, 1971                                       | Bismarck Is., Solomon Is.                                                                         | F      |
| <i>B. testacea</i> (BRITTEN, 1926)<br>(= <i>B. lutea</i> (DYBAS, 1966) | South-eastern USA, Bahamas, Bermuda, Madagascar, Seychelles, Mascarenes, Bismarck and Solomon Is. | F      |
| <i>B. wagneri</i> (DYBAS, 1966)                                        | Florida, Marianas, Saipan Is., Mascarenes, Sri Lanka                                              | MF     |

KEY: In the key to Central European genera of Ptiliidae (BESUCHET 1971) *Bambara* keys out in couplet 8 with *Euryptilium* MATTHEWS. Although species of *Euryptilium* usually differ externally from species of *Bambara* by their larger size and much more elongate bodyform, some *Bambara* species, e.g. the unusually elongate *Bambara contorta* (DYBAS), strongly remind of an *Euryptilium* and, hence, might easily be confused. These problems can be avoided by changing the key to also include the genus *Bambara* (p. 313):

- 8    Grösste Hsch.Breite an der Basis. H.Hü. sehr genähert (Fig. 1, mt<sub>x</sub>). Pygidium in 2 kleine Spitzchen endend oder ganz ungezähnt (Figs. 1, 7, py) [Pronotum widest basally. Metacoxae almost contiguous (Fig. 1, mt<sub>x</sub>). Pygidial apex bifid or non-dentate (Figs. 1, 7, py)]..... 8a
- Grösste Hsch.Breite vor der Basis. H.Hü. breiter getrennt. Pygidium in ein kleines Spitzchen endend oder mehrfach gezähnt [Pronotum widest before base. Metacoxae more or less widely separated. Pygidial apex unidentate or serrate]..... 9

- 8a Grösser (0,75 - 0,9 mm). Körperform gestreckt, Fld. lang [G. 7.2]. Pygidium in 2 kleine Spitzchen endend. Augen hinten nicht ausgehöhlt. Kein Kiel vor M.Hü. Kondyl zwischen H.Hü. mit zwei Spitzchen [Larger (0.75 - 0.9 mm). Body elongate with long elytra, rather slender. Pygidial apex bifid. Eyes normal. Median mesosternal keel absent. Intermetacoxal condyle bifid] ..... **7 *Euryptilium* Matth. S. 324**
- Kleiner (0,6 - 0,7 mm). Körperform oft gedrungener mit kürzeren Elytren (Fig. 2). Pygidium ganz ungezähnt (Figs. 1, 7, py). Augen hinten ausgehöhlt mit scharfer Kante (Fig. 1, em). Deutlicher aber kurzer Kiel vor M.Hü. (Fig. 1, mk). Kondyl zwischen H.Hü. mit einfacher Spitze (Fig. 1, cd) [Smaller (0.6 - 0.7 mm). Body usually more compact, elytra shorter (Fig. 2). Pygidial apex non-dentate (Figs. 1, 7, py). Eyes posteriorly emarginate, forming a flange (Fig. 1, em). Distinct, rather short median mesosternal keel present (Fig. 1, mk). Intermetacoxal condyle simple (Fig. 1, cd)] ..... **7a *Bambara* Vuillet**

### ***Bambara fusca* (DYBAS)**

*Eurygyne fusca* DYBAS, 1966: 28

*Bambara fusca*; JOHNSON, 1968: 76

#### **EUROPEAN MATERIAL:**

GERMANY: 1 ♀: Niedersachsen [Niederelbegebiet] Holtorfsloh, Kreisstadt Winsen/Luhe 18-VIII-1997 "Autokätscher" 2626-4-02, leg. Meybohm (coll. Sörensson); 2 ♀: Niedersachsen [Niederelbegebiet] Holtorfsloh, Kreisstadt Winsen/Luhe 21-VIII-1997 "Autokätscher" 2626-4-02, leg. Meybohm (coll. Meybohm; coll. Sörensson); 1 ♀: Schleswig-Holstein Forst Beimoor, Kreisstadt OD 3-VIII-1998 "Autokätscher" 2327-2-04, leg. H. Meybohm (coll. Meybohm).

**DIAGNOSIS:** Easily distinguished from other European ptiliid species by its almost contiguous metacoxae, compact (*Acrotrichis*-like) body form with largest width across the base of pronotum, rearwards tapering elytra and unique spermatheca.

**DESCRIPTION:** Length of body (dry condition; n = 3): 0.62 - 0.63 mm. Pronotum width: 0.32 - 0.33 mm, length: 0.19 mm. Dark, blackish-brown species with contrasting pale yellow antennae and legs; "*Acrotrichis*-like". Body rather compact, domed, widest across basal pronotum, not constricted between thorax and elytra (Fig. 2). Dorsal surface finely and densely pubescent, hairs decumbent; puncturation fine, dense, microreticulation weak. Head shiny with weak but still distinct irregular punctures. Eyes small. Antennal flagellar mid-segments (IV-VII) about 3x longer than wide. Pronotum about 1.6 - 1.7x wider than long, prominent, wider than elytra at shoulders, widest across hind angles, with dense, fine, more or less irregular, stippled puncturation, basally with a tendency to form transverse rows; pronotal surface rather shiny due to weak microreticulation; pronotal sidemargin not demarcated by impression, weakly and evenly curved; pronotal hindmargin partly yellowish along narrow strip, very faintly and narrowly notched at posterior corners. Mesosternal "collar" with hind margin not extending on to sternal humeri (cf. Fig. 1, cl). Elytra somewhat shiny, distinctly tapering rearwards; microreticulation fine; stippled puncturation fine, dense, arranged in a regular 'rhomboid' fashion (Fig. 2). Metacoxae rounded posteriorly, not angular. Female spermatheca simply built (Fig. 5).

Male unknown. Probably a parthenogenetic species (DYBAS 1966).

**LARVA:** Unknown.

**ECOLOGY:** European specimens were collected by "Autokätscher" [car net] driven along winding mixed forest roads intermingled by meadows and open fields. Berlesed from leaf litter, oak-pine compost and one beech tree hole in areas close to the Gulf of Mexico, Florida (USA) (DYBAS 1966). Further away from coastal areas in other parts of south-eastern and central USA only found in sawdust piles left from sawmill activities (DYBAS 1966). Also found flying in the air above such piles and at light. According to H. Meybohm (pers. comm.) the sudden presence in the Hamburg-area is likely not to be accidental, since collections made in similar ways during

previous years along the same driving routes yielded no specimens. Therefore, a recent introduction, possibly via timber or some wood products, seems the most probable explanation for the recent occurrence. Obviously *B. fusca* and *B. contorta* have established firm populations in the Hamburg-area since specimens have been caught repeatedly during several years.

DISTRIBUTION: Central-south-eastern USA, Germany.

### *Bambara contorta* (DYBAS)

*Eurygyne contorta* DYBAS, 1966: 38

*Bambara contorta*; JOHNSON, 1968: 76

#### EUROPEAN MATERIAL:

GERMANY: 1 ♀: Niedersachsen [Niederelbegebiet] Achterdeich, Kreisstadt Winsen/Luhe 25-VIII-1997 "Autokätscher" 2526-4-11, leg. Meybohm (coll. Sörensson); 1 ♀: Niedersachsen [Niederelbegebiet] Achterdeich, Kreisstadt Winsen/Luhe 31-VII-1999 "Autokätscher" 2526-4-11, leg. Meybohm (coll. Meybohm); 1 ♀: Niedersachsen [Niederelbegebiet] Holtorfsloh, Kreisstadt Winsen/Luhe 11-VIII-1998 "Autokätscher" 2626-4-02. leg. Meybohm (coll. Sörensson).

DIAGNOSIS: Distinguished from other European ptiliid species by its small size, almost contiguous metacoxae, elongate (*Euryptilium*-like), parallel body form and unique spermatheca. For differences in relation to *Euryptilium*, see generic key above.

DESCRIPTION: Length of body (dry condition;  $n = 2$ ): 0.60 - 0.61 mm. Pronotum width: 0.28 mm, length: 0.18 mm. Dark, blackish-brown species with contrasting pale yellow antennae and legs; "*Euryptilium*-like". Body elongate, somewhat flat, widest across mid elytra, slightly constricted between thorax and elytra (Fig. 3). Dorsal surface rather shiny, finely and densely pubescent, hairs decumbent; puncturation fine, rather dense, microreticulation weak. Head shiny with weak but still distinct irregular punctures and faint reticulation. Eyes comparatively large. Antennal flagellar segments (IV-VII) about 2-3x longer than wide. Pronotum comparatively small, only a good half wider than long, not wider than elytra, widest in rear third, with dense, fine, more or less irregular stippled puncturation, medially and basally usually forming obliquely transverse rows; pronotal surface rather shiny due to weak microreticulation; pronotal sidemargin not demarcated by impression, very weakly curved; pronotal hindmargin only faintly lightly coloured, notch at posterior angles absent. Mesosternal "collar" posteriorly widened, with hind margin extending on to sternal humeri (Fig. 4). Elytra somewhat shiny, parallel; microreticulation rather fine, distinct; stippled puncturation distinct, rather dense, arranged in a somewhat obscurely 'rhomboid' fashion (Fig. 3). Metacoxae rounded posteriorly, not angular. Female spermatheca simply built (Fig. 6).

Male unknown. Probably a parthenogenetic species (DYBAS 1966).

LARVA: Unknown.

ECOLOGY: European specimens were collected by means of a car net ("Autokätscher") used along winding mixed forest roads intermingled by meadows and open fields. Berlesed from leaf litter, compost debris and logs in Florida (USA) (DYBAS 1966). Sieved from humid litter in South Yemen at an altitude of 1350 m (JOHNSON 1989). Also taken at light. Widely spread in the tropics (JOHNSON 1989) and thought to be restricted to that zone. The peripheral occurrence in north-western Europe is therefore much surprising. Apparently *B. contorta* has established firm populations in the Hamburg-area since specimens have been caught repeatedly during several years.

DISTRIBUTION: Germany, North Yemen, South Yemen, Nigeria, USA (Florida), Trinidad, Galapagos Islands. Pantropical species.

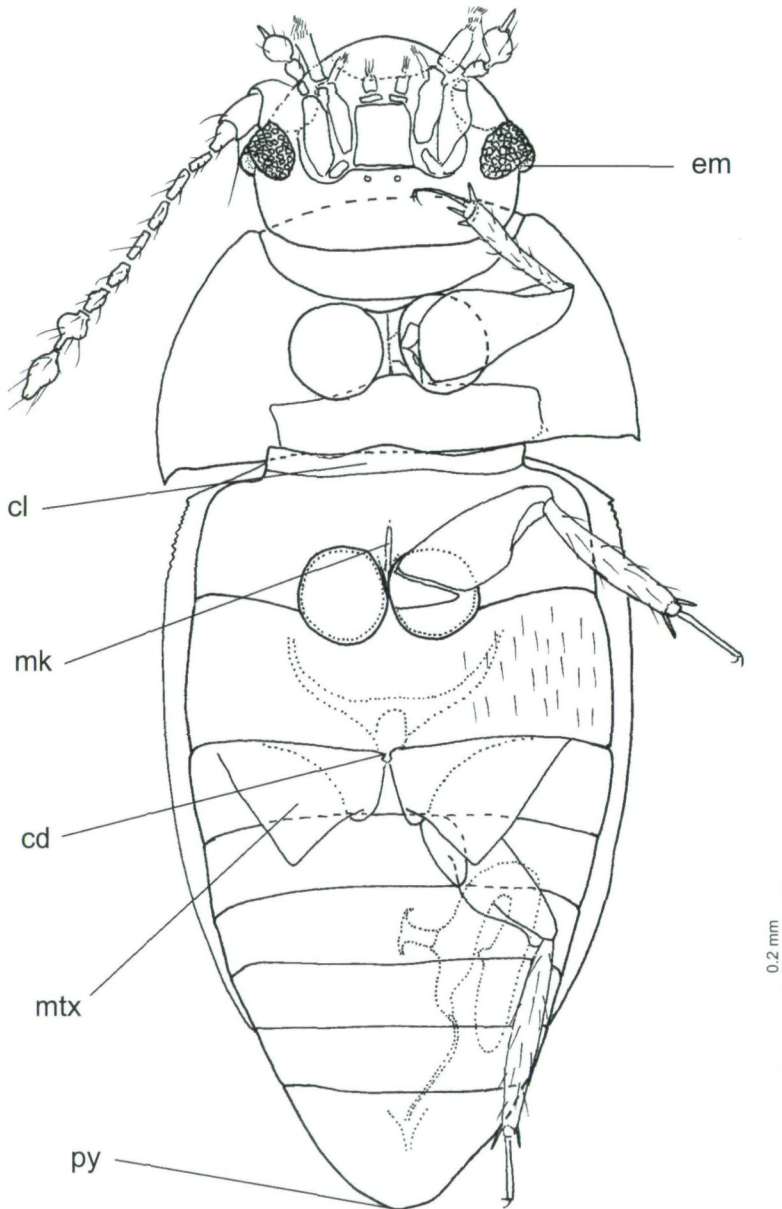
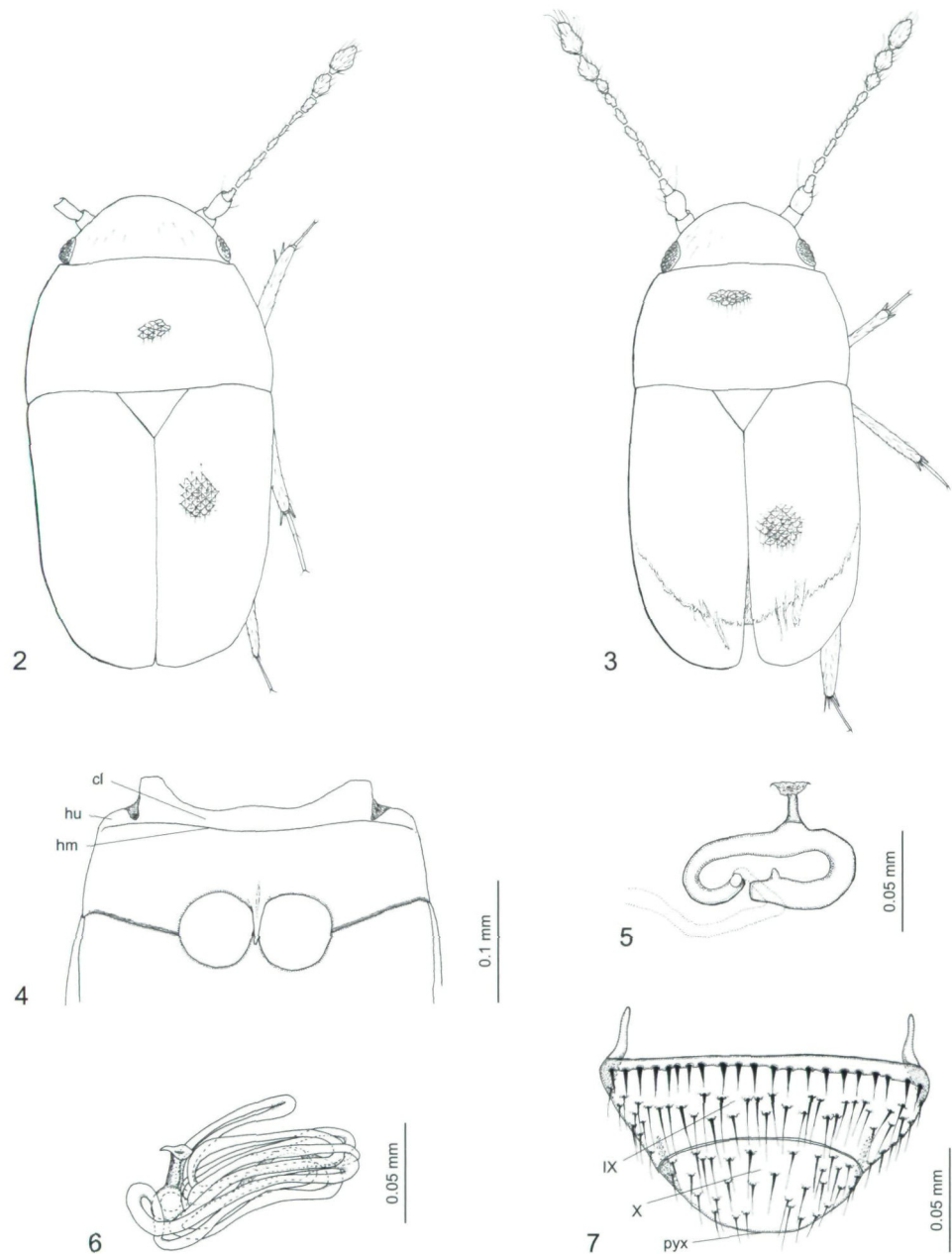


Fig. 1: Venter of *Bambara testacea*; em = emarginate eye with flange; cl = mesosternal collar (Kragen); cd = intermetacoxal condyle; mk = mesosternal median keel; mtx = metacoxae; py = pygidial apex.



Figs. 2 - 7: 2) *Bambara fusca*, habitus, length of body: 0.63 mm; 3) *B. contorta*, habitus, length of body: 0.61 mm; 4) *B. contorta*, mesosternal venter; cl = collar (Kragen); hm = hindmargin of collar; hu = mesosternal humeri; 5) *B. fusca*, female spermatheca; 6) *B. contorta*, female spermatheca; 7) *B. fusca* (female), abdominal tergites IX and X (pygidium), dorsal view; pyx = pygidial apex.

### Key to European species of *Bambara*

- 1 Körper etwas gedrungen. Hsch. deutlich breiter als Fld. (Fig. 2). Fld. hinten verengt. M.Br.Kragen kurz, hinten nicht erweitert, die Brustschultern nicht erreichend (vgl. Fig. 1, cl). Spermatheca kompliziert (Fig. 5) [Body more compact. Pronotum distinctly wider than elytra. Elytra tapering rearwards (Fig. 2). Mesosternal 'collar' narrow, posteriorly not extending on to mesosternal humeri (cfr. Fig. 1, cl). Spermatheca complicated (Fig. 5)]..... *fuscata*
- Körper schlank, gestreckt. Hsch. nicht breiter als Fld. (Fig. 3). Fld. parallel. M.Br.Kragen lang, hinten erweitert, die Brustschultern erreichend (Fig. 4, cl). Spermatheca einfach (Fig. 6) [Body slender, elongate. Pronotum not wider than elytra (Fig. 3). Elytra parallel. Mesosternal 'collar' widened posteriorly, extending on to mesosternal humeri (Fig. 4, cl). Spermatheca simple (Fig. 6)]..... *contorta*

REMARKS: Although most species of *Bambara* seem to be restricted to the tropics some species obviously may survive cooler climates, at least temporarily, as shown by the records above. Further species may therefore turn up in the future. A potential future species in Europe is *Bambara frosti* (DYBAS), described from Florida and widely distributed in the tropics, however, also recorded from Jordan and North Yemen in the Palearctic (JOHNSON 1989). It is closely related to *B. testacea* and *B. invisibilis*. For discrimination and structure of spermatheca, see DYBAS (1966) and JOHNSON (1985, 1989).

### The immigrant species of Ptiliidae in Europe

In order to be labelled as an immigrant or invasive species in Europe ideally at least two prerequisites are needed: undisputable evidence of an extra-European occurrence of older age and undisputable evidence of a later appearance and sudden/continuous expansion of its range in Europe. Not infrequently, however, one of them is not fulfilled thereby obscuring a proper evaluation and correct labelling. More time and/or further studies may sometimes solve such dilemmas but occasionally their status remain unclear.

In Table 2 all European Ptiliidae known to the authors as safe and more or less recent (i.e. 20<sup>th</sup> century first records) immigrants are listed. The single 19<sup>th</sup> century record previously given (cf. JOHNSON 1987) for *Acrotrichis henrici* (MATTHEWS) (as syntypic material of *Acrotrichis fratercula* (MATTHEWS)) is now being considered erroneous and a result of mislabelling (Johnson, unpubl.).

From the list of primary immigrant countries it can be deduced that two main routes for dispersal into Europe have been (and probably are) present: one via Great Britain/western Europe and one via Finland and north-eastern Scandinavia. It is interesting to note that only one species arrived via southern Europe (*Acrotrichis sanctaehelenae* JOHNSON). Two further, southern species are potential members of the list (*Ptiliolum africanum* PEYERIMHOFF; *Ptinella mekura* KUBOTA) but for the time being they are not included due to our unsatisfactory knowledge of the fauna of most Mediterranean countries.

As with many other organisms sea harbours and other centers of communication probably played an important role for the dissemination of ptiliids into Europe. The present distribution of, e.g. *Ptinella simsoni* (MATTHEWS) around London and Liverpool and the recent finds of two *Bambara* species near Hamburg (Germany) suggest such an invasive pattern. The frequent import of timber and wood products from Russia, North America and other remote places has probably facilitated dispersal of various species living under bark, like some *Ptinella* species, others, like some compost/dung dwellers, might have been introduced via garden products. For a few species the possibility of a natural spread and advancement from the eastern Palearctic westwards through the taiga into Finland seems likely (e.g. *Ptinella johnsoni* RUTANEN, *Baeocrara japonica* (MATTHEWS) and *Acrotrichis cognata* (MATTHEWS)). In such cases



dispersal also might have been facilitated by man somewhere underway since they would otherwise have been already present in Europe long time ago.

The majority of the ptiliid species included in the list of immigrants (nine out of thirteen) is in Europe recorded only in the female sex. Some of them are known from both sexes in their respective "ancestral areas" or areas of origin (e.g. most parthenogenetic species of *Acrotrichis* MOTSCHULSKY) whereas in others the male is completely unknown. As has been stated before (DYBAS 1966) parthenogenetic females provide a powerful tool for rapid dissemination and colonization of new sites and environments, hence, it is not a surprise to find a high degree of parthenogenesis within the immigrant ptiliid fauna of Europe. About half the number of species in Table 2 occurs predominantly in ephemeral, very unstable habitats such as dung, compost heaps, rotting fungi, etc. Another group (i.e. most species of *Ptinella* MOTSCHULSKY) lives under bark of rotting or dying trees, which is also a kind of unstable, unpredictable habitat. Only *Acrotrichis henrici* is safely said to be bound to an ecologically more stable habitat (humid leaf litter in swamps, at lake shores, stream margins etc).

The comparatively high incidence of parthenogenesis among European ptiliid immigrants suggests a tight connection between dispersal power and reproduction mode. According to e.g. DYBAS (1966, 1978), small size, maturing of only one egg at a time, and flight wing polymorphism are features facilitating a high degree of thelotoky. In fact, Ptiliidae seem to show the highest relative abundance of parthenogenesis within the whole Coleoptera (DYBAS 1978). Since dispersal in general is facilitated by accomplishment of parthenogenesis it is not surprising to find a high incidence in the Ptiliidae. Combined with flight wings apt for dispersal by stronger wind currents and modest ecological requirements the prerequisites for colonising new areas are excellent.

A simple statistical test shows that the incidence of parthenogenesis among European ptiliid species is strongly correlated with immigrating behaviour, dispersal and distribution pattern. From a total of 127 ptiliid species occurring in Europe (excluding Caucasus and Turkey east of the Bosphorus, including the Atlantic islands) 11 are regarded as parthenogenetic. Nine species out of 11 are being labelled as immigrants. The remaining two are currently being regarded as autochthonous elements. Among the immigrants nine species out of 13 seem to be parthenogenetic (see Table 2). This is an overwhelming majority as compared to the relationship among the autochthonous species (4/114) and this deviation from the 'normal distribution' is statistically highly significant as shown by testing for the independence in a 2x2 table (chi-square with Yates correction = 58.9; d.f. = 1;  $P < 0.001$ ).

These figures suggest that most (if not all? - see e.g. discussion on *Ptinella mekura* in DYBAS (1978)) parthenogenetic species of Ptiliidae in Europe are non-residents having immigrated more or less recently, obviously as a result or with the aid of human activities and interactions. Consequently, it may be postulated that future discoveries of 'new' ptiliid species in Europe may either refer to previously undetected, naturally occurring faunal elements if bisexual or to foreign immigrants if parthenogenetic.

It should be pointed out that further ptiliid taxa in Europe might very well be the result of 'older' immigrations having taken place further back in history (last millenium). Especially anthropophilic species showing more or less close affinities to man-made products such as compost, stables, cattle dung, etc. may belong to that section. Examples include e.g. *Nephanea titan* (NEWMAN), *Acrotrichis grandicollis* (MANNERHEIM) and *A. sericans* (HEER), and species of genera such as *Oligella* MOTSCHULSKY and *Ptiliola* HALDEMAN.

Aside from species of the genus *Bambara* (see above) there are other species which may turn up in a near future in Europe. *Acrotrichis* (*Ctenopteryx*) *discoloroides* JOHNSON, a further parthenogenetic, anthropophilic ptiliid species, recently recorded from various sites in eastern

USA (SÖRENSON 2003) and widely spread in disturbed areas in tropical-subtropical parts around the globe, is a potential future immigrant and expected to occur in southern Europe.

Table 2: Oldest records and probable origin of assumed immigrant species of Ptiliidae in Europe (mainland). Arranged after year of first record. P = parthenogenetic species in Europe, only females known. For details and references, see text.

| Species name                                    | Year | Country        | P | Origin            |
|-------------------------------------------------|------|----------------|---|-------------------|
| <i>Ptinella errabunda</i> JOHNSON, 1975         | 1925 | Britain        | P | Australia         |
| <i>Ptinella simsoni</i> (MATTHEWS, 1878)        | 1929 | Britain        | - | Australia         |
| <i>Acrotrichis cognata</i> (MATTHEWS, 1877)     | 1932 | Sweden         | P | North America     |
| <i>Ptinella cavelli</i> (BROUN, 1893)           | 1936 | Britain        | P | New Zealand       |
| <i>Acrotrichis insularis</i> (MÄKLIN, 1852)     | 1965 | Norway/Britain | P | North America     |
| <i>Acrotrichis henrici</i> (MATTHEWS, 1872)     | 1966 | Britain        | P | North America     |
| <i>Ptinella taylorae</i> JOHNSON, 1977          | 1967 | Britain        | - | New Zealand       |
| <i>Acrotrichis sanctaehelenae</i> JOHNSON, 1972 | 1970 | Portugal       | - | ?Atlantic islands |
| <i>Baeocrara japonica</i> (MATTHEWS, 1885)      | 1974 | Finland        | - | E. Palearctic     |
| <i>Ptinella johnsoni</i> RUTANEN, 1985          | 1978 | Sweden/Finland | P | ?E. Palearctic    |
| <i>Acrotrichis josephi</i> (MATTHEWS, 1872)     | 1987 | Britain        | P | North America     |
| <i>Bambara fusca</i> (DYBAS, 1966)              | 1997 | Germany        | P | E. USA            |
| <i>Bambara contorta</i> (DYBAS, 1966)           | 1997 | Germany        | P | ?E. USA           |

### *Ptinella errabunda* JOHNSON

This might be the oldest British immigrant species of Ptiliidae. Described on the basis of material from a large number of British localities (JOHNSON 1975a). Although common today no records older than from 1925 are known from Great Britain. JOHNSON (1975a) suspected a possible New Zealand origin based on the parallel occurrence of *Ptinella cavelli* (BROUN), see below. However, since it has still not been found in New Zealand, the species is probably Australian, especially since species of a similar form (but unstudied yet) occur there. *Ptinella errabunda* has slowly expanded its range outside Britain. On the continent it first appeared in 1989 in western Germany (LUCHT 1992) and soon after in 1991 in Holland (VORST 1993). It is also known from Ireland (ANDERSON et al. 1997). Its wide and rapid spread in Great Britain is at least in part due to its parthenogenetic nature, only females being known.

### *Ptinella simsoni* (MATTHEWS)

Although first described from Tasmania (as *Ptilium simsoni* MATTHEWS) this species gained no notice until BRITTEN (1932) redescribed it from Windsor Forest as *Ptilium subvariolosum* BRITTEN, 1932. The first specimens were found in 1929 (Johnson, pers. obs.). Later, BESUCHET (1971) erected the new genus *Plitium* BESUCHET to accomodate it. The genus *Plitium* was, however, synonymized with *Ptinella* MOTSCHULSKY in JOHNSON (1982). It is regarded as an adventive species in England, mainly occurring in heaps of crass cuttings in wooded areas around certain large coastal cities, e.g. London, Liverpool (JOHNSON 1982). It is a bisexual, alate species and no continental records are known at present.

*Acrotrichis cognata* (MATTHEWS)

The first occurrences of *Acrotrichis cognata* (MATTHEWS) in Europe seem to represent the two main invasive routes for foreign Ptiliidae into Europe (see above). Originally described from western North America (British Columbia) it suddenly and rather simultaneously turned up in central Sweden 1932 (Sörensson, unpubl.) and Scotland in 1936 (Johnson, unpubl.), a few years later also in Finland (RENKONEN 1945). PALM (1947) and SUNDT (1958) both regarded *A. cognata* as an eastern immigrant, presumably because it did show up first in the taiga zone in the northern and central parts of Fennoscandia. Very probably it had already been present for a while when it was first detected. The dispersal westwards and southwards continued and it was recorded from central Norway in 1954 (Sörensson, unpubl.) and southern England in the 1960s (JOHNSON 1967). The jump across the Channel and the North Sea was made soon after and it was recorded from Denmark in 1984 (SÖRENSON 1988), from the Netherlands in 1984 (JANSEN & HEIJNSBERGEN 1986), and from western Germany a few years earlier [sometime before 1983] (LUCHT 1985). It is also known from Ireland (ANDERSON et al. 1997). In 2000 the first find from Austria and the Alps was made (JOHNSON 2003) and it will probably continue to disperse into forests and forested ecosystems on higher elevations in different parts of Central Europe.

*Acrotrichis cognata* uses ephemeral microhabitats such as dung, rotting fungi and carcasses, sometimes also heaps of grass and compost, often in shady sites. Its parthenogenetic nature (males are unknown in Europe) and excellent flight abilities facilitates rapid dissemination. On calm summer afternoons it can be seen in flight in great numbers along forest paths and road sides.

*Ptinella cavelli* (BROUN)

This is the largest among the four immigrant species of *Ptinella* in Great Britain. It occurs under bark of broadleaved as well as coniferous trees. Originally a New Zealand element it probably arrived with timber products, just as the other three species obviously did. The oldest British specimens date from 1936 (JOHNSON 1975c). Males are lacking and it is apparently a parthenogenetic species and, hence, of good dispersal ability. Yet, no continental finds have been made and only Ireland (ANDERSON et al. 1997) has been secondarily colonized up till now.

*Acrotrichis insularis* (MÄKLIN)

This North American species, originally described from Sitka, Alaska, is widespread in the western USA and Canada, the populations usually being made up only by females. It also occurs in eastern Canada (Sörensson, per. obs.) and is often found in rotting fungi, forest floor litter, dung, compost heaps, etc. In 1965 *A. insularis* almost simultaneously turned up in southernmost Norway and in the northern British Isles (JOHNSON 1966; SUNDT 1968). From these "bridgeheads" it apparently dispersed northeastwards and southeastwards, reaching Sweden in 1971 (GILLERFORS 1973), Denmark 1976 (PRITZL & MAHLER 1980), Germany 1977 (LOHSE & LUCHT 1989), Finland 1981 (RUTANEN 1982), Holland 1985 (JANSEN & HEIJNSBERGEN 1986), France 1993 (JOHNSON 2003), Austria 1995 (KAPP 1998) and the Czech Republic in 2000 [CZ: northern Moravia: 1 ♀: 5969/6/ Jeseníky-Praděd mt, 28.IX.2000, leg. M. Mantič "Vekykotel-prosev" (coll. Mantič)] (Sörensson, pers. obs.). During this period it was also recorded from Ireland (ANDERSON et al. 1997), Switzerland (LOHSE & LUCHT 1989) and the Azores (JOHNSON 2003). In 1972 *A. insularis* also first appeared on Madeira [MADEIRA: 1 ex.: Pico Alto 5.XI.1972 leg. T. Palm (ZMUL)] (Sörensson, pers. obs.). Apparently the spreading took place rapidly, facilitated by its parthenogenetic nature and ecological generalism. Today it is abundant in many parts of north-western Europe. In southern Sweden it might even be regarded as the most common *Acrotrichis* species of all. Often dominant in the air plankton fauna.

### *Acrotrichis henrici* (MATTHEWS)

*Acrotrichis henrici* was originally described from Vancouver Island, western North America. Subsequent investigations have proved it to be widespread in British Columbia and also further eastwards (Sörensson, pers. obs.). In Europe it surprisingly turned up in material collected in Yorkshire, England in 1966 (JOHNSON 1967). Later, JOHNSON (1987) by examining the nineteenth century type material of *Acrotrichis fratercula* (MATTHEWS, 1878) – a species described from Britain and found to be a junior synonym of *A. henrici* – concluded that the presumed introduction seemed to date further back. This notion has later been abandoned as indirect proof of Matthews' sometimes careless handling of labels and specimens have accumulated (Johnson, pers. obs.). Thus, the syntypical *A. fratercula* specimens are now being regarded as mislabelled and actually originating from North America (Johnson, unpubl.). *Acrotrichis henrici* is nowadays a common species in Britain (Johnson, pers. obs.). Lately, it has begun to slowly disseminate eastwards through continental Europe. It was thus recorded from Holland in 1982 (JANSEN & HEIJNSBERGEN 1986), southern Norway 1992 (SÖRENSON & KVAMME 1995), western Germany 1993 (SÖRENSON 2001), Denmark 1998 (HANSEN et al. 1999) and was in 2002 also recorded from southern Sweden (Sörensson, pers. obs.). In 2002 it was found as southerly as in Bavaria, south Germany (unpublished data). In Europe and many parts of North America only female populations are known. No doubt, parthenogenesis is a powerful tool for supporting dispersal and enhancing the efficiency of invasive power.

### *Ptinella taylorae* JOHNSON

*Ptinella taylorae* JOHNSON seems to be a rather recent introduction in Europe as no specimens taken before 1967 exist. The oldest specimens seen are from England [BRITAIN: 14 exs.: Freshfield (just north of Liverpool), leg. W.O. Steel, 4.IX.1967, "under bark" (Merseyside Museum, Liverpool)] (Johnson, pers. obs.). It is a woodland species occurring under bark of various trees and appears to be another immigrant from New Zealand introduced via the timber trade. It is as yet unknown on the continent but occurs in Ireland (JOHNSON 1990). The rather slow spreading of this bisexual species as compared to parthenogenetic congeners of close relationship is probably a typical trait.

### *Acrotrichis sanctaehelenae* JOHNSON

*Acrotrichis sanctaehelenae* JOHNSON was originally described from the Atlantic island St. Helena (JOHNSON 1972) based on material sampled in the high island mountains in 1965-67. However, already in 1930 it had been met with in the Azores, although filed under a different name and for long not recognized (JOHNSON 1975b). It is interesting to note that the oldest Madeiran specimens are of about the same age, viz. 1935 [MADEIRA: 1 ex.: Paul da Serra, Rabaçal, 1250 m leg. O. Lundblad, 29.VII.1935, "cow droppings" (NISK)] (Sörensson, pers. obs.). The extensive collectings made on the Atlantic islands during the last 75 years reveal a rather nice pattern of a slow, eastwardly advancing invasive front. Thus, the oldest Canary Islands specimens seen date back to 1964 [TENERIFE: 10 exs.: Puerto de la Cruz, 30.I.1964, leg. T. Palm (ZMUL)] (Sörensson, pers. obs.). The European mainland was "conquered" via Faro in southernmost Portugal in 1970 (JOHNSON 1975b), then followed by a rather rapid expansion northwards. The first southern England specimens were recorded in 1985 (JOHNSON 1987) and the first from France and Switzerland in 1987 (JOHNSON 2003). In Britain it has steadily expanded its range now reaching northern Wales (Johnson, pers. obs.). In southern Italy it appeared in 1999 [PUGLIA: 10 males, 11 females: Valenzano (BA), VI.-XII.1999, leg. L. de Marzo (coll. Sörensson)] (Sörensson, pers. obs.). Spanish mainland records fail but this is certainly only due to lack of sampling efforts.

The rapid spread of this bisexual species is probably due to its adaptation to anthropogenic environments and habitats such as dung, compost and other rotting organic substances. It will most probably continue to disperse in southern and Central Europe.

### *Baeocrara japonica* (MATTHEWS)

The dispersal and spreading of *Baeocrara japonica* (MATTHEWS) reminds of that of *Acrotrichis cognata* (see above). Both species utilize ephemeral habitats such as dung and compost and both obviously invaded Europe from the east, probably reaching the north-eastern parts first. Both also show a rather broad hemiboreal/boreal distribution pattern and might, at least theoretically, have been able to disseminate through the Russian taiga. *Baeocrara japonica* was described from Japanese material and first appeared in Finland 1974 (RUTANEN & MUONA 1977) and eastern Sweden 1976 (RUTANEN & MUONA 1977). Obviously, it invaded eastern Europe on a broad front. The oldest continental record (from eastern Germany) dates back to 1985 [GERMANY: 2 exs.: Lieske bei Bautzen, 6.VII.1985, leg. M. Sieber, "Luftkätscher" [air net] (coll. Sieber, coll. Sörensson)] (Sörensson, pers. obs.). It was collected in Hungary in 1987 (SÖRENSON & MERKL 1999), in Austria in 1992 (KÖHLER 1998), in the Czech Republic in 1993 (SÖRENSON & RŮŽIČKA 2001), and in Latvia in 1995 (BARSEVSKIS 2001). Later, it has also been recorded from Belarus in 1996 [BELARUS: 5 exs.: Vitebsk reg., 18.VIII.1996, leg. I.A. Solodovnikov, "kompost" (coll. Solodovnikov, coll. Sörensson)] and Slovakia in 2002 [SLOVAKIA OCC.: 3 exs.: 7173/2/ Opalovce, 27.X.2002, leg. M. Mantič, "stara slama-prosev" (coll. Mantič, coll. Sörensson)] (Sörensson, pers. obs.). In northern Europe it was recorded from Norway and western Scandinavia in 1989 (ØDEGAARD 1992). It reached Denmark in 1992 (HANSEN et al. 1993) and western Germany in 1997 (KÖHLER 1998). Thus, it seems as Central Europe was colonized via two main routes: one northern through Scandinavia and one eastern continental. The dispersal of the bisexual *B. japonica* much reminds of other ptiliid species confined to ephemeral habitats. It will certainly continue its spreading westwards through Central Europe, reaching France and Britain, possibly also the northern parts of southern Europe.

### *Ptinella johnsoni* RUTANEN

*Ptinella johnsoni* RUTANEN is evidently a recent introduction in Europe. It was almost simultaneously collected in southern Finland and central Sweden in 1978 (RUTANEN 1985) and was early presumed to have arrived from Russia, perhaps via the timber trade. However, no proof for its existence in Russia existed until recently when the first author identified window trap material from 1995 collected in the Moscow district [RUSSIA: 1 ex.: Moskovskaya oblast, Prioksk.-Terr. zap., 12.-20.VI.1995, leg. N.B. Nikitsky, "okannoye lovushki" (det. Sörensson; ZMLM)]. This (and later finds) supports the idea that *P. johnsoni* might have expanded its range through the Russian taiga. It also occurs in eastern North America, as seen from recent finds (SÖRENSON 2003). SÖRENSON (2003) ranked it as an indigenous faunal element implying a possible Nearctic/eastern Palearctic origin but this hypothesis needs corroborating by the existence of older finds from that area in the museum collections. The distribution and present occurrences indicate a rather pronounced affinity to the boreal/hemiboreal vegetation zone and it is assumed that it will continue its dissemination in suitable habitats in north-western and north-eastern Europe, possibly also in Central Europe. In fact, it was quite recently also identified from material taken by car net 1996 in South-Central Norway [NORWAY: 1 ex.: BV: Rollag Veggli, 20.VIII.1996, leg. B. Sagvolden "Car-net" (det. Sörensson, coll. Sagvolden)].

Although a rather limited material is available more and more localities in northern and central Scandinavia are becoming known. It seems, however, that almost all records refer to individuals taken in flight or by window traps, and only in the female sex. Obviously, like many of its

congeners, it is a parthenogenetic species whose spreading has been facilitated by this breeding system.

### *Acrotrichis josephi* (MATTHEWS)

*Acrotrichis josephi* (MATTHEWS) was originally described from Vancouver Island, western North America. It is widely spread in western North America and occurs rather frequently in various kinds of litter and rotting organic matter. Based on material probably imported from North America to southern New Zealand and some Subantarctic islands it was redescribed as *A. subcognata* JOHNSON (JOHNSON 1975c). In the summer of 1987 it was surprisingly collected from grass mowings in Britain, Yorkshire, most probably as a result of a recent introduction (JOHNSON 1992). Despite much effort only one further find has been made since (Johnson, pers. obs.). The situation and distribution pattern reminds of other former immigrant ptiliid species, e.g. *Acrotrichis insularis* (see above) although the dispersal within Europe is still in its infancy. No continental records are known at the present.

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