Identification of females of the Finnish species of *Altica* Müller (Coleoptera, Chrysomelidae)

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The possible use of secondary genitalia (styles and spiculum ventrale) for the identification of females of *Altica* is investigated. Two identification keys are presented, one using both morphological and secondary genital characters and one using secondary genital characters only. The Finnish species are reviewed: *A. cirsii* Israelson is deleted, and *A. quercetorum saliceti* Weise and *A. carduorum* (Guerin-Meneville) are added to the Finnish list, now comprising 12 species. The geographical and temporal aspects of the distribution of the species in Finland is shown on UTM maps.

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1. Introduction

Identification keys available today for identifying females of the genus *Altica* Müller are often mainly based on distinctive morphological characters (e.g. Lindberg 1926, Hansen 1927). In the case of males, differences in the aedeagus have also been taken into consideration (e.g. Heikertinger 1912, Hansen 1927, Mohr 1966). However, the rarity of males among the most common Finnish species restricts the possibility of using the characteristics of male genitalia for specific identification (comp. Phillips 1979:291). Moreover, intraspecific variation of morphological characters is more conspicuous in most species of the genus than is general. As a result the identification of females remains unsure in many cases (e.g. Kevan 1962:189–192, Phillips 1979, Döberl 1986:3–14). For this reason we set out to determine the possibilities for identifying females of the Finnish species.

Thus far the distinctive characters of *female genitalia* have been very seldom used for the identification of species. Spett & Levitt (1925, 1926) in their investigations on the significance of the female *spermatheca* (receptaculum seminis) of Chrysomelidae as a taxonomic character also explained the structure of the spermatheca of *Altica*. Kevan (1962) was the first author to take into consideration the *styles* as well as the spermatheca as a distinctive specific characteristic. Konstantinov (1987) made more profound examinations of female styles. Phillips (1979) and LeSage (1990) likewise paid attention to this organ as a taxonomic characteristic.

Our aim was to prepare an identification key which would be easy to use and capable of giving the best possible result. Besides the distinctive specific characters discussed above, we also tried to examine the usefulness of the *spiculum ventrale* (Lindroth 1957).

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2. Applicability of the specific characters to the identification key

2.1. Spermatheca

The spermatheca of Finnish *Altica*-species offers comparatively few specific characters. The size and proportions of the spermatheca, for example, vary considerably. By using exact measurements based on extensive material it might be possible to discover at least some statistical differences between some species or some groups of species. Spett & Levitt (1926:134–135, fig. vi) described the spermatheca of the genus (*A. oleracea*) in more detail and compared the spermathecas of three different species (*A. oleracea*, *A. quercetorum* and *A. tamaricis*). The authors mainly paid attention to the distal part of the spermatheca (collum), where the spermathecal tube (ductus receptaculi) begins. They found some specific differences in the structure of this less sclerotized part, e.g. the length of the direct "neck" part (stem) or the convolutions of the tube. Likewise Kevan (1962:191–192) takes only the collum into consideration and he finds some differences in the length of the stem-part in different species. He divides the seven British species into two groups: species with a long stem and species with a short stem. The size and form of the spermatheca as a specific character are passed over by both Spett & Levitt and Kevan. Also the length of the "neck" seems to vary in the material examined. Konstantinov (1987) does not pay any attention to the spermatheca, either (for other literature see Döberl 1986). In the case of the Finnish species we also decided not to take the spermatheca into consideration in our identification key because of the difficulty of using these slight differences as specific characteristics (obs. also LeSage 1990:1232, 1233).

2.2. Secondary genitalia

The *styles* have proved to offer specific differences which are more conspicuous and easier to use. As far as we have been able to trace, Kevan (1962) was the first author to pay attention to this characteristic. He confined himself to ascertaining the difference in the size of this organ in different species and divides the seven British species into two groups according to the size of the styles (also Phillips 1979:291) mentioning one species (*A. oleracea*) as intermediate in this respect. He too failed to describe the form and structure of this organ. Konstantinov (1987), by contrast, examined the styles of ten species from the European USSR very carefully, making precise measurements and drawings. He also discovered useful specific characteristics for the species examined in his study.

The Finnish fauna consists of twelve species of *Altica*. Size differences are found, for example, between the styles of different species. However, differences in form, structure and certain proportions have been shown to be more significant. Of particular interest is the situation at the point where both halves of the styles are nearest to each other. This point we have called the *contact point* of the styles (Fig. 1). On the basis of this character the Finnish species can be divided into three groups:

1) contact point situated within the head of styles;
2) contact point situated within the shaft of styles;
3) contact point has changed to a contact surface.

There is only one intermediate case: *A. carinthiaca*, where the contact point is situated at about the limit between the head and shaft of the styles. Konstantinov (1987) has not used this character, but this fact can be clearly seen from his drawings.

A second useful character in the styles are the proportions length/breadth of head (Fig. 1, b:a), and length of head / length of shaft (Fig. 1, b:c). Both these characters are also used by Konstantinov (1987:45–46). In addition, the proportions of the end of the shaft (Fig. 1) can offer useful distinctive characters.

A third specific character can be the form of the styles, especially the opposite sides of the halves and the outer border of the stronger sclerotized area and also the end of the shaft. However, variation in the characters mentioned above in many species is so broad that these characters cannot be utilized for identification purposes, even when the character in question occurs as a specific character in the majority of individuals of the species. On the other hand, strong evidence of the validity of the characteristics of the styles is provided by the fact that the

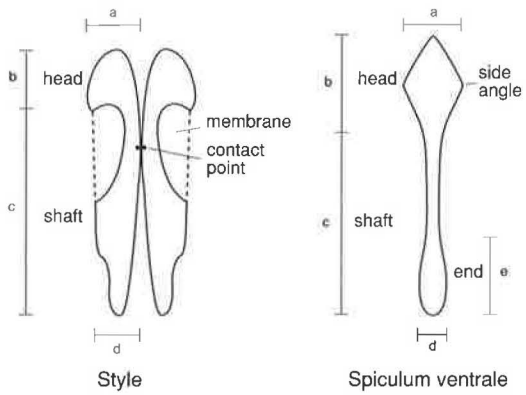


Fig. 1. Styles and spiculum ventrale of *Altica*. — a breadth, b length of head; c length, d breadth of shaft; e length of shaft end.

styles of six species common to both our material and that of Konstantinov (1987) (*A. lythri*, *A. quercetorum saliceti*, *A. tamaricis*, *A. oleracea*, *A. carduorum* and *A. longicollis*), as also in four common species (*A. lythri*, *A. longicollis*, *A. palustris*, *A. oleracea*) in Phillips' (1979:295) material, in terms of their proportions and form in all essentials correspond with each other. In the pictures by Phillips 1979 the styles of only one species, *A. carduorum*, differ from the styles of the same species mentioned above.

The *spiculum ventrale* is an arrow-like, strongly sclerotized organ which gives support to the ovipositor and also functions as an attachment surface for the muscles (Lindroth 1957). It has not been previously used as a specific character when separating species. Spett & Levitt (1925:39, 44) do mention that "this organ is present in Halticini", but do not devote any more attention to this matter. Likewise Kevan (1962:192) passes this organ over by merely mentioning that "it has no practical use for identification, because the arrowhead is very variable in size and form". Certainly this organ varies in form and size in different species, but it also varies intraspecifically. This variation can also be relatively broad between the individuals of some species, so that the spiculum ventrale is not a good character for the identification of species. However, our experience shows it can be useful in some cases. The side angles, as well as the distal angle, of the spear- or arrow-like enlarged distal head of the spiculum vary in both their degree of projection and sharpness, as well as in the proportions of the size and form of the head and shaft (Fig. 1, a:b, b:c, b:d, a:e).

If we consider the possibilities of determining the Finnish species according to the characters of the styles or spiculum alone, we can obtain some kind of picture about the significance of these characters for the identification of species. Of the twelve species of the Finnish fauna, nearly half, i.e. five species, can be determined with certainty by the characteristics of the styles alone. In addition, two pairs of species and a group of three species can be distinguished. Using the form and size of the spiculum alone one species can be distinguished, in addition to most of the individuals of two species, as well as two pairs of species. The significance of both these organs for the identification of species, when they are used together or along with morphological characters, is being confirmed.

2.3. External characters

In spite of the broad variation in the external morphological characters, these can be utilized for specific identification, if we consider that the number of abnormal individuals in relation to several specific characteristics is relatively small, usually only single individuals.

Most unreliable is to rely exclusively on the *colour* of the beetle as a specific characteristic (comp. e.g. Phillips 1979:291).

The *micro-reticulation* and *puncturation* can also be misleading characters, although they are in many cases of assistance in specific identification (e.g. micro-reticulation in *A. engstromi* and puncturation in *A. longicollis*).

Other commonly used external characteristics are the *form* and *size* of the beetle, as well as different *inequalities* of the upper surface of the elytrae and pronotum (bulges, ridges or depressions) (compare e.g. Heikertinger 1912, Hansen 1927, Mohr 1966, Lindberg 1926). All these characters are of appreciable help in indentifying species, although one of the characters alone is inadequate. In the case of Finnish species the form alone in one case is sufficient to enable the species to be recognised (*A. engstromi*); the size is in general only indicative, and in some cases it

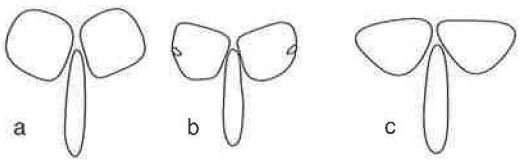


Fig. 2. Frontal tubercles and carinae of *Altica*. — a *A. chamenerii* Håkan Lindberg, from Hartola, b from Janakkala; c *A. quercetorum saliceti* Weise.

is even misleading (e.g. *A. lythri* and *A. chamaenerii*). The inequalities of the surface of the elytrae are used in two cases as a specific character for Finnish species. Firstly, the small but evident depressions by the suture near the apex of the elytrae are usually mentioned as a specific character of *A. oleracea* (e.g. Aurivillius 1917, Heikertinger 1912, Lindberg 1926, Kevan 1962). Hansen (1927) mentions this character as occurring "in general". Although this is basically true, the same character can exceptionally also occur in at least *A. lythri* and *A. opacifrons*. Secondly, longitudinal carinae of the elytrae are mentioned as a specific characteristic of *A. aenescens* (e.g. Mohr 1966). This characteristic also varies considerably in the species in question and it can occur in some other species too, at least as weak traces (e.g. *A. lythri*).

The most useful external character in many species are the *frontal tubercles* (Fig. 2), especially their form, position, micro-reticulation and the definition of their margins. These characters are most often employed in the determination keys (e.g. Heikertinger 1912, Hansen 1927, Lindberg 1926, Kevan 1962). Although variation exists — especially concerning the micro-reticulation — in the material examined by us, the frontal tubercles are a character worthy of attention, while not, however, being sufficient when used alone. In particular it should be mentioned that in some species this character can occur in two different types (e.g. *A. aenescens*, *A. lythri*).

As an additional aid to identifying some species the *frontal carina* can also be used, a formation situated between and frontal to the tubercles (Lindberg 1938). Although it tends to vary more than the frontal tubercles, it has some specific characteristics (breadth, height, micro-reticulation).

The *mandibles*, more accurately the number of teeth and their proportions, were used e.g. by Kevan (1962) and Konstantinov (1987). Kevan (1962:189) divides the British species into two groups:

1) mandibles with three teeth gradually decreasing in size, and
2) mandibles with four teeth, the middle two being larger than the others.

Kevan does not exactly describe the mandibles of different species, while Konstantinov (1987:44, 47) examined the form and proportions of the mandibles in more detail with the aid of drawings. He compares length/breadth relations and the site of the uppermost tooth in different species with precise measurements and averages the results and the variation within one species. All the species in his material have four teeth. However, no reliable specific characteristics were discovered using this difficult method. The result in the first place was the distinguishing of three groups of species, but in addition two more or less intermediate species were left over. In this study we have decided to abandon the use of this character as an aid in the determination key, because our experience showed it to be rather difficult to use and relatively unprofitable.

2.4. Food plant

The food plant, when known with certainty, is naturally in many cases a most useful aid to identification, especially when there is only one species of *Altica* feeding on the plant in question. The great difference in food plants in general is a good indication that there are two different, but in many respects closely related, species (e.g. *A. lythri* – *A. aenescens* and *A. oleracea* – *A. opacifrons*).

2.5. Conclusions

The preceding consideration about the fitness of various specific characteristics led us to the following conclusions:

1) when preparing an identification key which could lead to a satisfactory result, both the

characteristics of the secondary genitalia and the external morphological characters should be used;

2) the range of the frequently occurring variation of the characters discussed above — concerning the external morphological as well as the characters of the secondary genitalia — in different species is of differing extent and the variation of each character does not depend on the range of variation of the other characters; additionally individuals are found which sharply diverge or even radically diverge in regard to one or more character(s); such wide variation causes uncertainty in identification;
3) there are always individuals which cannot be relegated to a species (however, extremely abnormal individuals are relatively rare).

Some characters which were studied during the treatment of our material are not included here, because they were considered too unreliable. It is also possible that some new, unexamined useful characters will be found in the future.

3. Review of the females of Finnish *Altica*-species and their most important specific characters

During this century the Finnish list of *Altica*-species has increased from six species (plus four forms) (Sahlberg 1900:114) to twelve according to the latest list (Silfverberg 1979:60).

In the following specific review, only observations on the food plant in Finland are included. In the descriptions of the *spiculum ventrale*, an arrow-like spiculum is referred to unless otherwise mentioned.

In the descriptions mentioned above and in the descriptions of the *styles* and *spiculum*, the species whose styles or spiculum is most easily confused with the corresponding organ of the species in question are mentioned (with clarification where necessary) and the specific characteristic of these organs evaluated. The general descriptions of species are based on Finnish material examined and are intended to portray a typical individual of the species in question.

Altica aenescens Weise, 1888

Largest of the Finnish species (4.5–5.2 mm), fairly convex, ovate, more or less dark-blue, sometimes even black, less shiny or dull (black individuals); frontal tubercles more or less micro-reticulated and shiny, or strongly micro-reticulated and dull (black individuals); elytrae have generally more or less clearly visible longitudinal carinae.

Styles (Fig. 3): large, contact point situated within the first third of the shaft, head as long as broad, about one fifth of the length, the inner side of the shaft straight, within its middle part (sometimes a long way) widened, at the end obtuse, only a little diverged, variation is slight. In the main specifically characteristic, but sometimes possible to confuse with abnormal styles of *A. lythri*.

Spiculum ventrale (Fig. 16): long, head about one fourth of the length, fairly narrow, side angles blunt, situated behind the middle, apical angle sharp, the shaft narrow, its end very large (longer and broader than the head). Variation slight, but not very characteristic (belongs to a group of three species). Nearest two species are *A. engstromi* and *A. carduorum*.

Distribution in Finland (Fig. 29): *EK*: Vehkalahti (L. Fagerström, 1956); *ES*: Luumäki (W. Hellén, 1949), Joutseno (E. Thuneberg, 1935, 1952; G. Blomqvist 1951), *LK*: Parikkala (W. Hellén, 1945), also found in Karelia.

Food plant: *Betula*.

Altica lythri Aube, 1843

In general a large species (size is variable) (3.5–5.0 mm), oblong, slightly flat (especially large females), colour varies from bright-green to (most often dark)blue, weakly shiny; frontal tubercles more or less shagreened, generally slightly (sometimes more) shiny; elytrae have often more or less clearly visible traces of longitudinal carinae, puncturation varies, most often it is fairly dense.

Styles (Fig. 4): large, contact point situated within the first third of the shaft, length of the head is variable (in typical case: about twice as long as broad and even one third of the length of the styles; often only about as long as broad (type II), the breadth of the shaft varies (in the end part it can be even twofold), the end is more

or less acute (sometimes the ends are converging as in *A. carinthiaca*). Variation fairly broad, when typical, the styles are specifically characteristic. Nearest species: *A. aenescens* (if head short in *lythri*) (Fig. 4c), also *A. engstromi* (if typical *lythri*).

Spiculum ventrale (Fig. 17): long, only slightly or not at all arrow-like (the shaft tapers evenly to the apex, type II), typically the head is widened (in general at most twice as broad as the shaft) at about one fourth or one third of its length, without side angles (some abnormalities exist), the shaft fairly broad and widening to its end, where it reaches at least the breadth of the head. Variation quite broad, but in typical case very characteristic.

Distribution in Finland (Fig. 29): Provinces *V, U, EK, St, EH, ES, LK, PK, KP, OP, PeP, KiL.* Also found in Karelia.

Food plant: *Epilobium montanum*, possibly also other *Epilobium*-species.

Altica quercetorum saliceti Weise, 1888

Description based on foreign individuals.

Large or fairly large (length 4.3–5.0 mm, foreign individuals), ovate, fairly convex species, colour most often bright-green to greenish blue; frontal tubercles triangular (hind margins straight and very nearly transverse, Fig. 2) shiny, but sparsely, with very small punctures, over the whole surface micro-reticulated, frontal carina narrowing towards the tubercles and densely micro-reticulated; elytrae usually with a distinct swelling between shoulder tubercles and scutellum, puncturation fairly strong and dense.

Styles (Fig. 5): medium-sized, contact point most often situated within the first third or within the distal half of the shaft (varies slightly), head about one fourth — one third of the length, shaft broad, slightly curved, at the end within a short distance about as broad as the head, proximal end typically with oblique notches. Specifically characteristic, variation slight. Nearest species: abnormal individuals of *A. chamaenerii*. (*A. q. quercetorum* has very similar styles, see Fig. 6).

Spiculum ventrale (Fig. 18): Fairly long, delicate, not arrow-like, head large (breadth varies, length about one third of the spiculum), with evenly curved sides, without side angles, shaft narrow, broader at the end. Varies to some extent, specifically characteristic. No close Finnish species (abnormal individuals of some species — e.g. *A. chamaenerii* — can be misleading).

Distribution in Finland (Fig. 29): *U*: Helsinki, one male (J. Muona, 1974).

Food plant: No certain observations in Finland. Literature: *Quercus*, *Salix* (Hansen 1927, Mohr 1966, Koch 1992).

Altica tamaricis Schrank, 1785

A medium sized (4.2–4.8 mm), oblong, fairly flat, most often intense blue coloured species; frontal tubercles situated obliquely towards each other, much longer than wide, entirely micro-reticulated, thorax distinctly narrower than the base of elytrae; humeral tubercles very prominent, puncturation of elytrae most often quite fine (varies to some extent) and micro-reticulation fine, but very dense with nearly silky sheen.

Styles (Fig. 7): Large, contact point situated within the first third of the the shaft, head quite small (short), strongly curved to the side (diverging), shaft long (about four fifths of the length of the styles), narrow, equally wide (within over three quarters of its length fairly straight), the end fairly acute. Variation slight, specifically very characteristic, nearest: *A. longicollis*.

Spiculum ventrale (Fig. 20): Fairly long, head relatively small (about one fourth of the length of the spiculum), narrow, the end of the shaft shortly rounded, of same width as the head. Variation fairly slight, however poorly characteristic, nearest: some individuals of *A. chamaenerii*, belongs to a group of four species (see *A. chamaenerii*).

Distribution in Finland (Fig. 29): *U*: Helsinki (J. Sahlberg), *PeP*: Kemi (A. Rantaniemi), Rovaniemi (J. Sahlberg); *SoL*: Pelkosenniemi (R. Forsius, R. Frey, G. Stenius 1937); KiL: Muonio (J. Siitonen 1991 and 1992).

Food plant: *Salix* (*AK*: mouth of the river Pisijoki, Russia, Y. Kangas); *Alnus incana* (*KemL*: Muonio, Aareajoki, J. Siitonen in litt.)

Altica engstromi J. Sahlberg, 1893

Medium-sized or large (4.0–5.0 mm), oblong, flat species. Colour varies from green to blue,

sericeous shiny, micro-reticulation of elytrae strong, partially covers the punctures, the side-margin formed by thorax and elytra is almost continuous.

Styles (Fig. 8): Large, the head and the broad proximal half of the shaft of about the same length (more than twice its breadth), contact point about in the middle of the styles, the end of the shaft rounded. Variation slight, specifically very characteristic, nearest species: *A. lythri* (typical form).

Spiculum ventrale (Fig. 21): Long, head about one fourth or more of the length of the spiculum, broad (half of its length), side angles distinct (situated three fifths from the apex), shaft narrow, slightly widening towards the end (about two-fold). In spite of slight variation not very characteristic specifically, nearest: *A. carduorum* (and some abnormal individuals of *A. lythri*).

Distribution in Finland (Fig. 29): *U*: especially surroundings of Helsinki; *V*: the vicinity of Lohja; *EH*: Kangasala; old records also from *KP*: Raahe and *OP*: Hailuoto. Also in Karelia (Salla, Y. Kangas).

Food plant: *Filipendula ulmaria*.

Altica oleracea (Linnaeus, 1758)

Small or fairly small (2.8–4.0 mm), ovate, fairly convex, colour varies from blue-green to blue or blackish blue; frontal tubercles wholly micro-reticulated, almost dull; frontal carina in general narrow; elytrae slightly shiny, puncturation moderately strong, apex usually with a weak longitudinal sutural depression.

Styles (Fig. 9): small, contact point within the head of the styles, head usually longer than its width, less than one third of the length of the styles, shaft narrow, slightly curved, clearly diverging, more or less acute at the end. Some variation occurs, but most often specifically fairly characteristic, (belongs to a group of three species), nearest: *A. opacifrons* and *A. palustris*.

Spiculum ventrale (Fig. 22): Short, the arrow-like head (when typical) almost square-shaped, lateral and apical angles distinct (variation occurs, but not very often, in some extreme cases the angles can even be lacking), shaft in general fairly wide, at the end slightly widened (about twofold). Moderately characteristic when typical, nearest species: *A. longicollis*.

Distribution in Finland (Fig. 29): Whole country, in old records abundantly, but a clear decline during the last thirty years is evident.

Food plant: *Epilobium*-species.

Altica chamaenerii Håkan Lindberg, 1926

Medium-sized, rarely large (3.5–5.0 mm), oblong-ovate (especially large females), markedly convex species, colour varies from green to blue (most often bright green), usually fairly shiny; frontal tubercles shiny (scarcely micro-reticulated), more or less rounded triangular or quadrangular, the hind margin divergent and not distinctly straight (Fig. 2a, b); puncturation of elytrae fairly strong.

Styles (Fig. 12): medium-sized, contact point within the distal half of the shaft, head fairly short (generally less than one fourth of the length of the styles), shaft broad, at the end as wide as the head, cut off obliquely straight or sometimes slightly notched, inner margin of the style equally slightly curved. Some variation (not broad) occurs, moderately characteristic, nearest: *A. quercetorum saliceti*.

Spiculum ventrale (Fig. 25): Fairly long, head varies quite broadly (even quite abnormal forms occur); however, in general arrow-like, about one third of the whole length, lateral and apical angles strongly rounded (width of head also variable), shaft at the end more or less widened. Poor specific character; nearest: several species (belongs to a group of four species — *A. palustris*, *A. opacifrons*, *A. tamaricis* — typical forms mostly resemble the spiculum of *A. palustris*).

Distribution in Finland (Fig. 29): Almost the whole country (no records from *A, SoL, EnL* and *InL*), by far the most common species of the genus in South and Central Finland.

Food plant: *Epilobium angustifolium*.

Altica palustris Weise, 1888

Small or fairly small (2.8–4.2 mm), ovate, fairly convex, colour varies from blue to violet or blue-green or even bluish black (most often blue of

different intensity); frontal tubercles slightly over their whole surface (sometimes, however, defectively) micro-reticulated, fairly shiny, often slightly kidney-shaped: the side towards antennae more or less concave; puncturation of elytrae fairly dense, not very strong (variation occurs).

Styles (Fig. 10): small, contact point situated within the head, this is relatively large (one third of the length of the style), to some extent longer than wide, shaft straight, inner margins scarcely diverging, outer margins narrowing towards the end from about their middle. Variation fairly slight, moderately characteristic. Nearest: the other two species of the group: *A. oleracea* and *A. opacifrons*.

Spiculum ventrale (Fig. 23): short, size and form of the head varying (from one fifth to one fourth of the length of the spiculum, the angles most often strongly rounded), the end of the shaft usually as wide as the head. Variation moderately frequent, very poor specific character (similar to *A. carduorum*, *A. chamaenerii* and *A. opacifrons*).

Distribution in Finland (Fig. 29): *A, V, U, EK, St, EH, ES, LK, EP, PS, PH, OP, PeP and PK*.

Food plant: *Epilobium montanum*, possibly also other *Epilobium*-species, *Lythrum salicaria*(?).

Altica carduorum (Guerin-Meneville, 1858)

A. cirsii Israelson, 1956
A. carduorum cirsii Israelson, (Mohr 1966)

Medium-sized (4.1–4.7 mm Finnish and Swedish, 3.4–3.9 mm South and Central European individuals), elongate, slightly flat, quite dark blue, to some extent shiny; frontal tubercles elongate (with nearly transverse hind margins), micro-reticulated, less shiny, frontal carina fairly broad and flat; puncturation of elytrae dense, but not very strong.

Styles (Fig. 11): small, their halves in tight contact with each other within about three quarters of their length (surface-contact), only the narrow proximal ends of the styles (shafts) apart from each other, arrow-like head almost square, the shaft in the middle about as wide as the head. Variation: no observations (to a certain extent, when compared with foreign specimens). Very characteristic specifically (the form of styles is sufficient to confirm the specific identification).

Spiculum ventrale (Fig. 24): long, head almost one third of the length, side angles obtuse, apical angle acute, shaft relatively wide, narrowing towards the end, about three fifths of its length, the end nearly as wide as the head. No observations concerning variation. Poor specific character. Nearest: *A. engstromi* (belongs to a group of three species — *A. aenescens*, *A. engstromi*).

Distribution in Finland (Fig. 29): *PK*: Ilomantsi 1980 (Leimo Kangas leg.).

Food plant: no observations in Finland. In literature: *Cirsium* and *Carduus*-species (Israelson 1956, Mohr 1966, Koch 1992).

Mohr (1966:233) states *A. cirsii* as a geographic subspecies of *A. carduorum* and refers to the size of the form in question. Israelson (in litt.) does not consider this kind of interpretation as correct. We have compared male genitals of a Swedish *A. cirsii* with a South European *A. carduorum* ("Sicilia, Stierlin") and with the figures representing the aedeagus of *A. carduorum* of Mohr (1966:232). In our opinion there are no noteworthy differences between these two preparations and figures. On the basis of what has been stated above and what was given regarding the female styles it seems that *A. cirsii* quite well fits within the framework of the variation of *A. carduorum* (see also Kangas 1992).

Altica longicollis (Allard, 1860)

A. britteni Sharp, 1914, (Arnold 1990)

Small or medium-sized (3.3–4.5 mm), fairly parallel (elytrae), relatively convex (some variation occurs concerning the body form), colour varies (usually from green to blue-green or bronze-green, often even blue), fairly shiny; frontal tubercles slightly (typically with streaks) micro-reticulated (usually a small area in the front corner without micro-reticulation), shiny; puncturation of elytrae quite strong, partly dense (the punctures touch each other).

Styles (Fig. 13): medium-sized, contact point situated within the first third of the shaft, heads strongly diverging, about as much as the breadth of the head of styles, one fourth of their length, shaft equally wide at whole of its length, slightly curved, proximal end equally cut off. Variation slight, quite good specific character, nearest: *A. tamaricis*, single specimens of *A. chamaenerii* can also be confusing.

Spiculum ventrale (Fig. 26): fairly long, head as typical almost square-shaped (sometimes narrower), apical angle and side angles situated about in the middle, always acute, shaft narrow, equally widening towards the end (more than twofold). Variation slight, specifically characteristic. Nearest species: *A. oleracea* and *A. carinthiaca*.

Distribution in Finland (Fig. 23): *A, V, U, EK, St, EH, ES, LK, EP, PS, KP, OP, PeP* and *KiL*.

Food plant: *Calluna vulgaris*.

Altica opacifrons Harald Lindberg, 1938

Small or medium-sized (3.2–4.0 mm), ovate, slightly flat, colour varies from bronze-green to blue-green and even blackish (most often blue-green); frontal tubercles strongly isodiametric micro-reticulated, dull, like the whole head behind frontal tubercles, frontal carina in general very flat and wide, strongly micro-reticulated; puncturation of elytrae moderate to strong (variation occurs), not very dense (often signs of rows of dots).

Styles (Fig. 14): Small, contact point situated within the head, this often fairly short (varies between one fifth to two sevenths of the length, sometimes longer sometimes shorter than wide), shaft in general rather broad (more than one third to half of the width of the head), main part being of equal width and straight, diverging and more or less narrowing towards the end (in about one fourth or one fifth). Variation moderately frequent (not broad), rather poorly characteristic; nearest species: *A. oleracea* and *A. palustris*.

Spiculum ventrale (Fig. 27): short, lateral angles of the head situated quite far, at about three quarters from the apex, more or less rounded, apical angle in general more acute, shaft about two and a half times as long as the head, at its end only a little narrower than the head. Variation to some extent occurs, poorly characteristic; nearest species: *A. tamaricis*, *A. chamaenerii* and also *A. palustris*.

Distribution in Finland (Fig. 29): All provinces except *St*, but a clear decline during the past few decades in South and Central Finland is evident.

Food plants: *Calluna vulgaris* and *Empetrum nigrum*.

Altica carinthiaca Weise, 1888

Small (3.0–3.8 mm), fairly convex, colour varies from blue-green to dark blue, violet; frontal tubercles over whole surface micro-reticulated, oblong-triangular-shaped, dull; puncturation of elytrae varies from fairly fine to fairly strong.

Styles (Fig. 15): medium-sized, contact point situated about at the limit between head and shaft, the head is almost twice as long as its width, less than one third of the length of styles, the outer margin of the sclerotized part of the shaft typically S-shaped (its endpart as broad as the head), proximal ends acute and converging. Variation slight, very characteristic specifically; nearest to no Finnish species.

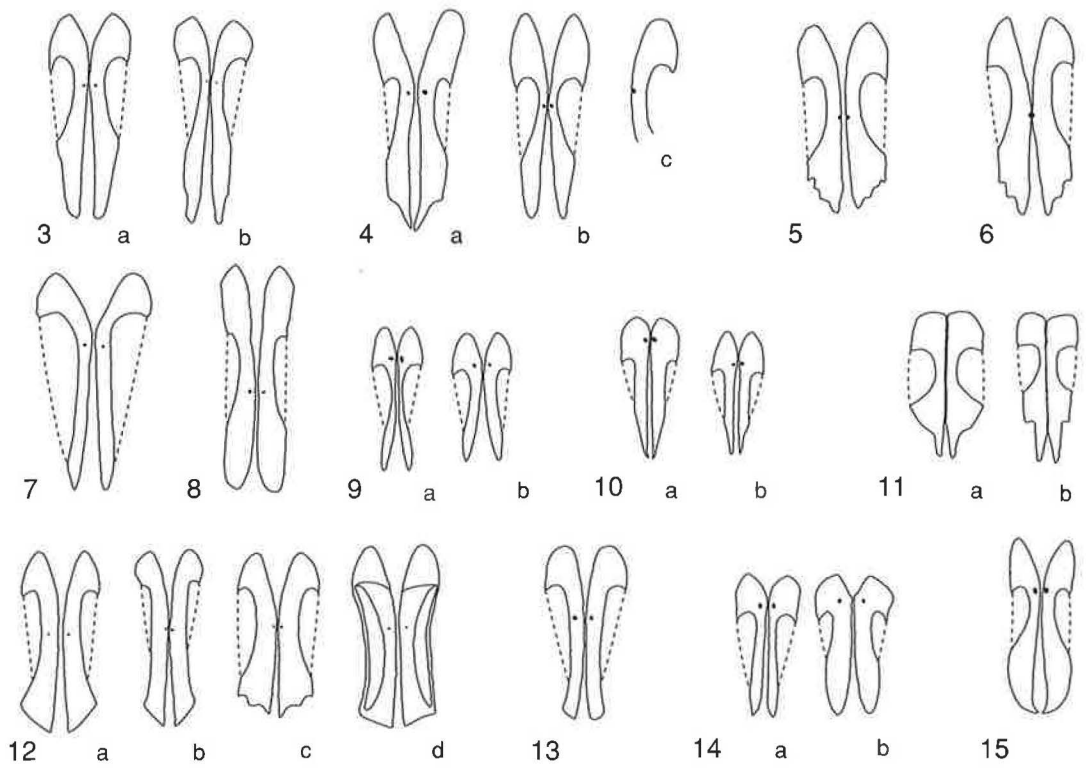
Spiculum ventrale (Fig. 28): fairly long, head about one fifth of the length, about twice as long as broad, side angles situated at about the middle of the arrow-like head, these acute like the apical angle, shaft fairly narrow, widening towards its end (to about three quarters of the width of the head). Variation slight, specifically characteristic; nearest *A. longicollis*.

Distribution in Finland (Fig. 29): *V, U, St, EH* and *Ks*.

Food plant: *Lathyrus pratensis*.

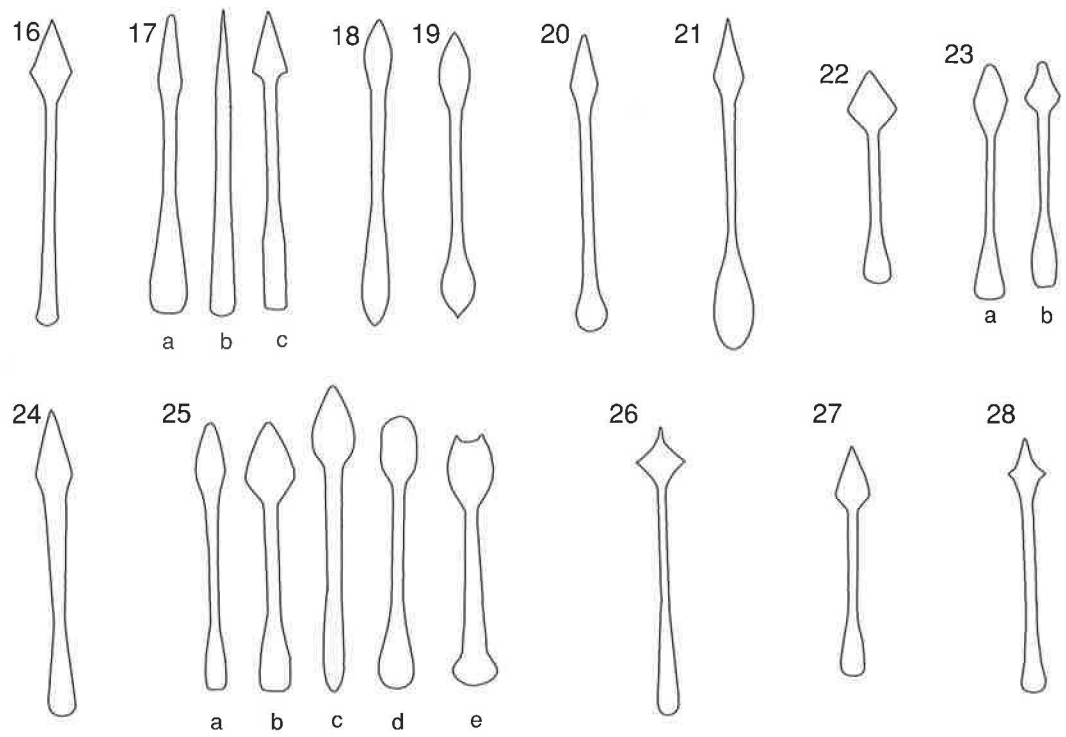
4. Key to the identification of the females of Finnish *Altica*-species

1. Thorax distinctly narrower than the base of elytrae, so that the shoulders are situated wholly outside the hind angles of thorax 2
— Base of thorax about as broad as base of elytrae or only a little narrower; hind angles of thorax situated at about the middle of the shoulder tubercles 3
2. Puncturation of the elytrae slight, micro-reticulation strong, so that the punctures in some places can hardly be distinguished from the micro-reticulated surface, gloss more or less strongly sericeous (in females), the side margins of thorax evenly curved. (In males punctures are stronger, well distinguished, the gloss is metallic). Styles characteristic, contact point normal, situated within the shaft, heads strongly diverging (Fig. 7) ..... *A. tamaricis*
— Puncturation of elytrae on the micro-reticulated surface distinct, moderately strong, gloss metallic (not sericeous), side margins of thorax slightly S-shaped. Styles very characteristic, with long contact area (Fig. 11) ..... *A. carduorum*



Figs. 3–15. Styles of *Altica*. — 3. *A. aenescens* Weise: a and b two different types. — 4. *A. lythri* Aube: a and b two different forms, c head of abnormal type (type II). — 5. *A. quercetorum saliceti* Weise (foreign individual, "Bohemia"). — 6. *A. q. quercetorum* Foudras ("Schlesien"). — 7. *A. tamaricis* Schrank. — 8. *A. engstromi* J.Sahlberg. — 9. *A. oleracea* (Linnaeus): a Danish individual, b Finnish individual. — 10. *A. palustris* Weise: a and b two different forms. — 11. *A. carduorum* Guerin-Meneville: a Finnish individual, b Swedish individual (*A. cirsii* Israelson). — 12. *A. chamaenerii* Håkan Lindberg: a and b two different typical forms, c abnormal form with notched end of the shaft, d abnormal form with sclerotized outer margin of the membranous part. — 13. *A. longicollis* (Allard). — 14. *A. opacifrons* Harald Lindberg: a and b two different forms. — 15. *A. carinthiaca* Weise.

3. Thorax about as broad as the base of elytrae, so that the sides of the beetle form almost a continuous line without any notch between thorax and the base of elytrae, micro-reticulation of elytrae very strong, partly covering the punctures, gloss sericeous. Large (4–5 mm), elongate (twice or more as long as wide) species, elytrae characteristically widening backwards. Styles characteristic with contact point at about the middle of the styles, their heads more than twice as long as their width (Fig. 8) ..... *A. engstromi*
— Thorax narrower, so that the side margins of the beetle form a notch between thorax and elytrae. Ovate (at most twice as long as wide) or elongate species, elytrae with variable micro-reticulation, with distinct puncturation, with metallic or without any gloss. Species of variable size. Styles different 4
4. Frontal tubercles dull, over their whole surface strongly micro-reticulated. Styles with contact point situated within the head (small species, < 4.1 mm) or within shaft (larger species, > 3.5 mm) 5
— Frontal tubercles more or less shiny, smooth, or slightly, sparsely or only partly micro-reticulated. Styles with contact point within shaft (or within head, see below 13, *A. palustris*) 9
5. Colour almost black (individual variation from normal colour): small species (< 4 mm), elytrae without carinae (*A. oleracea* and *A. opacifrons*, see below 8) or large species (> 4.5 mm), with slight longitudinal carinae (*A. aenescens*, see below 12).
— Colour green – blue-green – dark-blue – violet 6
6. Frontal tubercles longitudinally triangular with apex forwards, puncturation of elytrae more or less fine. Styles



Figs. 16–28. Spiculum ventrale of *Altica*. — 16. *A. aenescens* Weise. — 17. *A. lythri* Aube: a type I, b type II, c extreme abnormal form. — 18. *A. quercetorum saliceti* Weise (foreign individual, "Bohemia"). — 19. *A. q. quercetorum* Foudras ("Schlesien"). — 20. *A. tamaricis* Schrank. — 21. *A. engstromi* J.Sahlberg. — 22. *A. oleracea* (Linnaeus). — 23. *A. palustris* Weise, typical forms. — 24. *A. carduorum* Guerin-Meneville. — 25. *A. chamaenerii* Håkan Lindberg: a and b typical forms, c. and d. two extreme abnormal forms, e an extreme abnormal form with two-pointed apex (this kind of head occurs exceptionally in several species, in most extreme cases even bifurcate). — 26. *A. longicollis* (Allard). — 27. *A. opacifrons* Harald Lindberg. — 28. *A. carinthiaca* Weise.

characteristic with contact point situated between head and shaft, sclerotized outer margin of the shaft S-shaped, their ends acute and converging (Fig. 15) *A. carinthiaca*

— Frontal tubercles of other form, puncturation of elytrae usually strong. Styles with contact point situated distinctly either within head or shaft, sclerotized outer margin not S-shaped 7

7. Large (3.5–5 mm), elongate, usually blue to blue-green species. Styles with contact point situated within distal third of shaft, heads usually typically more than twice as long as their width (Figs. 4a, b), sometimes only as long as wide (Fig. 4c) ..... *A. lythri*

— Small (< 4.1 mm), more or less ovate species with varied colour. Styles with contact point within head, heads of other form. (Obs.: Small individuals of the species mentioned above (less ovate): contact point of styles within the shaft, see above 7, *A. lythri*) 8

8. Frontal carina wide, low and, like frontal tubercles and the whole head behind them, with very strong micro-reticulation, entirely dull; usually more or less greenish, sometimes bronze-green coloured, more or less shiny, fairly low and oblong ovate species. Head of the spiculum ventrale longer than its width, side angles rounded (Fig. 27) ..... *A. opacifrons*

— Frontal carina usually narrow, micro-reticulated, very often more or less shiny, frontal tubercles and the head behind them entirely micro-reticulated, slightly shiny or fairly dull, colour dark blue – green – blue – almost black. Generally a little shorter and more convex (elytrae at most 2.2 times as wide as high) species. Head of spiculum ventrale (when typical) almost square-shaped, with side and apical angles well marked (Fig. 22) ..... *A. oleracea*

9. Frontal tubercles shiny, almost smooth (possible micro-reticulation visible only with 60–100 times mag-

nification). Styles with proximal end of shaft about as wide as head 10

— Frontal tubercles more or less shiny but slightly, sparsely or only partly micro-reticulated. Styles with proximal end of shaft always narrower than head .. 11

10. Frontal tubercles (Fig. 2a, b) roundish triangular or quadrangular, hind margins oblique (not transverse), very shiny, smooth, often in outer edge with a dent and usually with some very small punctures (visible at 100 times magnification); puncturation of elytrae more or less strong. Convex species, elytrae most convex at their hind part. Styles with proximal end of shaft oblique, typically even (Fig. 12a, b, d), seldom notched (Fig. 12c). Head of spiculum ventrale typically (Fig. 25a, b) arrow-like with rounded side angles .... *A. chamaenerii*

— Frontal tubercles (Fig. 2c) more transverse and angular (triangular), the hind margins straight and next to transverse, very finely (usually thinly, but over the whole surface) micro-reticulated, clearly shiny; puncturation of elytrae relatively fine. Elytrae more evenly convex than in the previous species. Styles with proximal end of shaft oblique and stepwise notched (Fig. 5). Spiculum ventrale not arrow-like (sides evenly rounded, without side angles), the apex of head acute (Fig. 18) ..... *A. quercetorum saliceti*

11. Large species (3.5–5.2 mm), elytrae either with longitudinal carinae or with slight traces of them or entirely smooth. Contact point of styles within shaft, shaft is widest at about the middle 12

— Medium-sized or small species (2.8–4.5 mm), elytrae smooth. Contact point of styles within head, the width of the shaft variable, or within shaft, in which case the shaft is entirely equally wide 13

12. More ovate and distinctly convex (elytrae less than twice as wide as high) species, elytrae usually with slight longitudinal carinae (often only laterally), in general blue (or black, see above 5). Head of styles about as long as wide (Fig. 3). Spiculum ventrale with distinct side angles, apical angle long, acute, end of the shaft large. (Fig. 16) ..... *A. aenescens*

— More oblong, less convex (elytrae about 2.25 times as wide as high) species, elytrae usually smooth, sometimes with traces of longitudinal carinae, colour bluish green – blue – dark-blue. Head of styles usually more than twice as long as wide (Fig. 4a, b) sometimes like in *A. aenescens* (Fig. 4c). Spiculum ventrale typically not arrow-like, lacking side angles (Fig. 17a, b), variation broad (extreme abnormalities, e.g. Fig. 17c) ... *A. lythri* (Note: small individuals of the species are misleading, but the styles and spiculum ventrale are quite different from the following species).

13. Strongly metallic shiny, usually green – blue-green – bronze-green, puncturation of elytrae strong, near suture the punctures often touching each other, micro-reticulation of the frontal tubercles furrow-like, a small area in the front corner in general smooth. Styles medium-sized, contact point within the shaft, which is equally wide, slightly curved. Spiculum ventrale with head usually almost square, with lateral and apical angles tapering, acute (Fig. 26) ..... *A. longicollis*

— Slightly shiny – almost dull species, usually dark: blue – blue-green – violet, puncturation of elytrae moderately strong, punctures not touching each other, frontal tubercles more or less kidney-shaped with side towards antennae usually slightly concave, their micro-reticulation usually over the whole surface sparse. Styles small, contact point within the head, the inner margins of shafts straight and nearly parallel. Spiculum ventrale with head longer than wide, all angles or at least the side angles) rounded (Fig. 23) ..... *A. palustris*

5. The styles and spiculum ventrale of the Finnish species of *Altica*

In order to dissect the female (first joint of the anterior tarsus straight, not dilated) secondary genitalia, the specimens (dry material) should be first softened by keeping them for some hours in hot water or in a solution of water and acetic acid (70–30%) for 12–24 hours, after which the last (two or) three abdominal segments can be detached with a hooked or apically flattened and sharpened needle. The dissected abdominal segments are then opened from the side so that the distinctly sclerotized secondary genitalia (styles and spiculum ventrale) can be taken out and detached from the membranes by which they are enclosed. After that they are cleaned in a drop of water. This should be done with care in order to avoid breakage of the spiculum and loosening of the styli halves from each other. In fresh, still soft specimens the styles can be quite easily taken out by carefully pressing the abdomen dorsoventrally and drawing the styles out with a hooked needle. The spiculum is more difficult to draw out in this way.

The figures showing the styles and spiculum ventrale (Figs. 3–28) of the Finnish species were selected not only from among the typical forms but also from among some extremely abnormal forms in those species that vary widely as regards the form of the secondary genitalia. Otherwise the figure/figures shown are assumed to be adequate to express the essential features of the organs in question. The contact point is indicated with a dot in the drawing in both halves of the styles. The drawings of the styles are presented on the same scale, as also are the drawings of the spiculum ventrale.

6. Additional key according to styles and spiculum ventrale

1. Contact-area of styles long, about three quarters of their length (Fig. 11) ..... *A. carduorum*
— Contact-area short, more or less point-like 2
2. Contact point situated within head of styles or at the limit of head and shaft 3
— Contact point situated distinctly within shaft 5
3. Contact point at about the limit between the head and shaft, outer margin of sclerotized area of shafts smoothly S-shaped, proximal shaft ends acute and converging (Fig. 15). Head of spiculum ventrale longer than wide, its lateral and apical angles tapering, acute. (Fig. 28) ..... *A. carinthiaca*
— Contact point distinctly within head, outer margin of the sclerotized shaft not smoothly S-shaped, proximal end of shaft more or less curved outwards or straight. Spiculum otherwise 4
4. Inner margins of shafts of styles straight, not or only slightly diverging, at the beginning equally wide, after the middle towards their end narrowing (Fig. 10). Head of the spiculum ventrale narrower than its length, all angles more or less rounded. (Fig. 23) *A. palustris*
— Inner margins of shafts of styles curved, shafts narrow, distinctly diverging and at their proximal ends usually acute (Fig. 9). Spiculum ventrale of styles usually characteristic with head almost square-shaped, lateral and apical angles well marked (variation occurs). (Fig. 22) ..... *A. oleracea*
— Inner margins of shafts of styles at the beginning straight, equally wide, later narrowing and very slightly diverging, most especially at their end part, usually more or less rounded at their ends (variation considerable) (Fig. 14). Spiculum ventrale as in *A. palustris*. (Fig. 27) ..... *A. opacifrons*
5. Heads of styles strongly diverging, shafts equally wide within their whole length (Figs. 7, 13) 6
— Heads of styles less strongly diverging, shafts not equally wide 7
6. Heads of styles distinctly shorter than wide, strongly diverging (space between them almost twice as broad as the head), shafts narrow, straight, strongly diverging, proximally more or less pointed, the membranous part very long, extending almost to end of shaft (Fig. 7). Head of spiculum ventrale arrow-like, longer than wide, lateral angles obtuse. (Fig. 20) ..... *A. tamaricis*
— Heads of styles at least as long as their width, less strongly diverging (space between them little more than the width of the head), shafts broader, slightly curved, less strongly diverging, proximally equally cut off, membranous part about half of length of style (Fig. 13). Head of spiculum arrow-like usually as long as wide (about square-shaped), all angles tapering and acute. (Fig. 26) ..... *A. longicollis*
7. Heads of styles long, twice or more as long as their width 8
— Heads shorter, about as long as wide 9
8. Contact point situated within middle third of shaft, broad end parts of shafts as long and wide as heads, equally broad and rounded at their ends (Fig. 8). Spiculum with arrow-like apex, its lateral angles more or less distinct, proximal part of the shaft large. (Fig. 21) ..... *A. engstromi*
— Contact point situated within distal third of shaft, widened parts of shafts (within latter half of shaft) narrower than head, at their end narrower and rounded or acute and diverging (as in *A. carinthiaca*) (Fig. 4a, b). Spiculum not arrow-like, with head long (almost one third of the length), only slightly broader than the shaft and without distinct lateral angles (Fig. 17a) or lateral angles entirely lacking (Fig. 17b), shaft broad, widening towards its end (at least twice the width of the head), abnormalities occur, (e.g. Fig. 17c) .... *A. lythri*
9. Shafts of styles widest in their middle, usually narrower than the heads, and at their end more or less rounded or acute and diverging 10
— Shafts widest at their proximal parts and usually as broad (or nearly so) as the heads, their ends cut off obliquely, even or notched 11
10. Head of spiculum arrow-like, about one fourth of the length, lateral angles situated within its rear third, blunt but distinct, apical angle tapered and acute, shaft up to the end narrow (Fig. 16) ..... *A. aenescens*
— Head of spiculum (if typical) not arrow-like (Fig. 17a, b) (see above 8: *A. lythri*) ..... *A. lythri*
11. Shaft of styles widest at the outer hind corner, proximal end oblique, even or slightly notched (Fig. 12) (variation occurs, compare then spiculum and frontal tubercles). Spiculum usually with arrow-like head, although angles are often rounded, shaft (if typical) proximally cut off straight (Fig. 25a, b). (Broad variation of spiculum (Fig. 25c, d, e) may mislead determination, but as typical spiculum supports determination) ..... *A. chamaenerii*
— Shaft of styles widest within a short distance before outer hind corner, proximal end strongly oblique and stepwise notched (Fig. 5). Head of spiculum not arrow-like, side margins evenly curved, end of shaft laterally rounded, often with pointed apex (Fig. 18) ..... *A. quercetorum saliceti*

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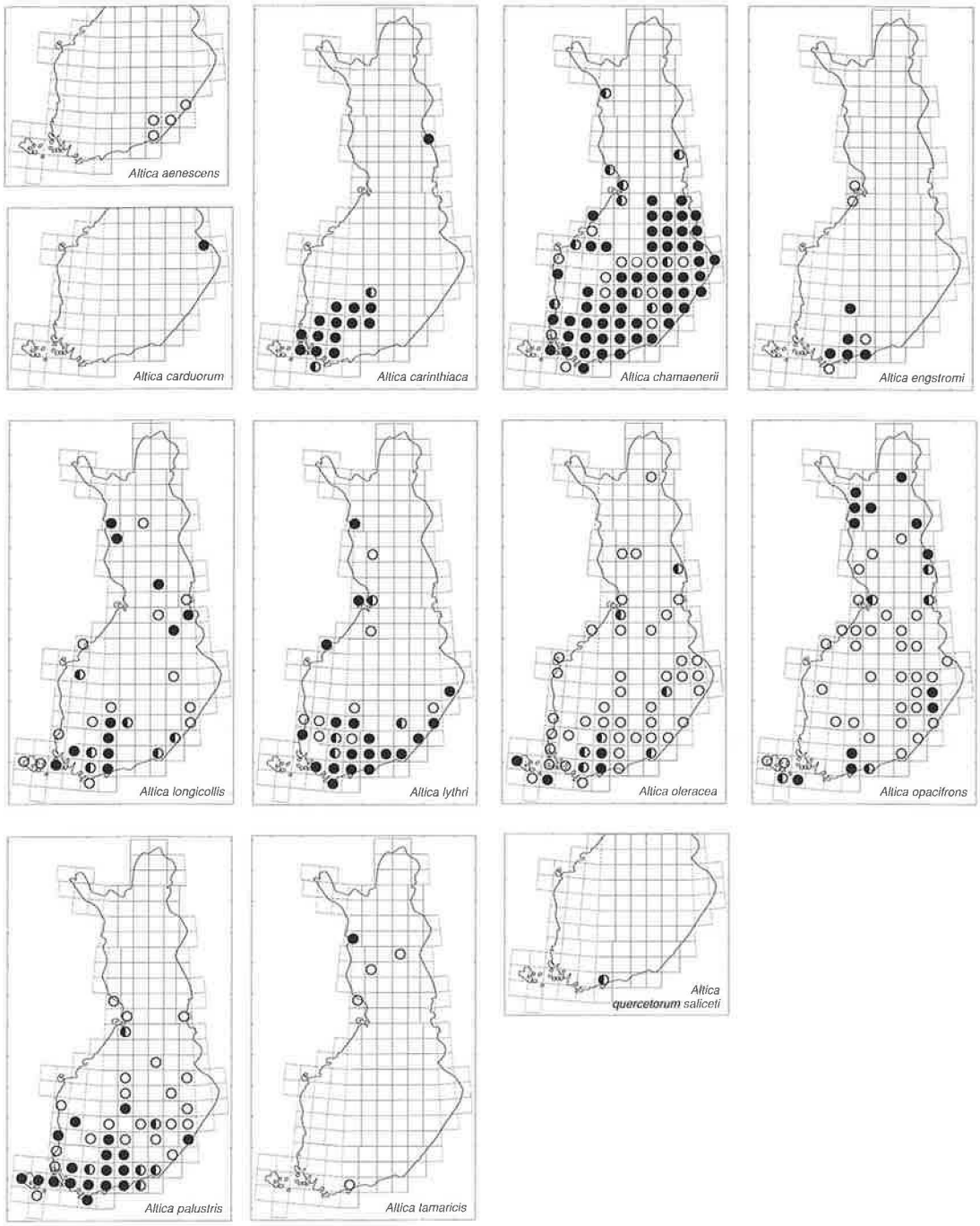

Fig. 29. UTM maps showing the distribution of the Finnish *Altica*-species. ○ = latest record before 1960; ◐ = latest record 1960–1979; ● = records from 1980 on.