

Exapate bicuspidella sp.n., a new species of Tortricidae from northeastern Finland (Lepidoptera)

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Exapate bicuspidella sp.n. is described on the basis of 8 specimens reared from larvae collected in 1984–86 at Kuusamo in northeastern Finland. The habitat was coniferous primeval forest interspersed with bogs with smooth-leaved willow (*Salix phylicifolia*), the host plant of larvae. The male *E. bicuspidella* differs from that of *E. congelatella* in details of wing pattern and in wing colour, the female in its darker and smaller appearance. Study of several morphological characters showed that *E. congelatella* is intermediate between *E. bicuspidella* and *E. duratella* of the Alps. The differences in characters are greater between *E. bicuspidella* and *E. congelatella* than between the latter and *E. duratella*. In the genus *Exapate* the sexual dimorphism of wing-length is most extreme in *E. bicuspidella*. Two hooks on pupal cremaster are subbasally widened and parallel, in *E. congelatella* tapering and divergent.

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1. Introduction

The genus *Exapate* Hübner, 1825 is restricted to two species described a long time ago, *E. congelatella* (Clerck 1759) and *E. duratella* Heyden, 1864. The first one is widely distributed in lowland of Europe except in its southern region, the second one occurs at high altitudes in the Alps in Austria, France and Switzerland (Razowski 1959, Medvedev 1978). Both species fly late in the autumn, the first in September–October and the second late in October–December (Burmann, pers. comm.). According to Kennel (1910) some pupae of *E. congelatella*

hibernate and the moths fly in early spring. We describe in this paper a new *Exapate* species, which occurs in northeastern Finland in moist coniferous primeval forest and emerges, unlike *E. congelatella* and *E. duratella*, in August (Bruun & Krogerus 1985ab).

2. Material and methods

Type material. Holotype ♂, Finland: Ks: Kuusamo, Oulanka 736:61, e.p. 7.8.1986 H. Bruun, gen.slide 614 (in the Zool. Mus., University of Oulu, Finland) — Paratypes 3♂♂, 4♀, Finland, locality data as for holotype. 1♂ e.p. 12.8.1984

(542), 1 ♂ e.p. 16.8.1986 (615), 1 ♀ e.p. 17.8.1986 (581, 582), 1 ♂ e.p. 23.8.1986 (619), all H. Bruun, 1 ♀ e.p. 12.8.1985, 1 ♀ e.p. 15.8.1986, 1 ♀ e.p. 25.8.1986, all H. Krogerus (all slides H. Bruun). The paratypes are in the collection of H. Krogerus and in the Zoological Museum, University of Oulu, Finland.

2.1. Material of closely related species

Exapate congelatella. Finland, northern Finland. Ks: Kuusamo, 736:60, Itämies & Kyrki, 6 ♂♂: 20.9–4.10.76 (gen. slides 541, 1144–1146), 1 ♂: 6.10.80 — J. Viramo, 1 ♀: 26.10.91. Ob: Rovaniemi mlk, 742:42, Itämies & Kyrki, 3 ♂♂: 19.9–3.10.77 (623, 1148) — 736:49, J. Itämies, 2 ♀♀: 17.9.92 — Muhos, 7191:452, Itämies & Kyrki, 2 ♂♂: 3.10.77 (518, 618, 1149) — Oulu, 7206:428, J. Kyrki, 2 ♂♂: 29.9.71, e.p. 1973, 731:38, J. Itämies, 1 ♀: e.p. 1987 — Oulunsalo, 721:41, J. Itämies, 1 ♂: 16.9.84 — Alatornio, 731:38, J. Kyrki, 1 ♂: 11–19.9.70, J. Itämies, 1 ♀: e.p. 1987. Lk: Kolari, M. Mutanen, 1 ♂: 17.9–1.10.93.

South Finland. Al: Eckerö, Skag, 670:09, 1 ♀: e.p. 16.10.51, 6 ♂♂: e.p. 18–24.10.82, 5 ♀♀: 18–26.10.82 — Jomala, Önninge 669:11, 2 ♂♂: 25.10–5.11.85 (583, 584A), 3 ♀♀: 20.10–2.11.85 — Lemland, Herrö, 667:12, 8 ♀♀: e.p. (*Lonicera xylostenum*) 16–21.10.82. Ab: Turku (Kärsämäki), 671:23; 3 ♂♂: 15.10.50 (613, 1152) — Turku (Impivaara), 671:23; 5 ♂♂: e.p. (*Lonicera tatarica*) 10–25.10.86 (588, 589), all H. Bruun. N: Helsinki, 667:38, 2 ♂♂: 26.10.41 (543, 1151).

Exapate duratella. Austria, Teriol. sept., Schlickeralm, 1 600 m, K. Burmann, 4 ♂♂: 23.10.56 (gen. slide 620), 26.10.57 (616), 27.10.59 (622), 27.10.59, 2 ♀♀: 27.10.59. Switzerland, 1 ♂: Stgde 942, coll. Tengstr., in Zool. Mus., University of Helsinki (546). (All slides H. Bruun). The length measurements were made with the LEITZ ORTHOPLAN microscope with a drawing attachment for magnifications up to 1 000×. Differences in morphological characters are supported by Student's *t*-test.

3. Diagnosis

The male of *E. bicuspidella* sp.n. differs from *E. congelatella* in northern Finland in being lighter and having more distinct streaklike, dark markings on forewing and more transparent hindwing. In the male genitalia the ratio of valva width/length is 17.5% (S.D. = 3.7%) higher than in *E. congelatella* (Fig. 15). The two hooks on pupal cremaster of the new species are subbasally widened and parallel, of *E. congelatella* tapering and divergent (Figs. 24–25).

The female differs from *E. congelatella*, in being dark brown-grey in colour and having higher

ratio of flagellomere length/width, and of vein-length/wing-length, and a higher longitudinal ridge density of wing scales. The difference in male-female wing length is larger and the length of the setae in furlike cover on wing shorter than in other *Exapate*-species. The new species emerges in August.

Etymology. The name is based on the two-tipped shape of the male hind-wing scales.

4. Description

Exapate bicuspidella sp.n., Figs. 1, 2, 4–6, 8, 10–17, 20–24.

Male (Fig. 1). Wingspan 21–22 mm; wing length (without ciliae) 9.7–10.2 mm (\bar{x} = 9.95, S.D. = 0.326, N (specimens) = 4, Ob (wings) = 6), not statistically different from *E. congelatella*, N Finland 9.5–10.5 mm (\bar{x} = 9.98, S.D. = 0.386, N = 10, Ob = 18, *t*-test $p > 0.05$), same species, S Finland 9.6–10.6 mm (\bar{x} = 9.96, S.D. = 0.437, N = 8, Ob = 15, $p > 0.05$) and *E. duratella* 9.6–10.7 mm (\bar{x} = 10.4, S.D. = 0.543, N = 5, Ob = 9, $p > 0.05$) (Fig. 10). Head, front and neck hairy, brownish in colour. Labial palpi 0.8 mm long, slope obliquely upwards in front of eye. Palpal hairlike scales forward-directed, dark brownish, length about half of palp; first segment curved forward, second straight, twice as long as first, third short and rounded. Antennae approx. 5.3 mm long, as in *E. congelatella* and *E. duratella*; number of flagellomeres about 36; scape scaled, pedicel and flagellomeres ciliated and scaled on one side, cilia length over half flagellomere width; flagellomere cylindrical, length about 2 × width, apical segment pointed.

Tegula and thorax brownish, scales pale-tipped. Abdomen with brownish hairs and yellowish scales. Legs yellowish brown, mid and hind tarsus and tibia pale luteous, margins of tibial and tarsal segments yellowish.

Wing venation (Fig. 4). Inner vein I of discal cell distinct. Hindwing vein M_3 and Cu_1 arise coalescent in four and remote in two of examined hindwings. Wing scales with two (Fig. 5) or three tips, former shape dominating in scale samples taken from hindwing surface between veins SC and R_1 ; longitudinal ridge density low, about 400 ridges/m (measured near tip ramification), the same as in males of other *Exapate* species.



Fig. 1. *Exapate bicuspidella* sp.n., Finland, Ks: Kuusamo, 736:61, 7.8.1986 male holotype(H. Bruun), (gen. slide 614).



Fig. 2 . *Exapate bicuspidella* sp.n., Finland, Ks: Kuusamo, 736:61, 17.8. 1986 female paratype (H. Bruun).



Fig. 3. *Exapate congelatella*, Finland, Ab: Turku (Kär-sämäki), 671:84,12.9.1976, female (H. Bruun).

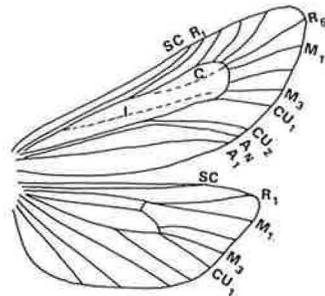


Fig. 4. *Exapate bicuspidella* sp.n., male forewing and hindwing venation (holotype).

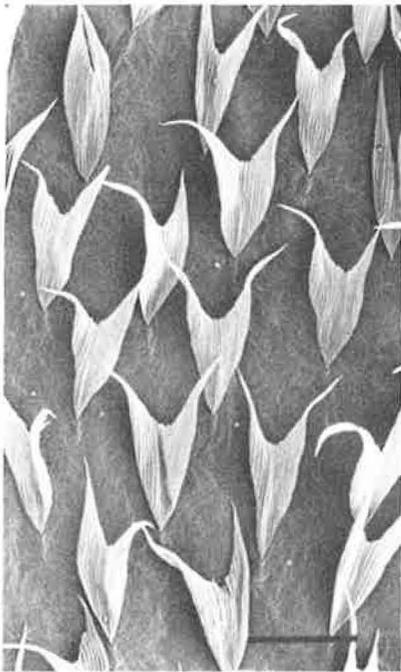
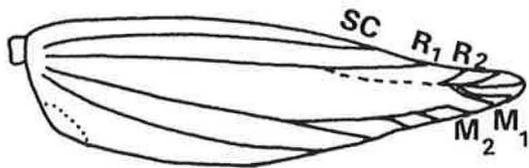
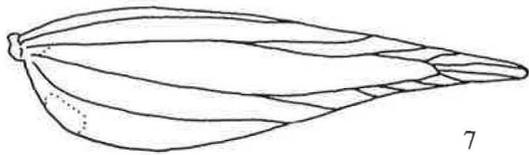


Fig. 5. Scales on male hindwing surface near vein Sc of *E. bicuspidella* sp.n. (holotype). SEM photo Scale 50 µm.



6



7

Fig. 6-7. Female forewing venation. — 6: *E. bicuspidella* sp.n., Ks: Kuusamo, e.p. 17.8.1986 (wing slide 581). — 7: *E. congelatella*, Al: Eckerö, 670:09, e.p. 25.10.1982, (wing slide 585).

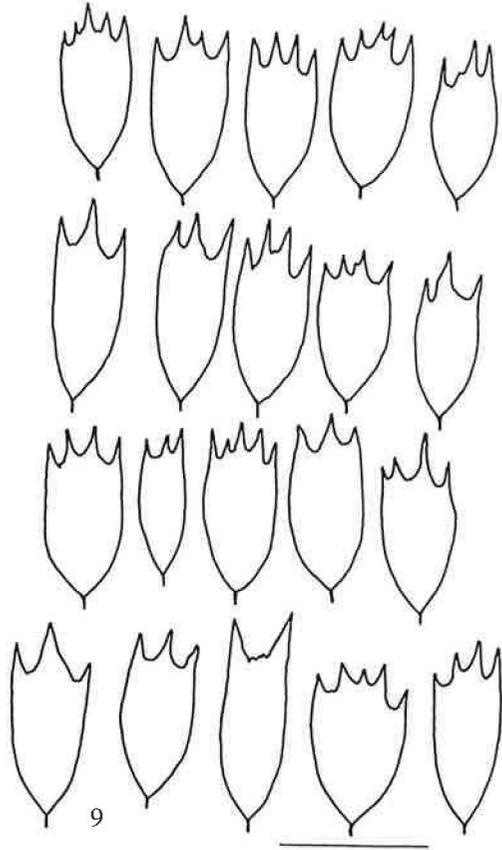
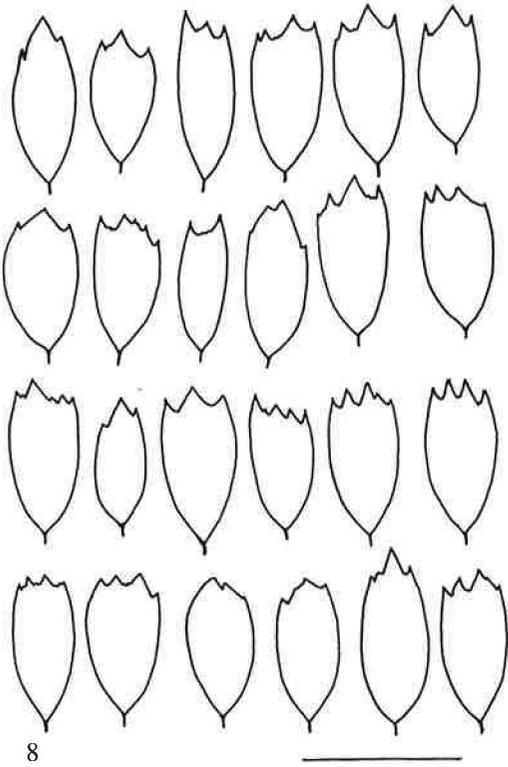


Fig. 8–9. Female hindwing scales collected from wing surface between veins Sc and R₁. — 8: *E. bicuspidella*. — 9: *E. congelatella*. Scale 100 μm.

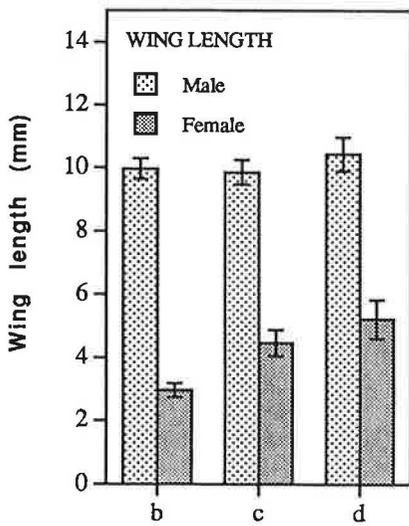


Fig. 10b–d. Male and female wing length (without cilia). — b: *E. bicuspidella* sp.n. — c: *E. congelatella*. — d: *E. duratella*.

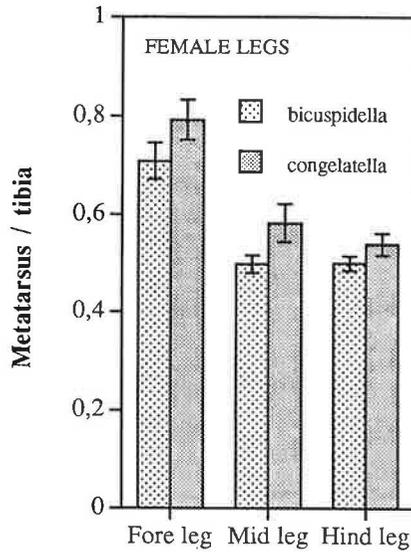


Fig. 11. Ratio of female metatarsus/tibia in fore-, mid- and hindleg. *E. bicuspidella* sp.n. and *E. congelatella*.

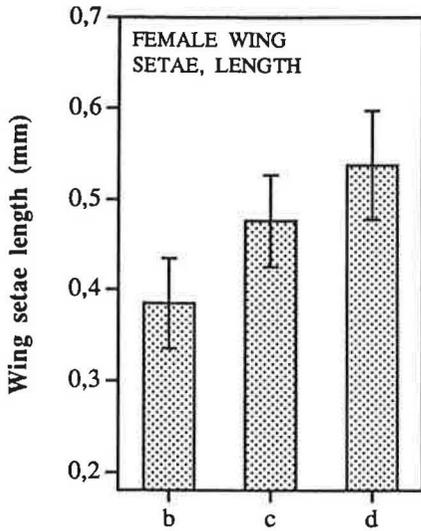


Fig. 12b-d. Length of female wing setae. — b: *E. bicuspidella* sp.n. — c: *E. congelatella*. — d: *E. duratella*.

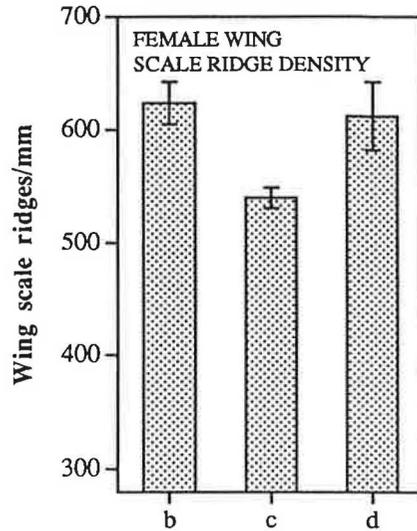


Fig. 13b-d. Number of scale ridges per mm scale width. — b: *E. bicuspidella* sp.n. — c: *E. congelatella*. — d: *E. duratella*.

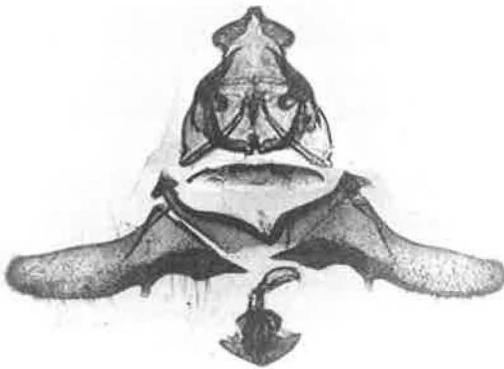
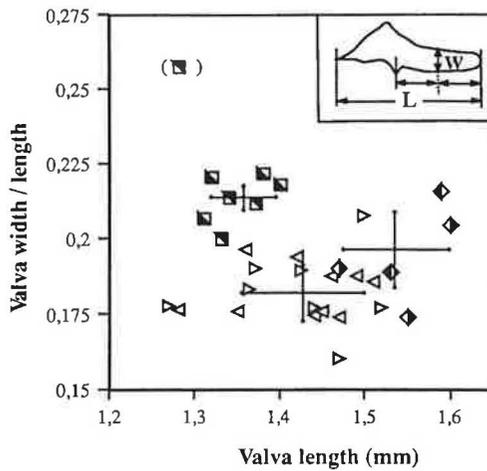


Fig. 14. *Exapate bicuspidella* sp.n., male genitalia, holotype.



- | | | | |
|---|---|---|---|
| ■ | <i>Exapate bicuspidella</i> n. sp., right valva | ▷ | <i>congelatella</i> N Finl. right valva |
| ▣ | <i>bicuspidella</i> n.sp., left valva | ◊ | <i>duratella</i> right valva |
| △ | <i>congelatella</i> N Finland, left valva | ◊ | <i>duratella</i> left valva |

Fig. 15. *Exapate*, male genitalia, ratio of valva width/length versus valva length. *E. bicuspidella* sp.n., *E. congelatella* (northeastern and northern Finland) and *E. duratella*. Both right and left valva indicated. For measuring length (L) and width (W), see drawing. Mean value and standard deviation indicated with cross. The asymmetric right valva of *E. bicuspidella* sp.n. e.p. 12.8.1984 (see text) not included in the calculations.

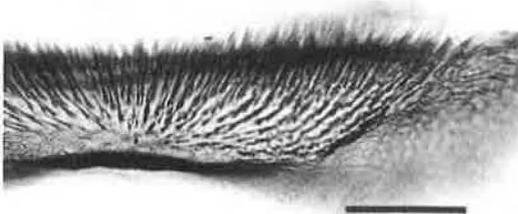


Fig. 16. *Exapate bicuspidella* sp.n., male genitalia, transtilla (542). Scale 100 µm.

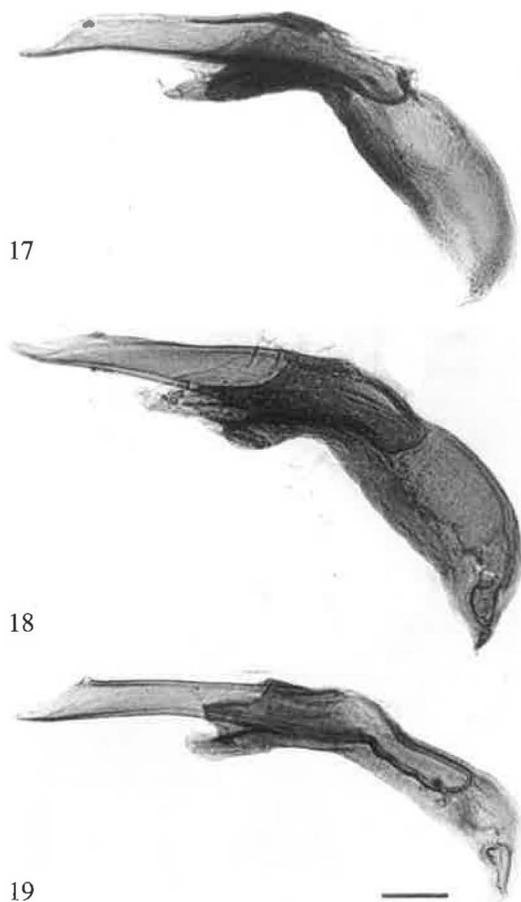


Fig. 17–19. Male genitalia, aedeagus with phallobase. — 17: *E. bicuspidella* sp.n. (615). — 18: *E. congelatella* (613). — 19: *E. duratella* (616). Scale 100 μ m.

Ground colour of forewing luteous, discal cell and distal area between veins R_4 , Cu_1 and termen pale grey, dorsal area brown-grey, medial part lighter. Costal area brown, distally of vein R_4 pale grey. Two conspicuous dark streaks subbasally and distally on inner vein I. Second streak forming subterminal fascia together with dark streaks on veins R_1 – R_4 near costa, on inner vein C near vein R_5 , on Cu_2 , A_N and A_1 and with spot of dark scales medially near costa. Basally dark spot at costa and anterior discal vein. Dark streak discernible subbasally on A_1 and medially on posterior discal vein, small dark spot on anterior discal vein near fork of inner vein C. Terminally few dark scales on vein tips. Fringe concolorous with wing, basal line distinctly darker.

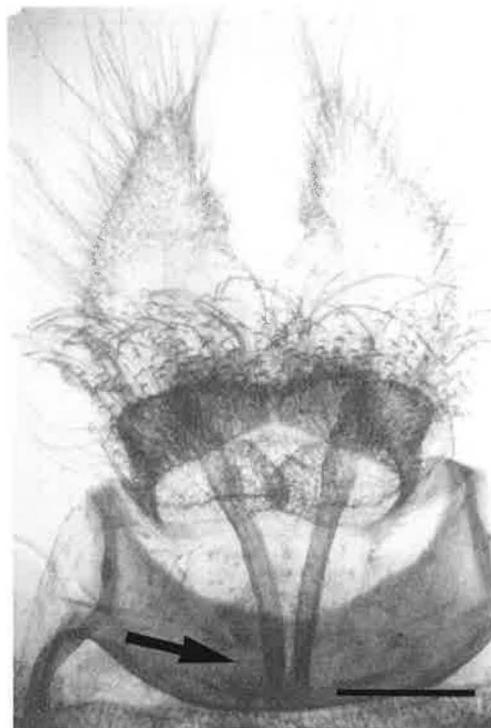


Fig. 20. *Exapate bicuspidella* sp.n., female genitalia (582). Antrum indicated with arrow. Scale 250 μ m.

Hindwing lighter than forewing, distinctly transparent, fringe concolorous, basal line distinct, pale grey-brown. Underside of forewing luteous brown with two dark streaks visible subbasally and distally on inner vein. Underside of hind wing distinctly lighter.

Female (Fig. 2, 3). Brachypterous, forewing much shorter than that of male, wing length 2.6–3.3 mm (\bar{x} = 2.96, S.D. = 0.24, N (specimens) = 4, Ob (wings) = 7), shorter than that of *E. congelatella* 3.9–4.9 mm (\bar{x} = 4.45, S.D. = 0.43, N = 8, Ob = 11, $p < 0.001$); wing length of latter not statistically different from that of *E. duratella* 4.5–5.8 mm (\bar{x} = 5.21, S.D. = 0.71, N = 2, Ob = 4, $p > 0.05$). Wing length difference male–female 6.4–7.3 mm (\bar{x} = 7.00, S.D. = 0.44, N = 4, Ob (randomly chosen wing pairs) = 11), wing length difference 26.3% (S.D. = 9%) larger than that of *E. congelatella*, 4.7–6.7 mm, (\bar{x} = 5.54, S.D. = 0.58, N = 8, Ob = 13, $p < 0.001$) (Fig. 10). Hindwing rudimentary. Head, front and neck hairy, dark-brown. Labial palpi 0.6 mm in length, diverging, weakly recurved, covered with hairs and, basally, also with scales; first

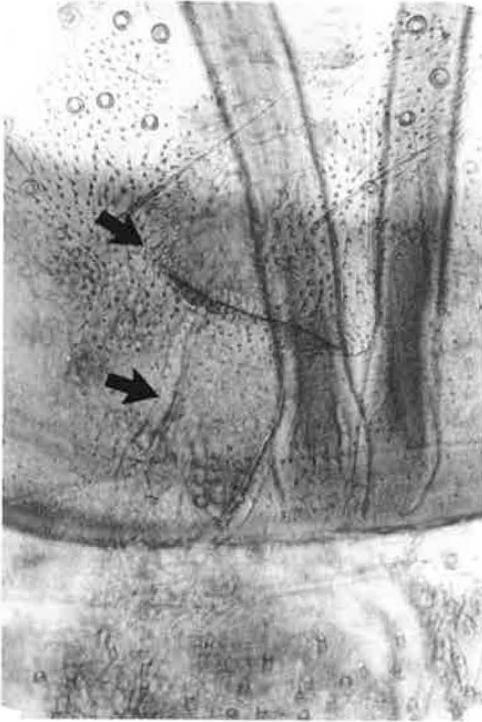


Fig. 21. *Exapate bicuspidella* sp.n, female genitalia, antrum (582). ventral and posterior margin of antrum indicated. Scale 50 μ m.

segment curved upward, second weakly recurved, its length $1.4 \times$ first segment, third segment short, pointed and directed weakly downward.

Flagellum length 3.2–3.5 mm ($\bar{x} = 3.35$, S.D. = 0.11, N = 4, Ob (flagella) = 8), shorter than in *E. congelatella* 3.5–4.1 mm, ($\bar{x} = 3.85$, S.D. = 0.22, N = 8, Ob = 15, $p < 0.001$); flagellomere number ca. 32, ratio of flagellomere length/width 2.1–2.7 ($\bar{x} = 2.33$, S.D. = 0.010, N = 4, Ob (flagellomeres) = 44), ratio higher than in *E. congelatella* 1.7–2.1, ($\bar{x} = 1.98$, S.D. = 0.068, N = 4, Ob = 42, $p < 0.001$). Tegula and thorax hairy, dark-brown with transparent scales. Abdomen brown with luteous brown to dark-brown hairs and scales, and greyish hairs. Tarsus dark luteous-brown, tibia and femur dark-brown; ratio metatarsus/tibia smaller than in *E. congelatella* (Fig. 11).

Wing venation (Fig. 6): Discal cell opening between veins M_1 and M_2 . Length of vein SC, discal vein including R_1 , and vein A_1 as percentage of wing length 71, 80 and 60, respectively (in *E. congelatella* 53, 70, 53). Forewing dark brown-

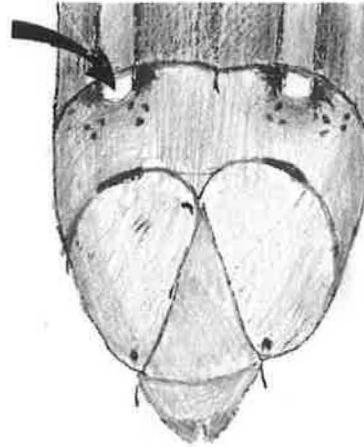
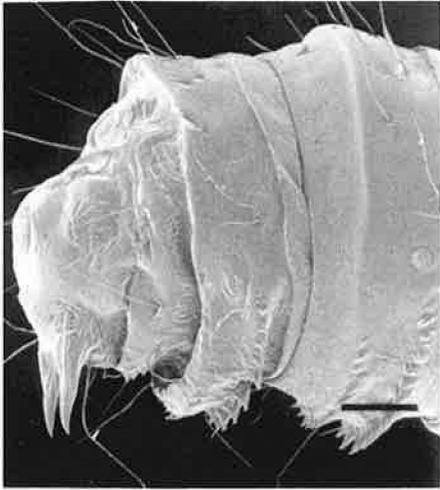


Fig. 22. *Exapate bicuspidella* sp.n., head of full-grown larva (pupating 10.–16. 7.1986). Eye-like spot marking indicated.

grey, spotted with grey scales, densely covered with stiff setae. Wing setae length 0.22–0.48 mm ($\bar{x} = 0.387$, S.D. = 0.0835, N = 4, Ob (setae) = 75), shorter than in *E. congelatella* 0.42–0.55 mm, ($\bar{x} = 0.478$, S.D. = 0.028, N = 9, Ob = 134, $p < 0.001$); length of latter shorter than in *E. duratella* 0.47–0.69 mm ($\bar{x} = 0.584$, S.D. = 0.0812, N = 2, Ob = 49, $p < 0.01$) (Fig. 12). Wing scales oval, tip or tips of scales often short, obtuse-angled (in *E. congelatella* more long-pointed) (Fig 8, 9). Density of longitudinal wing scale ridges 605–663 ridges/mm ($\bar{x} = 625$, S.D. = 22, N = 4, Ob (scales) = 65), higher than in *E. congelatella* 523–546 mm, ($\bar{x} = 540$, S.D. = 10, N = 9, Ob = 108, $p < 0.01$); ridge density of former not statistically different from *E. duratella* 582–642 mm ($\bar{x} = 612$, S.D. = 30, N = 2, Ob = 25, $p > 0.05$) (Fig. 13).

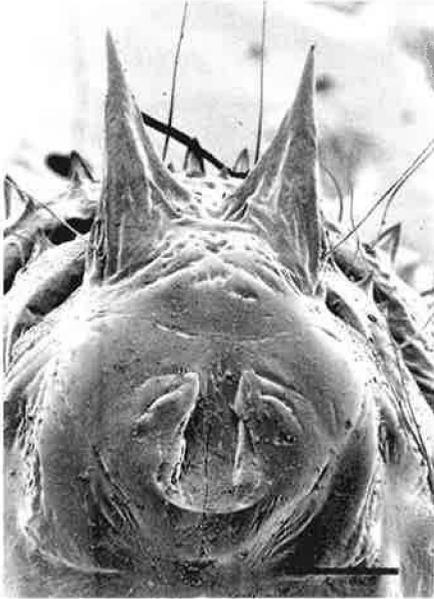
Male genitalia (Fig. 14). Socius tongue-shaped with almost parallel sides. Valva length 1.32–1.40 mm ($\bar{x} = 1.36$, S.D. = 0.0375, N = 4, Ob (valvae) = 7) slightly shorter than that of *E. congelatella*, N Finland, 1.36–1.52 mm, ($\bar{x} = 1.43$, S.D. = 0.0722, N = 10, Ob = 20, $p < 0.05$), valva of latter slightly shorter than that of *E. duratella* 1.47–1.60 mm, ($\bar{x} = 1.53$, S.D. = 0.0626, N = 3, Ob = 6, $p < 0.05$). Valva somewhat wider before cucullus; ratio of valva width/length 0.210–0.218 ($\bar{x} = 0.214$, S.D. = 0.004, N = 4, Ob (valvae) = 7), ratio 17.5% (S.D. = 3.7%) higher than that of *E. congelatella*, N Finland, 0.167–0.193, ($\bar{x} = 0.182$, S.D. = 0.0093, N = 10, Ob = 20, $p < 0.001$); ratio of latter not



23



24



25

Fig. 23–25. Cremaster of male pupa. 23–24. *E. bicuspidella* (holotype). — 23: Lateral view. — 24: Posterior view. — 25: *E. congelatella*, posterior, SEM photo. Scale 23. 250 μ m, — 24, 25: 200 μ m.

statistically different from that of *E. congelatella*, S Finland 0.169–0.193 mm (\bar{x} = 0.181, S.D. = 0.0085, N = 8, Ob = 16, $p > 0.05$) and *E. duratella* 0.182–0.204 mm (\bar{x} = 0.196, S.D. = 0.016, N = 3, Ob = 6, $p > 0.05$) (Fig. 15). Dorsal area of transtilla densely set with short, stiff setae (Fig. 16). Aedeagus short, ca. 0.42 mm (in *E. congelatella* ca. 0.48 mm, in *E. duratella* ca. 0.62 mm) (Fig. 17–19); distally, near left-hand slit edge, pointed keel. Juxta triangular, ventral tip weakly rounded.

Note. A male specimen (e.p. 12.8.84) exhibits, unlike other *Exapate* specimens studied, asymmet-

ric valvae, the right valva being ca. 8% wider (width/length = 0.258) than the left one (w/l = 0.218) (Fig. 15). The forewing pattern of the specimen is somewhat reduced; the forewing is silky and shining in colour, pale luteous brown-grey with the hindwing distinctly lighter. For figures of specimen and valva, see Bruun & Krogerus 1985a.

Female genitalia (Fig. 20, 21). Papillae anales distally triangular, apically more pointed than in *E. congelatella*. Apophyses posteriores somewhat stronger than apophyses anteriores, posteriorly wider; the posterior pair about twice as long as anterior one. Tergite VIII ventrally band-like, margin anteriorly curved, sclerotized. Antrum and surrounding colliculum transparent, natural position on left-hand of centre of tergite VIII, tube-shaped (in *E. congelatella* more sack-like) posterior margin of antrum collar-like, almost straight, about three times as wide as width of antrum. Length of antrum ca. 130 μ m and width ca. 60 μ m (*E. congelatella* ca. 220 μ m and ca. 90 μ m, respectively); posterior margin of antrum strongly spined. Both antrum and colliculum anteriorly concave. Ductus bursae and bursa copulatrix not sclerotized.

Male pupa. Pupal cremaster with two subbasally widened, parallel hooks (in *E. congelatella* hooks tapering and divergent) (Fig. 23–25). Hooks' apex distance 0.30–0.34 mm (\bar{x} = 0.323, S.D. = 0.023, N = 3, Ob = 3), smaller than that of *E. congelatella* 0.38–0.45 mm, (\bar{x} = 0.410, S.D. = 0.028, N = 12, Ob = 12, $p < 0.001$).

Biology. All type specimens were collected in 1984–1986 in the first week of July as full-grown larvae. The habitats were moist meadows and bogs with willow thickets, located in coniferous primeval forests in the Kuusamo district near the border of Russia. Finds were made at two sites, about 2 km from each other. The larva feeds on *Salix phylicifolia*, spinning together a bunch of leaves. In colour the larva is similar to the larva of *E. congelatella* but has black markings on the posterior prothoracic shield margin forming contours of two eyespots (Fig. 22). Normally hidden under the skin, the eyespots become visible when the larva is disturbed. The variability of the eye-marking was not studied. The larva pupates in the leaf bunch in a silken tube. Using the cremaster hooks the pupa moves quickly in the spinning.

The rearing of the larva in the bunches of leaves from the Kuusamo district was performed in southwestern Finland under conditions corresponding to moist coniferous forest. All the eight *E. bicuspidella* sp.n. specimens emerged in the period August 7 to 25, (the mean date August 15). Later, from the same rearing two specimens of *E. congelatella* emerged on October 14 and on October 21 to 28. These two dates agree, taking into account the milder clima of SW Finland, with the earliest flying dates of *E. congelatella* in northern Finland, September 11 to October 6 (the mean date of 16 specimens September 21). There must be a basic difference between these species as they hatch, even when kept in the same conditions, with an interval of more than one month. In accordance with this, *E. duratella* and *E. congelatella* have thicker and greater female wing fur than the earlier flying *E. bicuspidella* sp.n.

5. Conclusion

The wing size of the four males of *E. bicuspidella* sp.n. agrees with that of *E. congelatella* and *E. duratella* and the size is undoubtedly a normal and

specific property of *E. bicuspidella*, and not an artefact caused by the rearing. This is also true of the size of the four dark females of that species. The short rearing period of *E. bicuspidella* occurred during the insensitive pupal phase, and in fact, from the same rearing two *E. congelatella* specimens (male and female) of normal size hatched about one month later. The other morphological properties studied are also undoubtedly species-specific characters, and they also show a high level of statistical significance. For exact data about *E. duratella*, additional material of this rare species is needed.

In the study of the morphology of *Exapate bicuspidella* sp.n., *E. congelatella* (Clerck 1759) and *E. duratella* Heyden 1864 it has been indicated that *E. congelatella* is intermediate between *E. bicuspidella* and *E. duratella*. Thus, the differences in some characters are greater between *E. bicuspidella* and *E. congelatella* than between the latter and *E. duratella*. In addition, sexual dimorphism is most developed in *E. bicuspidella*, where the female is darker and smaller and has distinctly shorter wings than in the other *Exapate* species. Differentiation between the taxa is seen also in the flight period, since *E. bicuspidella* supposedly flies approximately a month earlier than *E. congelatella*. Differentiation between closely related taxa is of importance to avoid the risk of hybridisation, when the taxa occur sympatrically as in the case of *E. bicuspidella* and the abundant and more widespread *E. congelatella*; the difference of flight period is supposedly alone a strong isolating factor.

Distribution. The new species is known from only one area in northeastern Finland, near the boundary of Russia. The soils of the finding sites are calcareous.

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