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THE *ARION HORTENSIS* COMPLEX (PULMONATA: ARIONIDAE): DESIGNATION OF TYPES, DESCRIPTIONS, AND DISTRIBUTIONAL PATTERNS, WITH SPECIAL REFERENCE TO THE NETHERLANDS

by

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Winter, A. J. de: The *Arion hortensis* complex (Pulmonata: Arionidae): designation of types, descriptions, and distributional patterns, with special reference to The Netherlands.

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Key words: Gastropoda; Pulmonata; Arionidae; *Arion hortensis* complex; nomenclature; distribution.

A lectotype of *Arion hortensis* Férussac, 1819 and a neotype of *A. distinctus* Mabile, 1868 are selected in order to assure nomenclatural stability.

Descriptions of preserved specimens of these species from large parts of central and western Europe are provided, as well as of living animals from The Netherlands and Belgium. The main characters used by Davies (1977, 1979) to separate the British representatives of this complex were found suitable in the rest of Europe as well, in contrast to some characters given by De Wilde (1983). *Arion owenii* Davies, 1979 was not present in the material studied.

Provisional UTM-distribution maps (50 km grid) of *A. hortensis* and *A. distinctus* in Europe (except the British Isles and Belgium) are provided, besides 10 km grid maps for The Netherlands, based on material present in Dutch private and museum collections. Some records in the recent literature are discussed.

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INTRODUCTION

The subgenus *Kobeltia* Seibert, 1873 of the genus *Arion* Férussac, 1819 still offers many taxonomic problems. Since the description of *Arion hortensis* Férussac, 1819, many additional nominal taxa have been introduced, often on external characters only. Until recently, most of these were considered synonymous with *A. hortensis*. Unfortunately, most type specimens of the 19th century taxa have got lost.

Davies (1977, 1979) showed that three *Kobeltia* species could be recognised in Great Britain, one of which new to science: *A. owenii* Davies, 1979. The

other two were identified with *A. hortensis* and *A. distinctus* Mabille, 1868. In the Muséum National d'Histoire Naturelle at Paris two type specimens of *A. hortensis* could be examined by the late Dr. C. O. van Regteren Altena, one of which he selected as the lectotype. Davies (1977: 187) used this information to identify her species "R". However, the lectotype designation has never been officially published, due to the sudden death of Altena. No original material of *A. distinctus* could be found (Altena, unpublished notes; Davies, 1979: 124).

A. hortensis s.l. has been reported in the literature from all over Europe, but it is usually not clear to which of the species is referred. Recently, several other small arionid species with yellow soles were recognised, e.g. *A. alpinus* Pollonera, 1887 (see Falkner, 1980, 1982) and *A. franciscoi* Boato, Bodon & Giusti, 1983. It seems probable that more will be discovered in the future.

The first aim of the present paper is to assure nomenclatorial stability by designating a lectotype of *A. hortensis* and a neotype of *A. distinctus*. Descriptions of the type specimens, as well as of both living and preserved specimens will be provided. They are compared with the descriptions of Davies (1977, 1979) and De Wilde (1983). UTM-distribution maps of these species in Europe (50 km grid) and in The Netherlands (10 km grid) will be given, based on material present in Dutch musea and private collections studied by the author.

I am indebted to the following persons, who allowed me to study the material present in their collections: R. A. Bank, Haarlem; L. J. M. Butot, Bilthoven (material in ZMA); E. Gittenberger, Rijksmuseum van Natuurlijke Historie, Leiden; W. J. M. Maassen, Duivendrecht (material in WR); R. G. Moolenbeek, Zoölogisch Museum Amsterdam; J. A. J. H. Nienhuis, Usquert; W. H. Neuteboom, Heemskerk. Mlle C. Stévanovitch, Reims, collected the topotypes of *A. distinctus* from which a neotype could be selected. Dr. S. Tillier, Muséum National d'Histoire Naturelle, Paris, allowed me to restudy Férussac's types. Dr. E. Gittenberger provided me with Van Regteren Altena's notes and critically read the manuscript.

Abbreviations: BH = colln. Bank, Haarlem; MNHN = Muséum National d'Histoire Naturelle, Paris; NH = colln. Neuteboom, Heemskerk; NU = colln. Nienhuis, Usquert; RMNH = Rijksmuseum van Natuurlijke Historie, Leiden; WR = colln. De Winter, Renkum; ZMA = Zoölogisch Museum Amsterdam.

AC = attachment collar; BM = buccal mass; E = epiphallus; EO = ever-sible part of oviduct; ES = structure at outlet of epiphallus into upper atrium; FO = firm part of oviduct; L = ligula; LA = lower atrium; N = "nozzle"; RM = retractor muscle; S = spermatheca; SD = spermathecal

duct; T = thickening inside upper atrium; UA = upper atrium; VD = vas deferens.

NOMENCLATURE AND TYPE DESIGNATIONS

Arion hortensis Férussac, 1819

Férussac, 1819: 65, pl. 2 figs. 4, 5 (“à Paris et aux environs”).

In the collection of Férussac (MNHN) only one lot, with two specimens, is present; this sample is labelled “montagnes des env. de Clermont (Oise)”. One of them has been dissected and is here designated as the lectotype.

Arion distinctus Mabille, 1868

Mabille, 1868a: 42 (“environs de Sèvres”); 1868b: 137; 1870a: 27, pl. 1 figs. 7, 8; 1870b: 119.

As no original material could be found in the MNHN or elsewhere (Altena, unpublished notes), a neotype is selected from a lot collected on November 7, 1983 by Mlle C. Stévanovitch at Sèvres, Parc de St. Cloud. Many specimens from this sample belong to *A. hortensis*. In view of his inadequate description, based on external morphology only, it is not quite certain whether Mabille actually referred to only a single species and, if so, to which one. However, some features mentioned by Mabille, especially the colour (“gris jaunâtre”) and the collection date (“mars-avril”) are in support of the decision taken here. An additional argument may be that the interpretation of the nominal taxon in the most recent literature (e.g.: Davies, 1979; De Wilde, 1983; Jungbluth, 1983) is stabilized by the present neotype designation.

The neotype is deposited in the RMNH (no. alcohol 9120).

DESCRIPTIONS

Arion hortensis Férussac

(figs. 1, 3, 6, 10, 12)

External characters (live animals described after Dutch and Belgian specimens only). — Fully extended living specimens may measure up to 50 mm but are usually smaller. The lectotype and paralectotype measure about 13

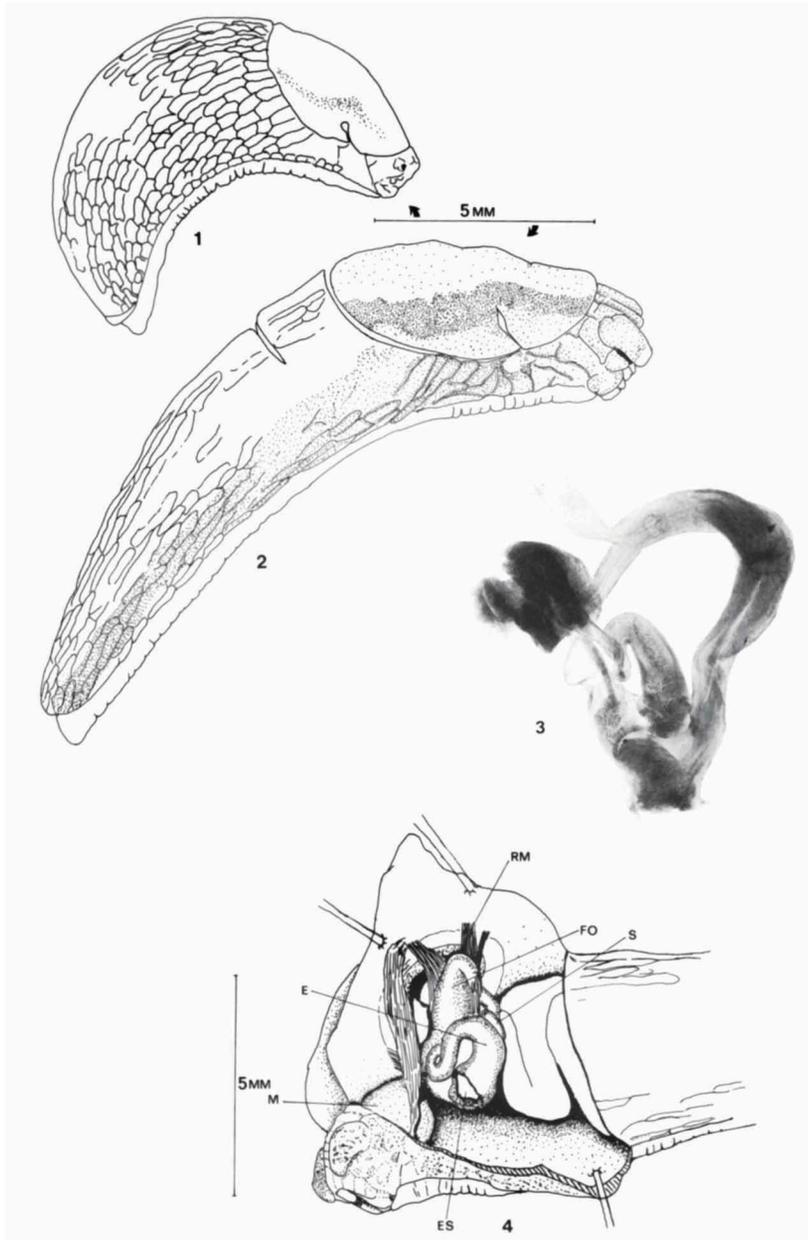


Fig. 1. *Arion hortensis* Férussac; paralectotype, external appearance (MNHN). Fig. 2. *Arion distinctus* Mabille; neotype, external appearance (RMNH no. alc. 9120). Fig. 3. *Arion hortensis* Férussac; lectotype, anterior genitalia (slide in MNHN). Fig. 4. *Arion distinctus* Mabille; neotype, showing position of anterior genitalia. Upper atrium opened to show structure in front of epiphallus.

and 10 mm, respectively. The dorsum is dark blue to nearly black. The sole is often deep orange. The first rows of tubercles above the foot fringe are densely speckled with snow-white pigment granules. Also on the dorsum white or pale-yellow pigment granules are present, giving this species a less brownish tinge than *A. distinctus*. Two dark bands run across the dorsum and mantle. On the mantle the bands are closer than in typical *A. distinctus*. On the anterior part of the mantle they usually run parallel or divergent, whereas in *A. distinctus* they are more often convergent. The right mantle band is arched over the respiratory pore. The tentacles have a more or less clear reddish or purple tinge when stretched in front of a white background. The genital pore is underneath the mantle slit, which runs to the pneumostome.

Many of these characters disappear after preservation in spirit. Both type specimens are very much bleached; only the mantle bands can be dimly seen. The right mantle band runs above the respiratory pore. This is most clearly discernable in the paralectotype (fig. 1).

Internal characters. — A Canada-balsam slide of the anterior genitalia of the lectotype was made by Altena in 1976. The structures which are described below can be more or less clearly seen (fig. 3).

The atrium is bipartite; from its upper part the free oviduct, the epiphallus and the spermathecal duct arise. These are situated more or less on one line. The free oviduct is relatively long and slender, about as wide as the broadest part of the epiphallus. It consists of a lower eversible part and a upper firm, muscular part. Inside the eversible part a ligula is present, which consists of two folds which eventually fuse and may be seen in front of the outlet into the upper atrium, resembling a papilla. The ligula may also be hidden deeper inside. The epiphallus is swollen at its base. Inside, rows of papillae are present. In front of the epiphallus, at the outlet into the upper atrium, there is an oblong structure, which may be somewhat curved, but is never conical or triangular as in *A. distinctus*. The spermathecal duct is short, usually without a swelling, the spermatheca itself being a more or less large, rounded sac. Around the outlet into the upper atrium there may be a thickening, which is rather variable in size and position. Retractor muscles are running from the lower and upper part of the free oviduct, the spermathecal duct, and the atrium to the body wall and diaphragma.

Eight spermatophores, all more or less damaged, could be studied from specimens belonging to two Dutch, one Belgian and one British population. They are about 4 mm long, with a hard hyaline attachment collar anteriorly. No "nozzle" (Davies, 1977: 177) could be observed; probably these were broken off. A longitudinal, serrated ridge is present, with anteriorly directed spines. In one spermatophore a second ridge can be observed, which does not run very far posteriorly.

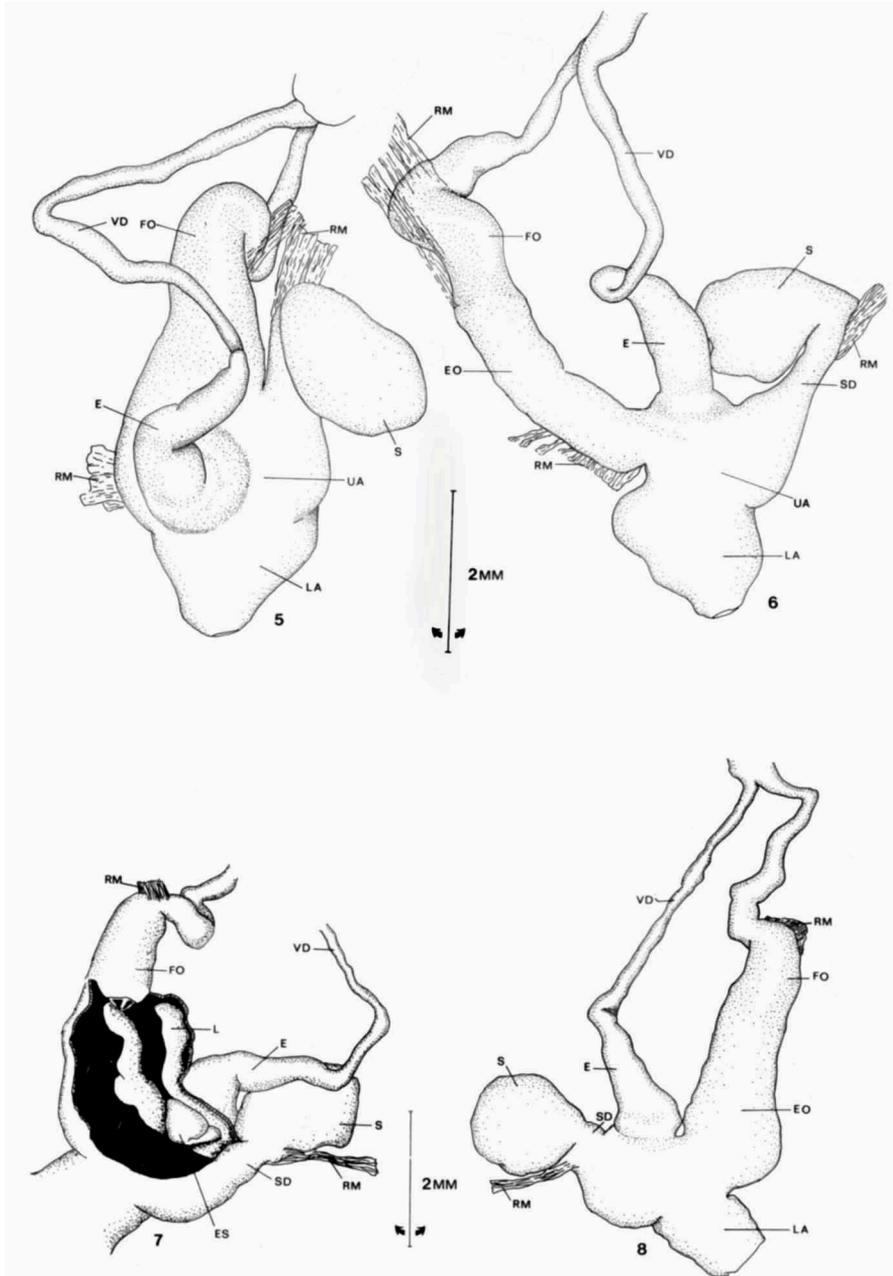


Fig. 5. *A. distinctus* Mabilie; anterior genitalia; The Netherlands, prov. of Gelderland, Renkum.
 Fig. 6. *A. hortensis* Férussac; anterior genitalia; The Netherlands, prov. of Limburg, Maastricht, Akerpoort. Figs. 7, 8. *A. distinctus* Mabilie, type B; The Netherlands, prov. of Zuid-Holland, Schiedam. 7, anterior genitalia. 8, atrium and oviduct opened to show internal features.

Arion distinctus Mabile

(figs. 2, 4, 5, 7, 8, 9, 11)

External characters (live animals described after Dutch and Belgian specimens only). — Size \pm as in *A. hortensis*. The neotype measures about 20×4 mm.

In most specimens the respiratory pore lies within the right mantle band. In some cases *A. distinctus* is indistinguishable from *A. hortensis* externally, at least in preserved specimens. In living specimens the dorsum usually has a brownish tinge, due to yellow pigment granules. The lowest rows of tubercles above the foot fringe are much less conspicuously white, as compared to those of *A. hortensis*. When stretched in front of a white background, the tentacles appear blue-grey, without a reddish tinge. Usually the sole is pale yellow.

In the neotype the lateral bands converge at the anterior edge of the mantle. In this specimen the bulk of the pigment of the right mantle band is above the respiratory pore (fig. 2).

Internal characters. — Two types of genitalia occur, as was already noticed by Davies (1977: figs. 5a, b).

Type A: The atrium is bipartite. The free oviduct, the epiphallus and the spermathecal duct are inserted at the upper atrium in a triangular position. The free oviduct is relatively short and broad, without an eversible part; its firm part is directly connected to the upper atrium. At the outlet of the epiphallus into the upper atrium there is a conspicuous, conical structure. Usually the spermathecal duct has a prominent swelling. The retractor muscles are similar to those in *A. hortensis*; the muscle which is in *A. hortensis* attached to the lower, eversible part of the oviduct, is attached to the upper atrium in type A of *A. distinctus*. This might indicate that the eversible part is only an extension of the upper atrium.

Type B: This type differs from type A in having an eversible part of the free oviduct, which contains a ligula. In most specimens available to me from The Netherlands, France and Switzerland the two folds of the ligula do not fuse before or at the outlet of the oviduct, as in *A. hortensis*, but diverge into the upper atrium. In some French specimens (e.g. from Château de la Balme, Hte-Savoie) only one fold could be observed. The insertion of oviduct, epiphallus and spermathecal duct is not necessarily in a triangular position.

Type B of *A. distinctus* can be easily distinguished from *A. hortensis* by (1) the structure at the outlet of the epiphallus, (2) the relatively larger firm part of the oviduct and (3) the eversible part of the oviduct, which is usually broader than the epiphallus.

Four spermatophores, from two Dutch localities, could be studied. They

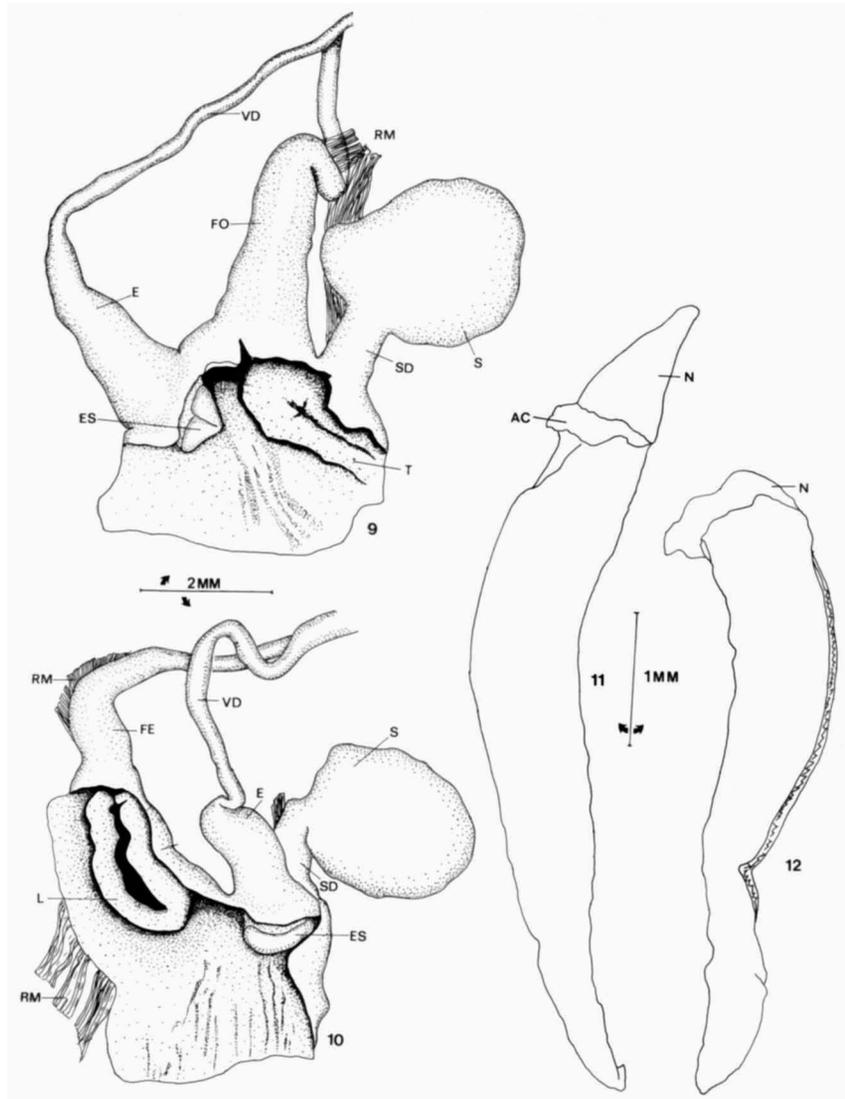


Fig. 9. *A. distinctus* Mabille, type A; anterior genitalia cut open, showing internal structures; The Netherlands, prov. of Gelderland, Renkum. Fig. 10. *A. hortensis* Férussac; anterior genitalia cut open, showing internal structures; The Netherlands, prov. of Utrecht, Nieuwegein-Zuid. Fig. 11. *A. distinctus* Mabille; spermatophore; The Netherlands, prov. of Noord-Holland, Zaandam. Fig. 12. *A. hortensis* Férussac; spermatophore; The Netherlands, prov. of Limburg, Maastricht, Akerpoort.

are about 6 mm long, more slender than in *A. hortensis* and without any spines. Only in one specimen a collar could be observed which, according to Davies (1977), is short-lived and indistinct in this species. In all specimens a "nozzle" is present.

DISTRIBUTION

A. hortensis s.l. has been reported in the literature from most European countries. However, most of the records probably refer to *A. distinctus*. *A. hortensis* s.s. seems to have a more restricted range. It is now known with certainty from the following countries: Great Britain (Davies, 1977, 1979), Ireland (Ross, 1984), The Netherlands, Belgium (De Wilde, 1983), W. Germany (one record only), Switzerland (one record only), and France. The easternmost record is Gruiten, W. Germany (about 7° E). On the European mainland Nieuwegein, The Netherlands, is the northernmost location known (about 52° N). No detailed distribution maps of the *A. hortensis* complex in Great Britain have been published. According to Davies (1979), *A. hortensis* occurs in England and Wales.

In The Netherlands *A. hortensis* has been found only at six out of the 54 UTM 10 km-squares from where members of the species complex have been recorded. In Belgium the species is more common. De Wilde (1983) reported it from 28 out of the 61 UTM 10 km-squares examined. In view of the approximately equal numbers of UTM squares examined in both countries, it seems likely that the rarity of *A. hortensis* in The Netherlands is real, and not caused by inadequate collecting. It may be that this species reaches its northern limit on the continent here.

A. distinctus seems to be widespread. It has been recorded now from Iceland, Great Britain (Davies, 1977, 1979), Ireland (Ross, 1984), Norway (Backeljau et al., 1983; Holyoak & Seddon, 1983), Sweden (according to von Proschwitz (1983), all Swedish records of *A. hortensis* refer to this species), Denmark, The Netherlands, Belgium (De Wilde, 1983), Luxemburg (Lamesch, 1953, s.n. *A. hortensis*), France, Switzerland, Austria, W. Germany, E. Germany (Vater, 1983), Poland (Wiktor, 1973, s.n. *A. hortensis*), Czechoslovakia, Bulgaria (Wiktor, 1983, s.n. *A. hortensis*) and the Azores. According to Jungbluth (1983), probably only *A. hortensis* occurs in Poland. However, in view of Wiktor's (1973) drawings and descriptions, this seems to be an error. It is not certain which species occurs in Hungary and Russia; probably this is *A. distinctus*.

In The Netherlands *A. distinctus* is a common species. It has been recorded

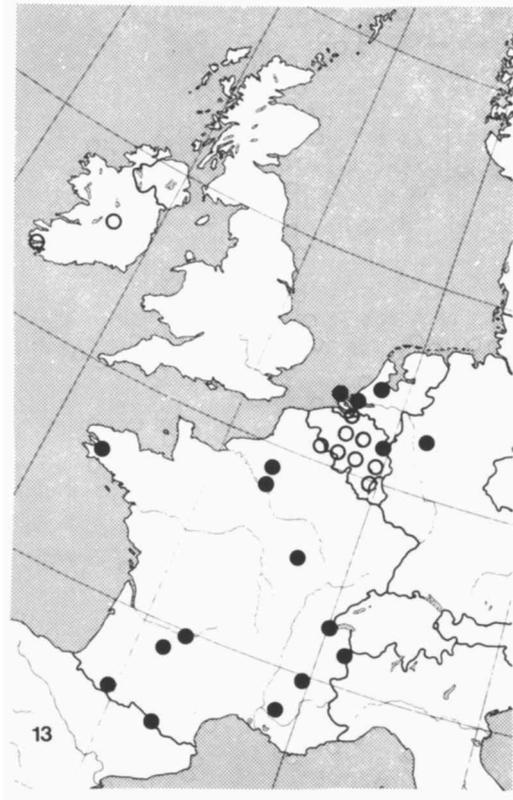


Fig. 13. *A. hortensis* Férussac. UTM 50 km-grid maps showing European records; closed circles: material studied by the author; open circles: records from the literature.

from 53 UTM 10 km-squares. The absence from certain large areas is undoubtedly caused by inadequate collecting.

Type B of *A. distinctus* has been found in the following countries: Great Britain (Davies, 1977), Sweden (very rare: von Proschwitz, in litt.), The Netherlands, France, Switzerland, W. Germany, and Austria. The dimorphism is not clearly correlated with geography. In our material type B seems to prevail in the western Alps, whereas in the rest of Europe A is the commonest type. It must be stressed, however, that not all specimens from each sample have been dissected. In the material studied no intermediates have been found.

At present no material is available from the Iberian Peninsula, Italy and most of SE. Europe. From the Iberian Peninsula several species have been described, which may belong to these or related species. Castillejo Murillo's

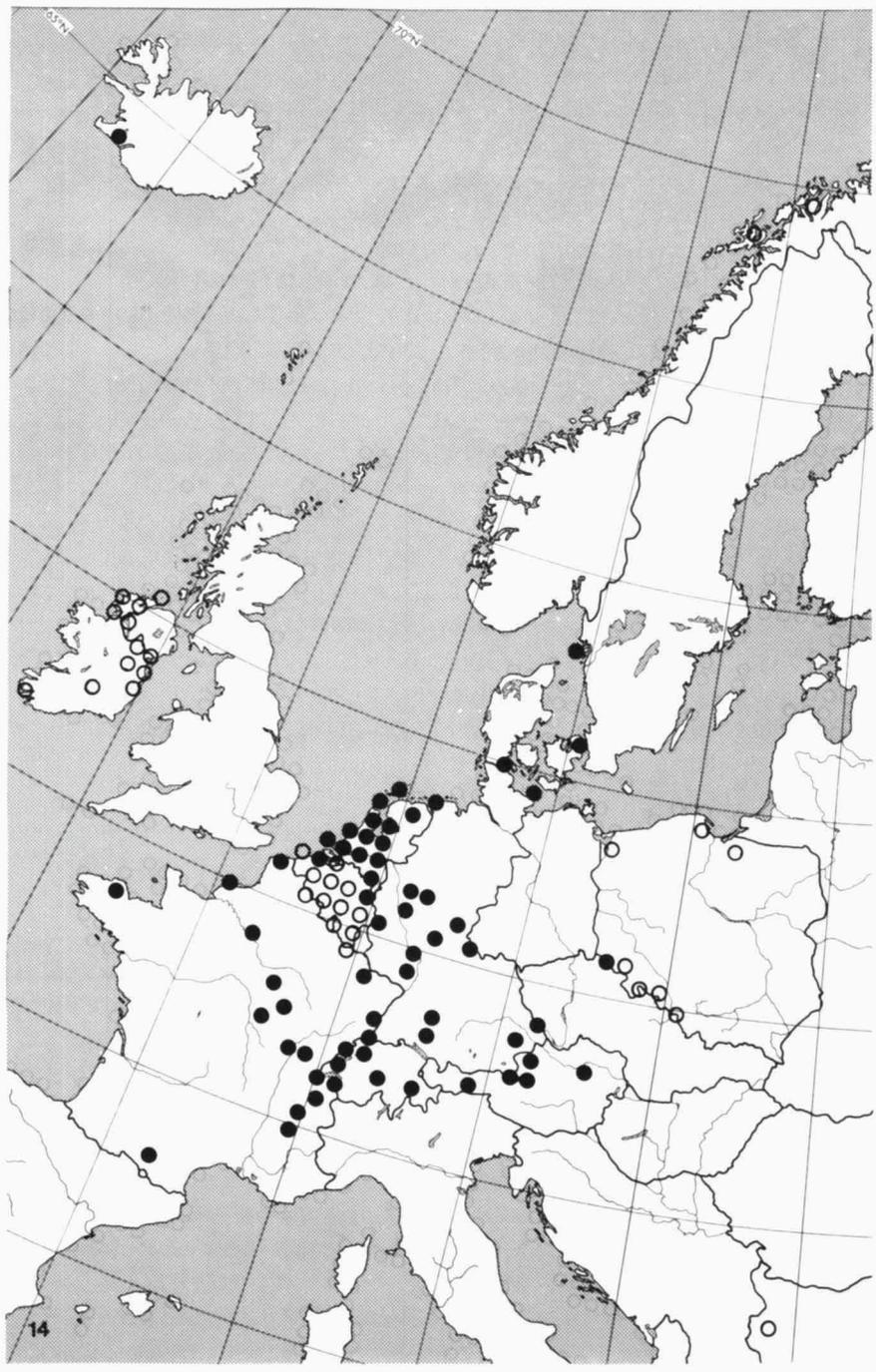


Fig. 14. *A. distinctus* Mabille. For explanation see fig. 13.

(1981) records of *A. hortensis* from Galicia may refer to this species, but his drawings are not accurate enough to be sure.

A. hortensis s.l. is reported from Italy (e.g.: Alzona, 1971; Boato et al., 1983). It is not clear to which of the species considered here these specimens belong. Recently an externally similar species, viz. *A. franciscoloi*, was described from NW. Italy (Boato et al., 1983).

According to Lupu (1974), Grossu's recordings (1970, 1983) of *A. hortensis* in Rumania actually refer to *A. subfuscus* (Draparnaud, 1805).

Only provisional European distribution maps can be given (figs. 13, 14). The accurate pattern in each country should be filled in by local workers. Nevertheless these maps, based solely on Dutch collections, give a first broad outline.

During our investigations no specimens of *A. owenii* have been discovered. Until now this species is only known from Great Britain and Ireland (Davies, 1979; Ross, 1984).

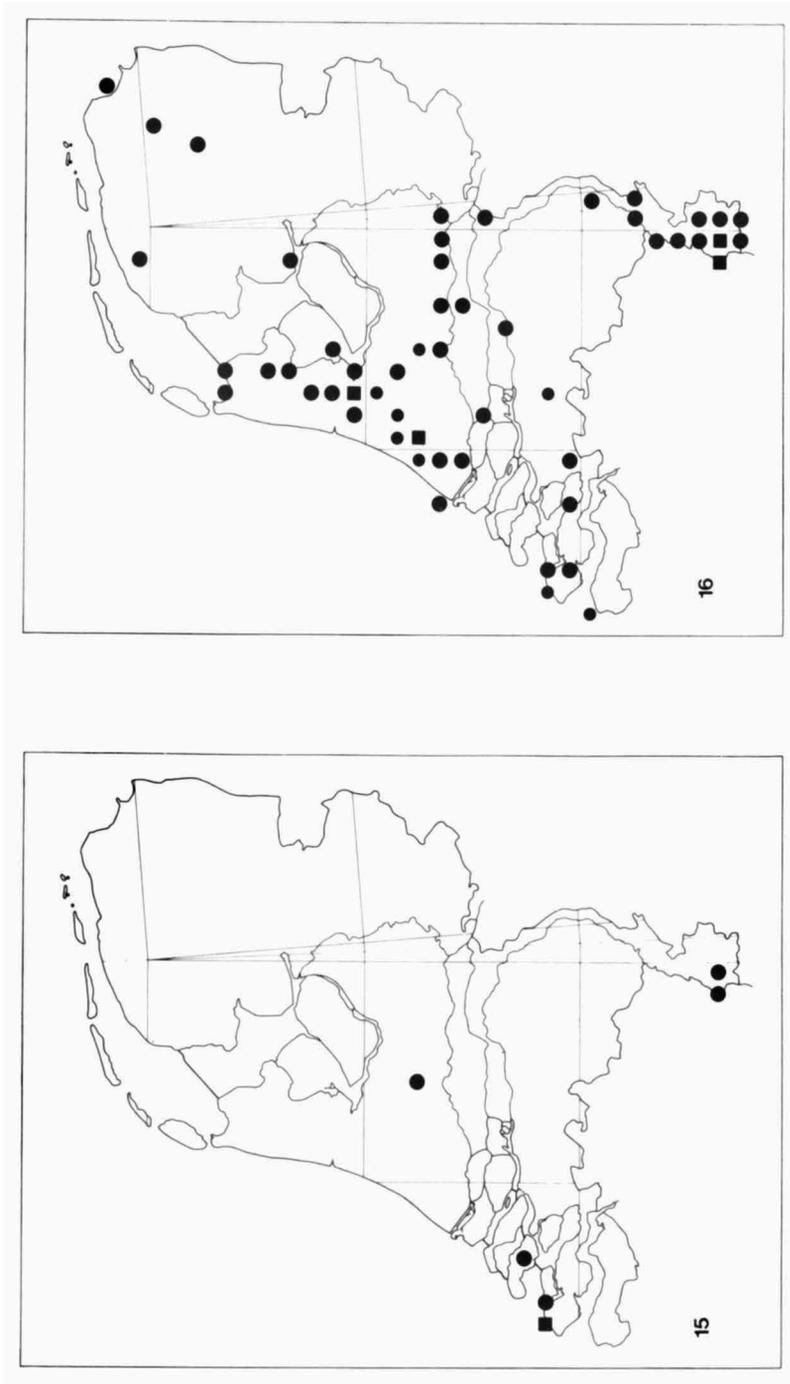
In The Netherlands both *A. hortensis* and *A. distinctus* can be considered anthropochorous species. Only in the deciduous woodlands in the south of the province of Limburg, the occurrence of *A. distinctus* may be natural. Both species can be serious pests. The oldest record of *A. hortensis* in The Netherlands dates back to 1916 (Westkapelle); the oldest record of *A. distinctus* which could be examined is from 1910 (Leiden). Therefore, these species are not recent introductions.

DISCUSSION

Our results confirm the conclusion of Davies (1977, 1979) and De Wilde (1983) that *A. hortensis* and *A. distinctus* are separate species, which usually differ clearly in external appearance and genital morphology and which have very different spermatophores. Besides, behavioural differences were observed by Davies (1977).

As already noted by Davies and De Wilde, identification on external characters only is rather risky, especially of preserved specimens. In my experience living specimens can be identified reliably, using mainly the colour of the tentacles and the colour and distribution of pigment granules and, to a lesser degree, the position of the mantle bands. This holds true at least for Dutch and Belgian specimens.

Concerning the genital morphology, I agree with Davies that the structure at the outlet of the epiphallus inside the upper atrium is a very useful and reliable character to separate these species. This was questioned by De Wilde



Figs. 15, 16. UTM 10 km-grid maps, showing the Dutch records; small circles: before 1950; large circles: after 1950; squares: before and after 1950. 15, *A. hortensis* Férussac. 16, *A. distinctus* Mabille.

(1983: 95), who considers the structure of the free oviduct the best discriminating feature. The latter character may be misleading, however, because in *A. distinctus* two types of oviduct occur, one of which resembles the oviduct found in *A. hortensis*, especially in not fully developed specimens, which may possess a rather slender eversible part. This type was not observed by De Wilde (1983) in Belgium. According to Davies (1977), both types were raised from the same batch of eggs, and copulae between both types have been observed (Davies, 1977: fig. 6a).

De Wilde (1983) considers the way of implantation of the epiphallus, free oviduct and spermathecal duct on the upper atrium (triangular in *A. distinctus*, on one line in *A. hortensis*) an important character. In my experience, however, it is not reliable in separating *A. hortensis* and type B of *A. distinctus*.

MATERIAL

All locality data are provided with the 10 km UTM-grid code, except for the Scandinavian records, because no UTM-maps seem to exist of this area.

In *A. distinctus* the type (A, B, or both) that was encountered in the dissected material is indicated between brackets.

A. hortensis (figs. 13, 15)

France. — Oise: DQ57, "montagnes des env. de Clermont", type locality (MNHN). Seine et Oise: DQ40, Paris, Sèvres, Parc de St. Cloud (WR); DQ40, Paris, Garcher (RMNH). Yonne: EN58, Cravant-sur-Yonne (RMNH). Finistère: VU11, Quimper, along the Odet (RMNH). Haute-Savoie: LR28, between La Fayette and St. Gervais-les-Bains (RMNH). Isère: GK06, 5 km E of Chichilianne (RMNH). Vaucluse: FJ89, N. slope of Mont Ventoux (WR). Dordogne: CK59, Montignac (RMNH). Lot: CK72, Cahors, Mont Angély (RMNH). Hautes Pyrénées: YN35, Cauterets (RMNH). Ariège: CH84, Ussat (RMNH).

The Netherlands. — Utrecht: FT46, Nieuwegein-Zuid (WR). Zeeland: ET 31, Oostkapelle (RMNH); ET31, Domburg (RMNH); ET41, Veere (WR); ET62, Zierikzee (RMNH, NH). Limburg: FS83, Maastricht, St. Pieter (WR); FS93, Maastricht, Akerpoort (WR, RMNH).

W. Germany. — Nordrhein-Westfalen: LB77, Gruiten (NH).

Switzerland. — Vaud: KS84, Gingins, la Barilette, 10 km NW. of Nyon (RMNH).

A. distinctus (figs. 14, 16)

Austria. — Salzburg: UN85, Radstadt (NH) (A); UN27, Unken (NH) (A); TN98, Walchsee (WR) (A). Tirol: PT83, Innsbruck (RMNH) (A). Oberoesterreich: UP54, Braunau am Inn (NH) (A); UP54, Ranshofen (NH) (A). Niederoesterreich: WP42, Rohrbach (RMNH) (A); WP42, Lilienfeld (RMNH) (A, B).

Azores. — S. Miguel, many localities (RMNH) (A).

Czechoslovakia. — WS42, Krkonose Mountains, Sněžka (RMNH) (A).

Denmark. — Sjælland, Hellebæk, 5 km NW. of Helsingør (RMNH) (A); Ellekilde-Bodeme (RMNH) (A). Jylland: Åbenrå (RMNH) (A).

France. — Pas de Calais: DS02, Boulogne-sur-Mer (RMNH) (A); DS03, Wissant (WR) (A); DS13, Ferquès, 13 km SW. of Calais (RMNH) (A); DS23, Guines, Forêt de Quines (NH) (A). Seine et Oise: DQ40, Paris, Sèvres, Parc de St. Cloud, type locality (RMNH, WR) (A, B); DQ40, Bois de Boulogne (RMNH) (A). Seine-Maritime: CR32, St. Valéry-en-Caux (RMNH) (A). Yonne: EN58, Cravant-sur-Yonne (RMNH) (B); EP14, Les Gouts, 5 km SW. of Pont-sur-Yonne (RMNH) (B). Moselle: KV83, Jouy aux Arches (NH) (A). Haut-Rhin: LU51, Mittlach (RMNH) (A). Finistère: VU45, Huelgoat (RMNH) (A). Nièvre: EN31, W. of St. Saulge (RMNH) (A). Saône et Loire: FM39, S. of Chagny (WR) (A). Doubs: LS05, 11 km W. of Clerval (WR) (A). Jura: FM95, between St. Amour and Orgelet (RMNH) (B). Savoie: KR84, Epierre, (NH) (B). Haute-Savoie: LS30, Chalêt de la Balme, 22 km S. of Chamonix, (RMNH) (B). Isère: GL12, La Correrie, 4 km W. of St. Pierre de Chartreuse (RMNH) (A); GK05, N. slope Col de Menée, S. of Cielles (RMNH) (B); GK06, 5 km E. of Chichilianne (RMNH) (B). Drôme: GK05, S. slope Col de Menée, E. of Die (RMNH) (B). Ariège: CH85, Foix (RMNH) (A).

Iceland — Árnessýsla, Hveragerdi (RMNH) (A).

The Netherlands. — Groningen: LE61, Delfzijl (RMNH) (A); LD49, Haren (NU) (A). Friesland: FV80, Cornjum (RMNH) (A); FV80, Wirdum, Leeuwarderadeel (ZMA) (A). Drenthe: LD 37, Assen (RMNH) (A). Overijssel: FU83, Schokland, Middelbuurt (NH) (A). Gelderland: FT53, Ammerzoden (NH) (A); FT65, Tiel (ZMA) (A); FT86, Heelsum (WR) (A); FT86, Renkum (WR) (A); FT86, Wageningen (WR) (A); FT96, Arnhem (NH) (A); GT04, Beek (WR) (A); GT04, Ubbergen (RMNH, ZMA) (A); GT06, Arnhem, Rosendaal (NU) (A); GT06, Arnhem (NH) (A). Utrecht: FT38, Loenersloot (ZMA) (A); FT47, Utrecht (RMNH, ZMA) (A); FT66, Wijk bij Duurstede (NH) (A). Noord-Holland: FT29, Amsterdam (RMNH); FU10, Haarlem-Noord (BH) (A); FU20, Amsterdam (RMNH, ZMA) (A); FU20, Sloterdijk (WR) (A); FU21, Nauernasche Polder (RMNH) (A); FU21, Oostzaan (RMNH) (A); FU21, Westzaan (RMNH) (A); FU21, Westzaan-Nauerna (RMNH) (A, B); FU21, Zaandam (RMNH) (A); FU21, Zaandammerpolder (RMNH); FU22, Oost-Knollendam (RMNH); FU26, Hollebalg (NH) (A); FU30, Amsterdam (RMNH); FU30, Diemen (RMNH) (A); FU33, Hoorn (NH) (A); FU34, Aardswoud (RMNH, NH) (A); FU36, Hippolytushoef (ZMA) (A); FU41, Marken (ZMA). Zuid-Holland: ET76, 's-Gravenzande (RMNH) (A); ET95, Schiedam (RMNH) (A, B); ET96, Delft (RMNH) (A); ET97, Den Haag (RMNH) (A); FT07, Leiden (RMNH, ZMA, BH) (A); FT08, Oegstgeest (RMNH, ZMA) (A); FT14, Ridderkerk (RMNH) (A); FT18, Ofwegen near Woubrugge (RMNH) (A). Zeeland: ES29, Cadzand (RMNH) (A); ET31, Oostkapelle (RMNH) (A); ET40, Ritthem (NH) (A); ET41, Veere (RMNH, ZMA, WR) (A); ET70, Yerseke (RMNH, NH, RMNH) (A). Noord-Brabant: ET90, Bergen op Zoom (NH) (A); FT21, Mariëndal near Ginneken (NH). Limburg: FS83, St. Pietersberg near Maastricht (RMNH, NH, WR) (A); FS83, Neercanne (NH, RMNH) (A); FS92, Eijsden, Eijsderbosch (RMNH, WR) (A); FS92, Eijsden (NH) (A); FS93, Maastricht (RMNH, ZMA, WR) (A); FS93, Maastricht, Akerpoort (WR) (A); FS93, Maastricht, Heer (RMNH) (A); FS93, Cadier en Keer, Schiepersberg (RMNH) (A); FS93, Cadier en Keer, Bundersberg (RMNH) (A); FS93, Geulhem (RMNH, WR) (A); FS93, Bemelen (ZMA); FS93, Savelsbos near Gronsveld, Trichterberg, Sjoene Grub (RMNH, ZMA, WR) (A, B); FS94, Elsloo (RMNH); FS94, Houthem (RMNH); FS94, Meerssen (RMNH); FS95, Limbricht (NH) (A); FS96, Stevensweert (RMNH) (A); GS02, Slenaken-Heyenrat (RMNH) (A); GS02, Bovenste Bosch near Epen (RMNH); GS02, Malensbosch near Vijlen (WR) (A); GS03, Sibbe, Oud-Valkenburg (RMNH); GS07, Roermond (RMNH) (A); GS07, Peelberg near Herten (RMNH) (A); GS04, Tulle; GS07, Puth (WR); KB97, Swalmen- Roermond (RMNH) (A); KB97, Roermond (RMNH); KB99, Maasbree (RMNH).

W. Germany. — Schleswig-Holstein: PF00, Sielbeck, W. bank of Ukleisee (NH) (B). Nordrhein-Westfalen: LB54, Rodenkirchen Auwald (NH); LB77, Gruiten (NH) (A); MB08, Hohenlimburg (NH) (A). Hessen: MA41, Dittelsheim, E. of Alzey (RMNH) (A); MA75, Frankfurt am Main (RMNH) (A); MA34, Eltville (NH) (A); NB10, Ulrichstein (NH) (A); MA44,

Wiesbaden-Biebrich (NH) (A); MA78, Butzbach, road to Hochweisel (NH) (A); MA65, Königstein (RMNH) (A). Rheinland-Pfalz: LA39, Blankenheim (WR) (A); LA47, Nohner Mühle near Nohn (WR) (A). Baden-Württemberg: MV71, 2 km S. of Pforzheim (WR) (A); NU41, Bad Schüsslenried (NH) (A); NU18, Neckartaifingen (RMNH) (A); LT96, Grenzach, E. of Basel (RMNH) (B); MV49, Heppenheim (RMNH) (A); NU36, Wittlingen, SE. of Urach (RMNH) (A). Bayern: TQ83, Regensburg (NU) (A); NA86, Münnerstadt (RMNH) (A); UQ71, Spiegelau (RMNH) (A); UP29, Landau, right bank of Isar (NH) (A).

Sweden. — Bohus, Kristineborg (RMNH) (A).

Switzerland. — Bern: MS06, Faulensee, SE. of Spiez (RMNH) (B); MS07, Merligen (WR) (A); MS07, Aeschlen (WR) (B); MS37, Meiningen, Hohlflech (RMNH) (A); LT42, St. Imier (NH) (B); LT54, SW. of Glovelier (RMNH) (B); LT73, Gorge du Moutier (NH, WR) (A); LT95, Kaltbrunnental near Grellingen (RMNH) (B). Vaud: KS 84, Gingins, NW. of Nyon (RMNH) (A). Graubünden: NS48, Parpan- Churwalden (NH) (A, B).

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