

Crucifers in the Nordic Flora

1. *Nasturtium* and *Rorippa*

BENGT JONSELL

In this and some future papers, accounts will be presented on a number of genera in the Brassicaceae, originally to be included in Flora Nordica, a joint Nordic project to produce a scientific flora for the Nordic vascular plants. Four volumes, including a general volume have so far been published.

Regrettably it is no longer possible to publish Flora Nordica in coherent volumes. Accounts on several brassicaceous genera have been completed and have also been commented on by Nordic referees. These will be presented in Swedish in Svensk Botanisk Tidskrift and English versions can be found in the SBT archive at svenskbotanik.se.

The arrangement follows the pattern of previous Flora Nordica volumes except that keys to the genera are lacking. Such a key may be published at the end of the series.

In the accounts, material from all Nordic countries and areas will be treated, namely Denmark (**D**), Sweden (**S**), Norway (**N**), Finland (**F**) and Svalbard with Bjørnøya and Jan Mayen (**AI**). The distribution records are based on flora provinces (**F**, **N**, **S**) with some modifications, but for **D** and **I** on newly defined areas (see Map 1),

Nasturtium R. Br. ex W.T. Aiton

Brown in W. T. Aiton, Hort. Kew., ed. 2, 4: 109 (1812).

Prostrate to ascending perennials, often mat-forming, richly branched, glabrous to sparsely hairy; hairs unbranched. *Stems* juicy, hollow, rooting at lower nodes. *Leaves* pinnatisect to pinnate, auriculate. *Racemes* ebracteate, narrowly cylindrical, rather dense to loose. *Petals* white, up to twice as long as the sepals. *Stamens* 6; distinctly tetradynamous; filaments linear; anthers yellow. *Ovary* linear. *Fruit* a linear to narrowly oblong siliqua with a short, narrow, distinct style; valves without distinct veins. *Seeds* nearly globose, finely reticulate.

Chromosome base number $x = 16$; diploids and tetraploids in Norden.

1 Fruits poorly developed, with no or very few well developed seeds.....3. **N. ×sterile**
– Fruits well developed and richly seed-setting2

2 Fruits 2–2.5 mm wide, seeds in two rows; seed-coat with 25–50 areoles on each half 1. **N. officinale**
– Fruits 1.4–2 mm wide, seeds in one row; seed-coat with c. 100 areoles on each half2. **N. microphyllum**

Taxonomy. *Nasturtium* has often, not least in later years, been included in *Rorippa* as sect. *Cardaminum*. Molecular studies based on sequence comparisons of chloroplast DNA (Al-Shehbaz & Price 1998, Les 1994) have shown that *Nasturtium* is very distinct from *Rorippa* and more closely related to *Cardamine*.

Biology. Self-compatible, richly seed-setting; effectively spreading by stem fragments within a water system.

1. *Nasturtium officinale* R. Br. ex W.T. Aiton

Figs 1, 2

Aiton, Hort. Kew., ed. 2, 4: 109 (1812). – *Sisymbrium nasturtium-aquaticum* L., Sp. Pl.: 657 (1753). – *Rorippa nasturtium-aquaticum* (L.) Hayek (1905). – Type: **S** *Sk*, Linnaean Herbarium 836.1 (LINN) lectotype, sel. by Jonsell, Svensk Bot. Tidskr. 67: 293 (1973).

D Tykskulpet Brøndkarse. **F** isovesikrassi. **I** brunnerperla. **N** grøn engelskkarse. **S** källfräne.

Hemicryptophyte. *Stems* creeping to ascending, 10–100 cm, usually with numerous ± patent branches. *Leaves* evergreen, usually pure green, up to 12, all cauline; petiole 8–40 mm, with distinct auricles; blade oblong to ovate in outline, 20–90 × 15–55 mm, pinnatisect to pinnate; lateral leaflets in (1–)2–9 pairs, narrowly elliptic, oblong to nearly orbicular, 6–30 × 4–20 mm; terminal leaflet suborbicular to ovate, 15–42 × 13–30 mm; margin entire to slightly sinuate or dentate.

Inflorescences terminal and on side branches, in flower dense, 7–12 × 10–17 mm, in fruit up to 11 cm long, loose to rather dense. *Pedicels* in flower 3.5–5.5 mm, in fruit 7–20 mm, 1–1.5 times as long as the fruit, patent, straight or somewhat arcuate. *Sepals* elliptic to oblong, green, 2.3–2.6 × 0.8–1.2 mm. *Petals* white (often with a violet tinge), obovate to broadly spatulate, apically rounded, 3.5–4.5 × 1.2–1.5 mm, c. 1.5 times as long as the sepals. *Anthers* c. 0.7 × 0.4 mm. *Fruit* broadly linear, straight or often somewhat curved and torulose, 10–18 × 2–2.5 mm, with seeds in two distinct rows; style 0.8–1.8 × c. 0.5 mm; stigma slightly expanded. *Seeds* dark brown, glossy, 0.9–1.3 × c. 0.9 mm, subglobose, distinctly reticulate, with 25–50 areoles on each face. – Mid-summer to early autumn.

[2n=32]

Distribution. Nemoral [–Boreonemoral] zone. – **D** scattered to rare in most regions, lacking in *Brn*. **I** *ISu Hveragerði* since 1958 perhaps resident at Varmá. **S** *Sk* scattered along Kävlingeån and in the Ängelholm area, rare in the southeast, otherwise very rare, *HI* Trönninge (since 1989) and a few old finds in the south; *Klm* Misterhult latest 1874, probably an escape from cultivation in *Vg* V. Tunhem 1877–1938, *Srm* Årdala 1990's, *Upl* recently established and spreading around Uppsala, also recorded from *Mpd* Skön on ballast c. 1900, but no vouchers. **N** *Bu* Lier 1993 (escape from cultivation); *Øf* Halden and *MR* Kristiansund (19th century, with ballast). – Map 2.

Europe, W Asia, Ethiopia; commonly introduced in other temperate regions and montane Tropics.

Habitat. In and along running eutrophic water. – Rivers, brooks, inundated grassland, springs; mostly in moderately grazed, somewhat trampled places, now vanishing because of overgrowth or drainage. Previously also on ballast. – Sold (as well as *N. ×sterile*, 3) as a vegetable, "water-cress"; somewhat cultivated in **D** and occasionally in **S** north to *Upl* (the Mälaren area).

Variation. Very variable in size, branching and leaf shape. Forms with markedly oblong leaflets have been named var. *siifolium* but they are most certainly only vigorous modifications. Also unbranched dwarf forms exist (seen from **S** western *Sk*), only 10–12 cm high, with very reduced (even undivided) leaves and short but readily seed-setting racemes.

Similar taxa. Easily mistaken for *Cardamine amara* especially in the vegetative state; *C. amara* differs by erect, not rooting stems, violet anthers and flat fruits.

Hybridization. Hybrids formed with *N. microphyllum* (*N. ×sterile*, 3).

2. *Nasturtium microphyllum* Boenn. ex Reichenb.

Figs 3, 4

Reichenbach, Fl. Germ. Exc.: 683 (1832). – *Rorippa microphylla* (Boenn. ex Rchb.) Hyl. (1948). – *Type*: Germany, Tab. 50/4360 in Reichenbach, Icon. Fl. Germ. Helv. 2 (1837–38) lectotype, sel. by Jonsell, Flora of Tropical East Africa, Cruciferae: 57 (1982).

D Tyndskulpet Brøndkarse. **N** brun engelskkarse. **S** bäckfräne.

Literature. Hylander 1950.

Hemipterophyte. *Stems* creeping to ascending, 10–100 cm, richly branched. *Leaves* not wintering, usually brownish green, up to c. 10, all cauline; petiole 10–22(–30) mm, with distinct auricles; blade oblong in outline, 40–105 × 25–95 mm, pinnate; lateral leaflets in 2–4 pairs, sessile, narrowly elliptic to lanceolate, 13–50 × 8–25 mm; terminal leaflet orbicular to broadly elliptic, 13–62 × 11–32 mm; margin entire to slightly sinuate-dentate.

Inflorescences terminal and on side branches, in flower 12–15 × 20–23 mm, in fruit up to 25 cm long, loose. *Pedicels* in flower 4.5–9 mm, in fruit 10–20 mm, about as long as the fruits, straight or somewhat arcuate. *Sepals* elliptic to oblong, 2.5–3.3 × 0.9–1.7 mm. *Petals* white, obovate to spatulate, apically rounded, (4–)5.5–8.2 × 2.5–4 mm, c. 1.5 times as long as the sepals. *Anthers* c. 0.8 × 0.5 mm. *Fruit* narrowly linear, straight or slightly curved, 16–30 × 1.4–2 mm, with seeds in one straight or zigzag-running row; style 0.6–0.8 × 0.4–0.6 mm; stigma slightly expanded. *Seeds* dark brown, glossy, c. 1.2 × 0.9 mm, subglobose, finely reticulate with c. 100 areoles on each face. – Mid-summer to early autumn.

2n=64 (*Sk* 8). – [2n=64]

Distribution. Nemoral zone. – **D** rather common in *Sjæ*, *FyL* and western *NJy*, scattered to rare in other parts of Jylland and *LFM* (only northern Falster and Møn), lacking in *Brn*. **S** *Sk* Södra Sandby and Hardeberga (Fågelsång), possibly Simris (until 1970's), *Gtl* Visby 1861–1883 (docks), *BhG* Göteborg 1955 (waste place). – Map 3.

Europe, W Asia, Ethiopia; commonly introduced in other temperate regions and montane Tropics.

Habitat. In and along running eutrophic water. Brooks, streams, ditches, springs; favoured by moderate grazing and trampling, strongly threatened by overgrazing, overgrowth and drainage. – Also in docks and as a ruderal (apparently spread by shipping).

Similar taxa. See under *N. officinale* (1).

Hybridization. Hybrids formed with *N. officinale* (*N. ×sterile*, 3).

3. *Nasturtium ×sterile* (Airy Shaw) Oefelein

Fig. 5, 6

Oefelein, Ber. Schweiz. Bot. Gesellsch. 68: 250 (1958). – *Rorippa ×sterilis* Airy Shaw, *Watsonia* 2: 73 (1951). – *Type*: Britain, W. Norfolk, Hillington 1946, E. L. Swann 1533 (K) holotype.

N. microphyllum × *officinale*

S vinterfräne.

Literature: Jonsell 1963.

Hemipterophyte. More vigorous than the parental species. *Stems* creeping to ascending, 10–

130 cm, richly branched. *Leaves* wintering, brownish green, up to c. 10, all cauline; petiole 10–22(–30) mm, with distinct auricles; blade oblong in outline, 50–100 × 20–80 mm, pinnate; lateral leaflets in 2–4 pairs, sessile, narrowly elliptic to lanceolate, 13–50 × 8–25 mm; terminal leaflet orbicular to broadly elliptic, 13–62 × 11–32 mm; margin entire to slightly sinuate-dentate.

Inflorescences terminal and on side branches, in flower 12–15 × 20–23 mm, in fruit up to 25 cm long, loose. *Pedicels* in flower 4.5–9 mm, in fruit 10–20 mm, about as long as the fruits, straight or somewhat arcuate. *Sepals* elliptic to oblong, c. 3.0 × c. 1.0 mm. *Petals* white, obovate to spatulate, apically rounded, 5.5–6.5 × 2.5–3.0 mm, c. 1.5 times as long as the sepals. Pollen poorly developed. *Fruits* only rarely well developed, but not with more than 0–2 seeds. *Seeds* irregular, not germinable. – Mid-summer to early autumn.

2n=48 (**S** *Sk* 2, *Gtl*).

Distribution and habitat. Nemoral – Boreonemoral zone. **D** *NJy* Fjerritslev 1995, *VJy* Esbjerg 2008, *ØJy* Tilst 1993, *SJy* Rødning 2006, *FyL* Bellinge 1954, 1961 (with both parent species), *Sjæ* Frederiksværk 2006. **S** *Sk* from Gårdstånga to Örtofta along new formed banks of Kävlingeån, probably formed at the locality (abundant in the 1960's, now probably extinct). *Gtl* along the coast from Visby to Lummelunda (Överstekvarn), abundant in brooks from springs below the limestone cliffs (known since 1840), probably arrived as a hybrid, *BhG* Morlanda 2003, occasionally escaped. – Map 4.

Biology. Spread by creeping, rooting, fragmentating stems, often forming large, pure stands.

Rorippa Scop.

Scopoli, Fl. Carniol.: 520 (1760).

Radicula Moench (1794).

Nasturtium R. Br. ex W.T. Aiton (1812) p.p.

Literature. Jonsell 1968, 1987.

Prostrate to erect annuals or perennials, often richly branched, glabrous to sparsely hairy; hairs unbranched. *Leaves* petioled, undivided, pinnatifid or pinnatisect, often auriculate. *Racemes* ebracteate, in fruit narrowly cylindrical, rather dense. *Petals* yellow, up to twice as long as the sepals. *Stamens* 6; filaments linear. *Ovary* globose to linear. *Fruit* globose (silicula) to linear (siliqua) with a short, narrow, distinct style; valves without distinct veins. *Seeds* nearly globose, verruculose, foveolate or colliculate.

Chromosome base number x=8; diploids to hexaploids in Norden.

- 1 Petals and sepals about the same length; runners and rooting stem portions absent.....2
- Petals at least 1.5 times as long as sepals; runners or rooting stem portions present.....3
- 2 Sepals less than 1.6 mm; ripe fruits 2 to 3 times as long as their pedicels; valves thin, often torulose; seeds very finely colliculate (epidermal cells 20–32 µm across)..... 1. **R. islandica**
- Sepals at least 1.6 mm (except towards the end of anthesis and in badly developed specimens); ripe fruits less than twice as long as their pedicels; valves thick, not torulose; seeds finely colliculate (epidermal cells 35–55 µm across)..... 2. **R. palustris**
- 3 Cauline leaves with distinct, often nearly clasping auricles; stem puberulent at the base; many pedicels straight, patent or erectopatent4
- Cauline leaves with small or no auricles; stem glabrous or with few scattered hairs below; pedicels sinuately curved, not straight5
- 4 Leaves undivided; fruits globose or nearly so 6. **R. austriaca**

- Leaves divided; fruits ellipsoid to oblong.....7. **R. ×armoracioides**
- 5 Upper cauline leaves undivided.....4. **R. amphibia**
- Upper cauline leaves divided.....6
- 6 Terminal segment of upper leaves narrow, short; styles in fruit to 1.2 mm.....3. **R. sylvestris**
- Terminal segment of upper leaves wide, 1/4–2/3 of the total leaf length; styles in fruit longer than 1.2 mm.....5. **R. ×anceps**

1. Rorippa islandica (Oeder ex Gunnerus) Borbás Figs 7–9, 12a

Borbás, Balaton Tavanak Partmellekenek Növénnyföldr. 2: 392 (1900). – *Sisymbrium islandicum* Oeder ex Gunnerus, Flora Norvegica 2: 106 (1772). – *Type*: ill. in Oeder, Flora Danica, t. 409 (1768; Iceland) holotype.

D Islandsk Guldkarse. **F** islanninnenätti. **I** kattarjurt. **N** islandskarse. **S** islandsfräne.

Therophyte. Slender, nearly glabrous annual, 4–40 cm, with leaf rosette; taproot thin. *Stems* 2–12, decumbent to ascending, branched from near the base. *Leaves* pure green (sometimes tinged with red). *Rosette leaves* often persistent, up to 12 cm, pinnatisect. *Cauline leaves* thin and slender; petiole indistinctly winged, without auricles; blade oblong in outline, 1–5 cm (length/width ratio 3–7), pinnatisect; lateral segments 3–5 pairs, elliptic; terminal segment short, narrow; margin finely serrate or entire.

Inflorescences terminal on stems and branches (raceme-bearing branches divaricate, arranged in one plane), 3–10 cm, in fruit loose. *Pedicels* in flower 1.5–2 mm, in fruit patent to deflexed, usually shorter than 4 mm, less than 1/3 as long as the fruit. *Sepals* ovate, 1.1–1.6 mm. *Petals* pale yellow, narrowly spatulate to obovate, 1–1.7 mm, to 1.3 times as long as the sepals. *Anthers* 0.3–0.5 mm. *Fruit* richly seed-setting, oblong to broadly elliptic, often torulose and when young markedly thicker towards the base, 6–12 × 2–3 mm; valves thin. *Style* 0.3–0.7 × 0.3 mm. *Seeds* light brown, 0.6–0.9 mm, very finely colliculate (from 20–32 µm broad epidermal cells). – Mid-summer to late summer.

2n=16 (**I** *ISu*, *INo* 3, **N** *NNo*, *SNo* 3). – [2n=16]

Distribution. Middle boreal zone. – **I** *INo* Mývatn, abundant on lava gravel on the shores, otherwise few records: *IVe* and *ISu* sparse, mostly at farms or hot springs; *IMi* Ódáðahraun (Laufrönd). **N** small off-coast islands in *NNo* Værøy and *SNo* Vega, Dønna (Åsvær, Vandve) and on the mainland at Gildeskål. – Map 5.

S Greenland, Scotland, Ireland, the Alps, the Pyrenees, Balkan mountains. In Russia and W Siberia subsp. *dogadovae* (Tzvelev) Jonsell.

Habitats. Open, clayey to gravelly shores of pools and lakes; moist trampled depressions; sometimes in kitchen gardens. In **N** usually on shell deposits.

Biology. Autogamous; spread entirely by seeds. The Nordic distribution reflects the track of birds, especially geese.

Taxonomy. *Rorippa islandica* was comparatively late distinguished as a species separate from *R. palustris* (Jonsell 1968). Molecular studies have shown that it belongs to a group of species centering in North America and that it is not closely related to *R. palustris*.

2. *Rorippa palustris* (L.) Besser

Figs 10, 11, 12b

Besser, Enum. Pl. Volhyn.: 27 (1822). – *Sisymbrium amphibium* var. *palustre* L., Sp. Pl.: 657 (1753). – *Radicula palustris* (L.) Moench (1794). *Nasturtium palustre* (L.) DC. (1821). – *Type*: Sweden(?), "Lapponia", Linnaeus 1732, Lapland Herbarium 262 (LAPP) lectotype, sel. by Jonsell, Symb. Bot. Upsal. 19(2): 157 (1968).
R. islandica s. auctt.

D Kær-Guldkarse. **F** rantanenätti. **N** brunnkarse. **S** sumpfräne.

Hemicryptophyte and therophyte. Rather stiff, usually glabrous annual or short-lived perennial, 5–110 cm, with leaf rosette; taproot rather stout. *Stems* single or few, erect or ascending, upwards with spreading branches. *Leaves* pure to light green (often tinged with red). *Rosette leaves* mostly absent. *Cauline leaves* rather stiff; petiole winged or petiole indistinct, with distinct, non-clasping auricles; blade oblong in outline, 1.5–12 cm (length/width ratio 3–5), deeply pinnatisect to lyrato-pinnatifid; lateral segments 1–6 pairs, lanceolate; terminal segment elliptic, 1/3–1/2 of total leaf-length; margin irregularly serrate.

Inflorescences terminal and from side-branches (raceme-bearing branches erectopate, variously directed), 2–10 cm, rather loose. *Pedicels* in flower 1.5–2.5 mm, in fruit horizontal to deflexed, 3.5–7 mm, 1/2–1/3 as long as the fruit. *Sepals* ovate, 1.6–2.4 × c. 1.2 mm. *Petals* pale to pure yellow, narrowly spatulate to obovate, 1.7–2.8 × c. 1 mm (in the latest flowers 1.5 mm long), to 1.5 times as long as the sepals. *Anthers* c. 1.5 × 0.3–0.6 mm. *Fruit* richly seed-setting, ellipsoid to oblong and curved (sausage-shaped), rarely spheroid, not torulose, 4–12 × 1.7–3 mm; valves of firm consistency. *Style* 0.4–1.2 × c. 0.3 mm. *Seeds* light, pure or reddish brown, 0.6–0.9 × c. 0.5 mm, finely colliculate (from 35–55 µm broad epidermal cells). – Mid-summer to early autumn.

2n=32 (**D** ØJy 2, Sjæ 4, SJy, VJy 2, **F** EH 3, ES 2, InL, KiL 3, KP, Ks, PeP 4, PH, PK 2, PS, SoL, St 2, U 2, V, **N** Ho 3, **S** Ång, Bl, Dlr 2, Gstr 2, Gtl 2, Hls 3, Hrj, Jmt, Klm 2, Mpd, Nb 2, Ög 5, Öl, Sk 6, SmI 2, Srm 7, Upl 9, Vb 2, Vrm, Vsm 2). – [2n=32]

Distribution. Nemoral–Northern boreal zone. – **D** fairly common. **N** fairly common to scattered in the lowland to *NT*, further north mostly scattered but frequent in *ØFi* along Tana river. **S** fairly common in the southern and central parts and in the Bothnian coastland; scattered in the interior of the north (mostly along roads and on disturbed river-shores), less common in *Öl* and *Gtl*. **F** common to fairly common; in the north scattered (mostly along road-ditches and river-shores). – Map 6.

Circumpolar in temperate to subarctic zones; widely introduced in the southern hemisphere and montane Tropics. In North America differentiated into a number of subspecies.

Habitats. Moist and muddy places with open, clayey to sandy, sometimes also peaty, soil. Shores of lakes, ponds and rivers, ditches, trampled ground, strongly favoured in man-made habitats; sometimes among sea-wrack on sandy beaches (very low-growing); in the north also in drier sandy or gravelly places, especially roadbanks, waste places, gravel pits, etc. Rarely abundant, often very few individuals in a place.

Biology. Predominantly autogamous; spread by seeds.

Variation. In the north (in **S** south to at least *Mpd*) the fruits are in average shorter and more rounded, particularly in plants from drier habitats; they may have a northeastern connection (Ahti & Hämet-Ahti 1971). The population of **N** *ØFi* (along Tana elv) diverges by stout, ascending shoots and very stout fruits; it is close to an Alaskan taxon, var. *williamsii* (Britton)

Hultén.

Particularly on sea drift but also on open lake shores, in moist arable fields and garden plots dwarf forms with inflorescences not surpassing the leaf rosette may be found. They are modifications; plants raised from their seed in cultivation do not keep their habit.

Hybridization. Hybrids of *R. palustris* are known with *R. amphibia* (4) and *R. sylvestris* (3); see also *Variation* under *R. ×anceps* (5).

A. subsp. palustris (S vanlig sumpfräne). – *Stems* and *leaves* glabrous or nearly so. *Terminal leaf segment* up to half of the total leaf-length. *Fruits* ellipsoid to oblong (sausage-shaped).

B. subsp. hispida (Desv.) Jonsell 1968 (S indianfräne). – *Stems and leaves* with dense, short, stiff hairs. *Terminal leaf segment* not more than a third of the total leaf-length. *Fruits* spheroid to ovoid, 3–5 mm.

Docks. N *Ho* Østerøy 1927. – E North America.

3. *Rorippa sylvestris* (L.) Besser

Figs 12 c, d, 13–15

Besser, Enum. Pl.: 27 (1822). – *Sisymbrium sylvestre* L., Sp. Pl.: 657 (1753). – *Nasturtium sylvestre* (L.) R. Br. (1812). – *Type*: Clifford Herbarium 336, *Sisymbrium* 2 (BM) lectotype, sel. by Jonsell, Symb. Bot. Upsal. 19(2): 160 (1968). – *Nasturtium sylvestre* (L.) R. Br. in Aiton (1812). – *Radicula sylvestris* (L.) Druce 1906

D Vej-Guldkarse. F rikkanenätti. I skógarflækja. N vegkarse. S strandfräne.

Hemicryptophyte. Glabrous perennial, 15–90 cm, often mat-forming with numerous adventitious shoots formed from roots with long, narrow, branching runners. *Stems* usually 2–5, decumbent to ascending (rarely erect), branched from the lower parts. *Leaves* dark to bluish green, all cauline; petiole distinct, without or with small auricles; blade oblong to elliptic in outline, 2–15 × 2–3 cm (length/width ratio c. 2), deeply pinnatifid or pinnatisect; lateral segments 4–6 pairs, lanceolate to rhombic; terminal segment lanceolate to oblong, 1/5–1/4 of total leaf length; margin entire to deeply doubly serrate.

Inflorescences terminal and on side branches, ± erect, usually 2–8 cm, rather loose, with a straight or faintly zig-zag axis. *Pedicels* in flower 2–3 mm, in fruit erectopate to patent, about as long as the ripe fruit. *Sepals* ovate, 1.8–3 × c. 1.5 mm. *Petals* bright to pale yellow, narrowly spatulate, (2.2)–2.8–5.5 × c. 1.5 mm, to 1.8 times as long as the sepals. *Anthers* 0.7–1 × 0.2 mm. *Fruit* rarely seed-setting, when so 9–22 × 1–1.2 mm, often curved; unfertilized ovaries enlarging to 4–10 mm. *Style* 0.5–1.2 × c. 0.2 mm; stigma ± expanded. *Seeds* red-brown, 0.6–0.8 × 0.5–0.7 mm, verruculose or foveolate. – Mid-summer to early autumn.

2n=32 (D *Sjæ*, *SJy*, F *U* 2, N *Ak*, S *Gtl*, *Hls*, *Ög*, *Öl*, *Srm*, *Upl* 2, *Vsm* 2); 2n=40 (N *Ak*, S *Upl*); 2n=48 (D *LFM* 2, *Sjæ* 2, F *U*, N *Ak*, *Øf*, *ST*, S *Ång*, *BhG*, *Dlr*, *Gtl*, *Hl*, *Klm*, *Nb*, *Sk* 3, *Srm*, *Upl* 6). – [2n =32, 40, 48]

Distribution. Nemoral – Southern boreal (–Middle boreal) zone. – D probably indigenous at streams and other wet places in *LFM* Lolland, Falster, *Brn* southern Bornholm, southwestern *Sjæ* and *VJy* Ribe, recorded mainly in the 19th century, now very rare or disappeared; from late 19th century increasingly spreading as a weed, now common all over the country. N first find in *Ak* Oslo 1834 (at stream); fairly common in *Ak* and in coastal areas in *Ho*, otherwise scattered to rare, mainly along the coast (older finds mainly at docks and

mills), north to *Tr* Harstad 1951 and Tromsø 1886. **S** probably indigenous on stream and lake shores in *Sk*, *Bhg* Göteborg, *Nrk*, central *Ög* and around Mälaren (in *Srm*, *Upl*, *Vsm*), now rare; as a weed first on ballast, from the end of 19th century spreading as a garden weed, now fairly common in *Sk*, in coastal areas to northern *BhG* and southern *Upl*, in farmland areas of *Vg*, *Ög*; elsewhere scattered to rare north to *Dlr* (Siljan area) and in the coastland to *Nb* (Övertorneå); rare and casual in the inland provinces of Norrland, at least to *PL*. **F** first finds on ballast (*U* Porvoo 1854, *V* Turku 1855); a fairly common weed in *A*, *V*, *U* (especially in the Helsinki area), *St*, *EH* and *ES*, otherwise fairly rare or casual northwards to *PeP* Rovaniemi. **I** casual garden and nursery weed; *INo* c. 12 records, *ISu* 3 records, *IVe* 5 records, *Inv* 2 records. – Map 7.

Europe, W Asia; introduced to N America.

Habitats. Open sand or gravel; as a weed in fairly dry sites and also on clay soils; a poor competitor in closed vegetation. – Open shores, especially exposed esker shores, banks of streams; much more common as an apophyte at disturbed places, e.g. at landing places (formerly often with ballast), railways, roadsides, etc. and especially as a noxious weed in gardens, parks and nurseries.

Biology. Self-incompatible; forming extended clones, spreading as runner fragments, especially with soil transports. Seed-set rare, but may be rich where genetically different clones meet.

Variation. The polyploid levels are partly correlated to morphology and ecology. Shore populations are tetraploid ($2n=32$), rather slender and small-flowered; tetraploids spreading with cultivation also occur. The forms in nursery gardens are hexaploid ($2n=48$), more vigorous and large-flowered. Among them is a widespread form (one clone perhaps, known from **D**, **N**, **S**) diverging by rhombic leaf segments, smaller flowers and male sterility (abnormal pollen). Pentaploids ($2n=40$) spread with cultivation and are only known to occur together with hexaploids. Aneuploids are easily formed in artificial crossings (Jonsell 1968) but have not been found in spontaneous material.

Hybridisation. Hybrids of *Rorippa sylvestris* are known with *R. amphibia* (4), *R. austriaca* (6) and *R. palustris* (2). The two first hybrids are treated as *R. ×anceps* (5) and *R. ×armoracioides* (7), respectively.

4. *Rorippa amphibia* (L.) Besser

Figs 12 e, f, 16, 17

Besser, Enum. Pl.: 27 (1822). – *Sisymbrium amphibium* L., Sp. Pl.: 657 (1753). – *Nasturtium amphibium* (L.) R. Br. (1812). – *Type*: Clifford Herbarium 337, *Sisymbrium* 3 (BM) lectotype, sel. by Jonsell, Symb. Bot. Upsal. 19(2): 148 (1968). – *Nasturtium amphibium* (L.) R. Br. in Aiton (1812). – *Radicula amphibia* (L.) Druce (1906).

D Vandpeberrod. **F** vesinenätti. **N** vasskarse. **S** vattenfräne.

Helophyte and hemicryptophyte. Aquatic or terrestrial, glabrous perennial, (20–)40–120 cm, with decumbent, rooting stem-bases and with axillary leaf rosettes from flowering shoots. *Stems* ascending, branched in the upper part; basal part decumbent, rather thick and juicy, rooting. *Leaves* pure green, 3–20 × 1.5–5 cm; lower leaves pectinate (whether submerged or not), upwards successively more broad-lobed; upper leaves undivided, elliptic to oblanceolate (sometimes lyrate), 4 to 8 times as long as broad, serrate to dentate, sessile with very small or

no auricles.

Inflorescences terminal and from the upper leaf axils, ascending, up to 15 cm, loose. *Pedicels* in flower 3–4 mm, in fruit curved downwards, 7–15 mm, many times longer than the fruit. *Sepals* ovate, 2.3–3 × c. 1.2 mm. *Petals* pure yellow to orange yellow, spatulate, 3.5–5.5 × 2–3 mm, about twice as long as the sepals. *Anthers* 0.7–1 × 0.2 mm. *Fruit* with few seeds, ovoid to oblong, 2.5–6 × 1.7–3 mm; unfertilized ovaries enlarge to c. 2 mm length. *Style* 1–2.5 × 0.2 mm. *Seeds* red-brown, 0.7–1 mm, verruculose. – Mid-summer to early autumn.

2n=32 (**D** *FyL* 2, *LFM* 3, *Sjæ* 3, *VJy* 2, **F** *EH* 2, *PeP*, *St*, **S** *Sk* 9, *Srm* 6, *Upl* 9, *Vsm*). – [2n=16, 32]

Distribution. Nemoral –Southern boreal zone. – **D** common in *FyL*, *LFM* and *Sjæ*, fairly common in *ØJy*, *SJy* and southern *VJy*, elsewhere rare (extinct in *Brn*). **N** on ballast: *Ak* Oslo and *AA* Lyngør (both 19th century) and *ST* Trondheim 1905–1908 [a record published from *Øf* Onsøy is an error for *R. austriaca*]. **S** fairly common in lowland in *Sk*, at Mälaren (in *Srm*, *Vsm* and *Upl*), and in eastern and northern *Upl* (north to Västland), *Bl* Sölvesborg area, *Öl* Sandby (discovered 1993), *Klm* Kalmar area (Hagbyån and Hossmoån) and Oskarshamn area (Emån), casual in *Hl* Släp 1907, *Onsala* 1985, *BhG* Nödinge 1944. Older records from several places in *Ög*, but vouchers lacking. **F** fairly common in central *St* (main stream of Kumojoki) and *EH* southern part of the lake system of Kumojoki from Tampere to Hämeenlinna. *U* Helsinki, seashore (probably recently spread across the sea from Estonia). Map 8.

Europe, W and C Siberia, Central Asia, Asia Minor; introduced to NE North America.

Habitat. Always in wet places, often in water; shores of eutrophic lakes, streams and ponds, often in tall vegetation and on reed banks. Sensitive to competition, favoured by digging; at landing places, embankments etc., but otherwise not anthropochorous.

Biology. Self-incompatible, forming clones; fragmented stem bases spread with water, rooting among drift. Seed set rather rare, but may be rich where different clones meet.

Hybridisation. Hybrids of *Rorippa amphibia* are known with *R. palustris* (2) and *R. sylvestris* (3); the latter hybrid is treated as *R. ×anceps* (5).

5. *Rorippa ×anceps* (Wahlenb.) Rchb.

Figs 12 g, h, 18, 19

Reichenbach, Comment. Icon. Fl. Germ. Helv. 2: 15 (1837–38). – *Sisymbrium anceps* Wahlenb., Fl. Upsal.: 223 (1820). – *Type*: **S** *Upl* Uppsala (Kungsängen) 9.VII.1818, G. Wahlenberg (UPS) lectotype, sel. by Jonsell, Symb. Bot. Upsal. 19(2): 152 (1968).

R. amphibia × *sylvestris*

F kärsänenätti. **S** mälärfräne.

Hemicryptophyte. Glabrous perennial, decumbent in basal parts, usually with vigorous rooting runners; adventitious shoots both from root-runners and stem-bases. *Stems* 2–5, 30–100 cm, ascending, in larger individuals richly branched in the upper parts. *Leaves* pure green, without or with small auricles; blade oblong to elliptic in outline, 4–12 × 1–5 cm (length/width ratio 2.5–4), lower ones lyrate-pinnatisect, upper ones pinnatifid; lateral segments 2–7 pairs, oblong; terminal segment elliptic, 1/4–2/3 of total leaf length; margin coarsely dentate.

Inflorescences suberect to ascending, usually 3–15 cm, loose. *Pedicels* in flower 2–8 mm,

in fruit curved downwards, about twice as long as the ripe fruit. *Sepals* ovate, 2–3.8 × 0.9–1.3 mm. *Petals* pure yellow, 3.5–5.5 × 2–2.4 mm, spathulate, about twice as long as the sepals. *Anthers* c. 0.8 × 0.2 mm. *Fruit* ellipsoid to oblong, 5–10 × 1.2–2(–2.5) mm, seed set often rich. *Style* 1.2–2.5 mm; stigma not expanded. *Seeds* irregular but partly well developed. – Mid-summer to early autumn.

2n=32 (**F** *PeP*, **S** *Vsm*, *Upl* 6, *Sk* 3, *Srm*); 2n=40 (**S** *Sk* 4). – [2n=32, 40]

Distribution. Nemoral – Middle boreal zone. – **D** *NJy* latest Pandrup 2002, *VJy* Ribe 1851–1993, *ØJy* Mausing 2000, *SJy* Als, *Sjæ* 5 records (latest Roskilde 2000) and *Brn* Nexø (latest 1938). **S** scattered in southern *Sk* and at Mälaren (*Srm*, *Upl*, *Vsm*) at least still in the 1970's; few records after 2000 (*Upl* Häggeby, Sankt Olof, Skokloster, Vallby). Formerly also *Ög* Vreta Kloster 1880's, *Nrk* Örebro 1890's and *Mpd* Timrå 1890. **F** *PeP* Alatornio (Torniojoki, found in 1959). – Map 9.

Outside Norden at least in C Europe and the British Isles.

Habitats. Open shores of eutrophic lakes and streams, especially on gravel and sand (at Mälaren mainly along esker shores), locally in large, variable populations (hybrid swarms). Favoured by human activities but also recorded at natural, fairly exposed shores.

Biology. Self-incompatible, but often seed-setting since many clones (of hybrids and parent species) often grow together; largely spreading by fragments of root runners and stem bases.

Variation. The hybrid derivatives form an almost continuous series between the parent species. Individuals with broader, more serrate leaf segments, found particularly in *Upl* (at northern Mälaren), may be triple hybrids involving also *R. palustris*.

6. *Rorippa austriaca* (Crantz) Besser

Figs 20–22

Besser, Enum. Pl.: 103 (1822). – *Nasturtium austriacum* Crantz, Stirpium Austr. Fasc. 1: 15 (1762). – *Type*: Austria, "Nusdorf via", Crantz s.n. (BP) holotype.

D Østrigsk Guldkarse. **F** eteläinenätti. **N** kulekarse. **S** klotfräne.

Hemicryptophyte. Perennial with numerous adventitious shoots formed from root runners. *Stems* 1–4, 40–100 cm, ascending to erect, branched in the upper part; the basal part with scattered to rather dense short hairs. *Leaves* dull to bluish green, sessile, with clasping auricles; blade elliptic in outline, 3–15 × 1.2–2 cm (length/width ratio 3–5), undivided, serrate to entire.

Inflorescences terminal or from the upper leaf axils, erect to erectopate, 5–20 cm, rather dense. *Pedicels* in flower 2–5 mm, in fruit erectopate to patent, usually straight but the outer part sometimes bent downwards, always much longer than the fruit. *Sepals* ovate, 2–2.5 × c. 1.2 mm. *Petals* pure yellow, spathulate, 3–4.5 × c. 1.5 mm, at least 1.5 times as long as the sepals. *Anthers* 0.6–0.8 × 0.2 mm. *Fruit* rarely seed-setting, when so c. 3 × 2.5–3 mm, globose to broadly ovoid; unfertilized ovaries globose, to c. 2 mm diam. *Style* 1–2 × c. 0.2 mm; stigma expanded. *Seeds* ellipsoid, red-brown, 0.7–0.9 × c. 0.7 mm, verruculose. – Mid-summer to early autumn.

2n=16 (**D** *VJy*). – [2n=16]

Distribution. Nemoral – Boreonemoral zone. – **D** first find 1914 (*ØJy* Randers, established in *NJy* Skagen (from the 1930s, sand-dunes), Kvissel (from 1920s, roadsides), *SJy* Løgumkloster

1951, *VJy* N Nebel (from 1950 – 60, railway), *FyL* Odense (latest 1961), *Sjæ* Lundby 1950. **N** first find in 1906 (*ST* Trondheim), now fairly regular at some docks and factories: *Øf* Moss, *Onsøy*, *Ak* Oslo area, *He* Stange 2002, *Bu* Drammen, *Lier*, *Vf* 3 localities, *Te* Skien, *Kragerø*, *VA* 3 localities, *Ro* 4 localities, *Ho* 5 localities, *ST* Skaun 1940's, Trondheim latest 1988. **S** *Sk* several localities, established at least in Helsingborg, *Klm* Kalmar 1910's, Örsjö (known since 1916), *Hl* Falkenberg 1940's, *BhG* Göteborg area (established since 1945), *Vg* Mariestad 1910's, *Srm* Brännkyrka 1924. **F** *EP* Kurkka railway (established since 1969), *EH* Kuusankoski 1950, *ES* Lappeenranta 1969–70. – Map 10.

C and E Europe, Kazakhstan; introduced to N America.

Habitats. Sandy to gravelly places in docks and at mills, railways, roadsides, waste places; sometimes naturalized.

Biology. Self-incompatible; seed set only occurs when clones meet; within Norden mostly spread as runner fragments. Introduced to the area as seeds with cereals imported from E Europe, mainly in the early 20th century.

Hybridisation. *Hybrids* formed with 3. *R. sylvestris* (see 7. *R. ×armoracioides*).

7. *Rorippa ×armoracioides* (Tausch) Fuss

Figs 12 i, 23, 24

Fuss, *Fl. Transsilv. Exs.*: 47 (1866). – *Nasturtium armoracioides* Tausch, *Flora* 45: 707 (1840). – *Described from* Czechia (Bohemia).

R. austriaca × *sylvestris*

F puistonenätti. **N** hybridkulekarse. **S** vägfräne.

Hemicryptophyte. Perennial, 40–150 cm, with root runners forming adventitious shoots, often in dense clumps (but not in mats). *Stems* ascending, richly branched; basal part with scattered short hairs. *Leaves* dark green; petiole short, with distinct auricles; blade ovate to elliptic in outline, 5–12 × (1–)2–6 cm (length/width ratio 2–3), usually pinnatifid (rarely undivided and deeply serrate); lateral segments 1–4 pairs, oblong; terminal segment elliptic, 1/4–2/3 of total leaf length; margin acutely serrate.

Inflorescences ascending to erectopatent, up to 20 cm, loose. *Pedicels* in flower 3–8 mm, in fruit erectopatent to patent, straight or in outer part bent downwards, 8–12 mm, about as long as or longer than the fruit. *Sepals* ovate, 1.8–3 × c. 1 mm. *Petals* pure yellow, 3–4.5 × 2–3 mm, spatulate, 1.5–2 times as long as the sepals. *Anthers* c. 1 × 0.3 mm. *Fruit* quite often richly seed-setting, ellipsoid to oblong, 3–9 × 1.5–2 mm. *Style* 0.8–1.5 × 0.2–0.3 mm; stigma rather flat, expanded. *Seeds* irregular but partly well developed. – Mid-summer to early autumn.

2n=32 (**D** *Sjæ*, *SJy*, **N** *Ak*, **S** *Sk*).

Distribution. Nemoral – Boreonemoral (–Southern boreal) zone. – **D** rare but increasing, especially in *Sjæ* the København area; scattered in *NJy*, *VJy* and *SJy*, otherwise rare. **N** rare at the south coast from *Øf* to *VA* and in *Ho*, *SF* Balestrand, in the inland *OP* Gjøvik, *He* Ringsaker more frequent and increasing in *Ak* (the Oslo area). **S** rare in most mainland provinces north to *Dlr* Borlänge 1930's, Rättvik 1922, *Mpd* Njurunda (established since 1950's), *Ång* Örnköldsvik 1939 and *Vb* Umeå 1971; more frequent in southern *BhG* (especially the Göteborg region) and *Vg* Borås area; increasing in many areas. **F** rare and mostly casual in the south and southwest: *V* Turku, *U* Hanko, Helsinki area, *St* Eura, *EH*

Jämsänkoski, *ES* Ruokolahti, *EK* 2 records 1920's. – Map 11.
At least C Europe.

Habitats. Rather dry, open, gravelly places. – Roadsides, railways, courtyards, ruderal ground; more rarely parks and gardens. Often established within an area, although rather casual in each locality.

Biology. Self-incompatible; spread by fragments of runners and by seeds from localities where different hybrid clones grow together or with *R. sylvestris*. Hybrid seeds seem to have arrived with imported cereals in the earlier part of the 20th century.

Variation. Very variable, particularly because of back-crossing to *R. sylvestris*, while individuals more similar to *R. austriaca* are rare.

Hybrids

Rorippa amphibia × **palustris**. – Perennial, without runners; well-developed fruits uncommon, c. 4 mm long. – Differs from *R. amphibia* in having more lobed cauline leaves and petals c. 3 mm (not more than 1.5 times as long as the sepals), and from *R. palustris* in the large terminal leaf segment, longer petals and taller growth with ascending stems and from *R. ×anceps* by the obvious, often clasping auricles of the stem leaves.

Documented with certainty only from **S** *Srm* Jäder 1986 (islet in the lake Mälaren). – *R. palustris* may be a component in triple hybrids also including *R. amphibia* and *R. sylvestris* (see under *R. ×anceps*, 5).

Rorippa palustris × **sylvestris**. – Long-lived perennial with runners; shoots ascending; petals c. 3 mm; fruit (when well developed) 8–12 × c. 1.2 mm, seeds badly developed. – Differs from *R. sylvestris* by the lyrate stem leaves with a 10–18 mm broad terminal segment, and from *R. palustris* by rooting runners.

Verified only from **N** *Ak* Oslo 1960s. **S** *Hls* Ljusdal 1920's; numerous specimens of not seed-setting *R. sylvestris* have been misidentified as hybrids with *R. palustris*.

- Sincere thanks to Thomas Karlsson for distribution records and valuable comments and to all Nordic scrutinizers of the manuscript.

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Figures

Figure 1. *Nasturtium officinale* – Uppland Vaksala, Årsta-enbacken, 22 September 2013.
Photo : Åke Svensson.



Figure 2. *Nasturtium officinale*, part of an infructescence. Drawing : Kalle Forss.

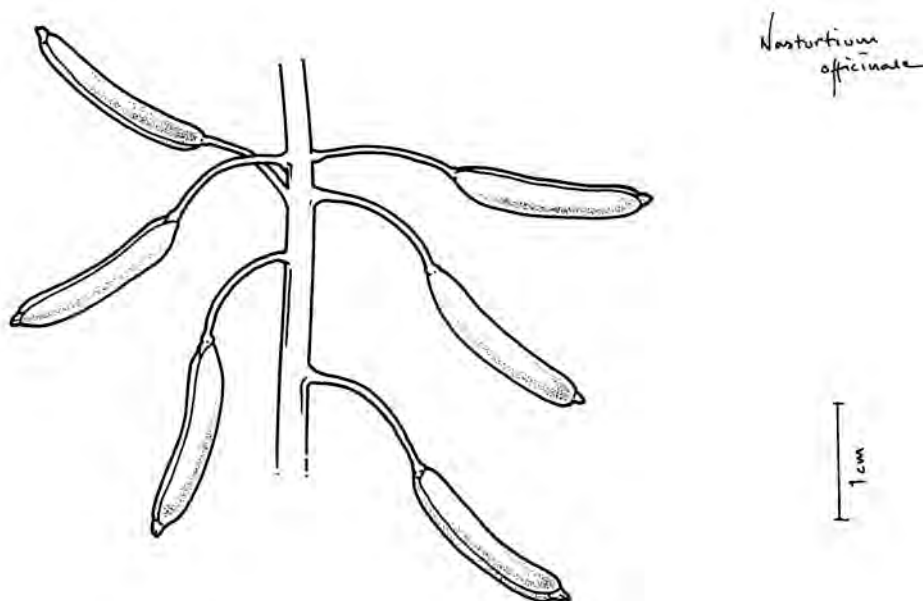


Figure 3. *Nasturtium microphyllum*, part of an infructescence. Drawing : Kalle Forss.

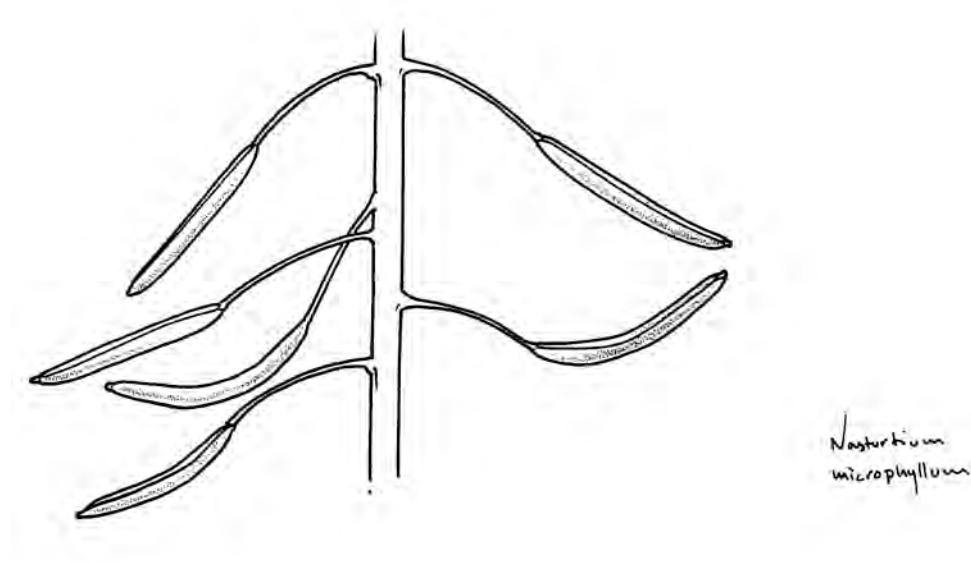


Figure 4. *Nasturtium microphyllum*. – Skåne, Södra Sandby, Sularpsbäcken, 29 June 2009.
Photo : Åke Svensson.



Figure 5. *Nasturtium* ×sterile, part of an infructescence. Drawing : Kalle Forss.

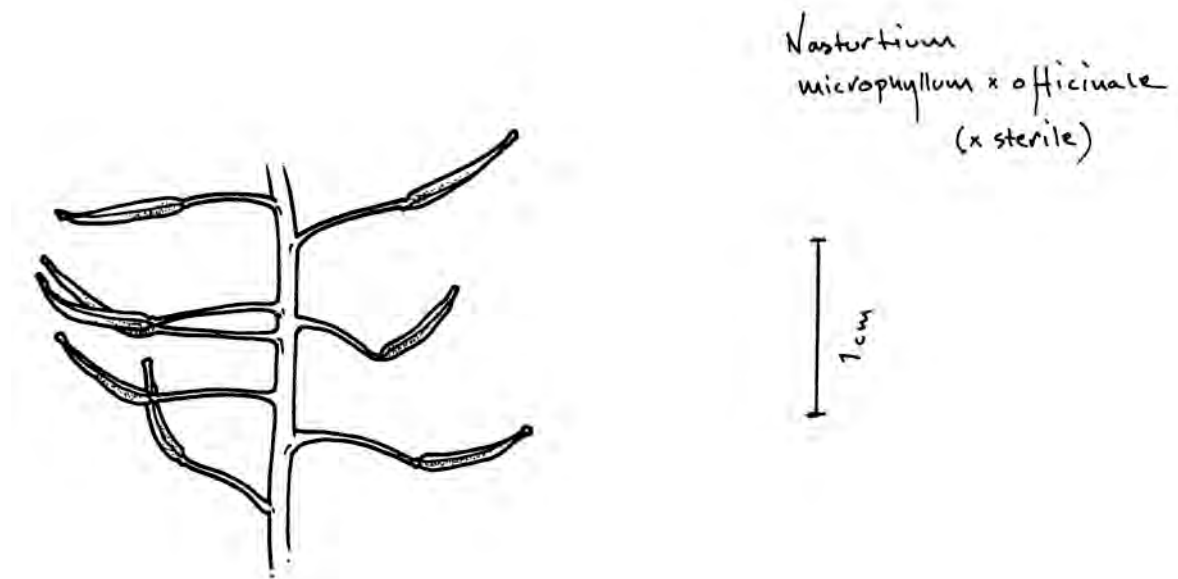


Figure 6. *Nasturtium* ×sterile, is as the species epithet indicates a sterile hybrid between *Nasturtium officinale* and *N. microphyllum* – Gotland, Brucebo, 2 July 2007, known here since 1840. Photo: Thomas Gunnarsson.



Figure 7. *Rorippa islandica*. – Lilla Saltsö Kangerlussuaq, Grönland, 4July 2014. Photo: Jan Thomas Johansson.



Figure 8. *Rorippa islandica*, ripe fruit. Drawing : Kalle Forss.



Figure 9. *Rorippa islandica*, specimen from Norway, Nordland, Vandve. Drawing: J. Induss.



Figure 10. *Rorippa palustris*, ripe fruit. Drawing : Kalle Forss.



Figure 11. *Rorippa palustris*. – Lund, Skåne, 18 August 2012. Photo: Jan Thomas Johansson.



Figure 12. Cauline leaves of *Rorippa* species. About 60% of natural size. a) *Rorippa islandica*. b) *R. palustris*. c, d) *R. sylvestris*, cauline leaf (c), cauline of male sterile form (d). e, f) *R. amphibia*, leaf in the leaf rosette (e), cauline leaf (f). g, h) *R. ×anceps*, two different specimens. i) *R. armoracioides*. j) *R. palustris* × *sylvestris*, two cauline leaves. Drawing: Bengt Jonsell.

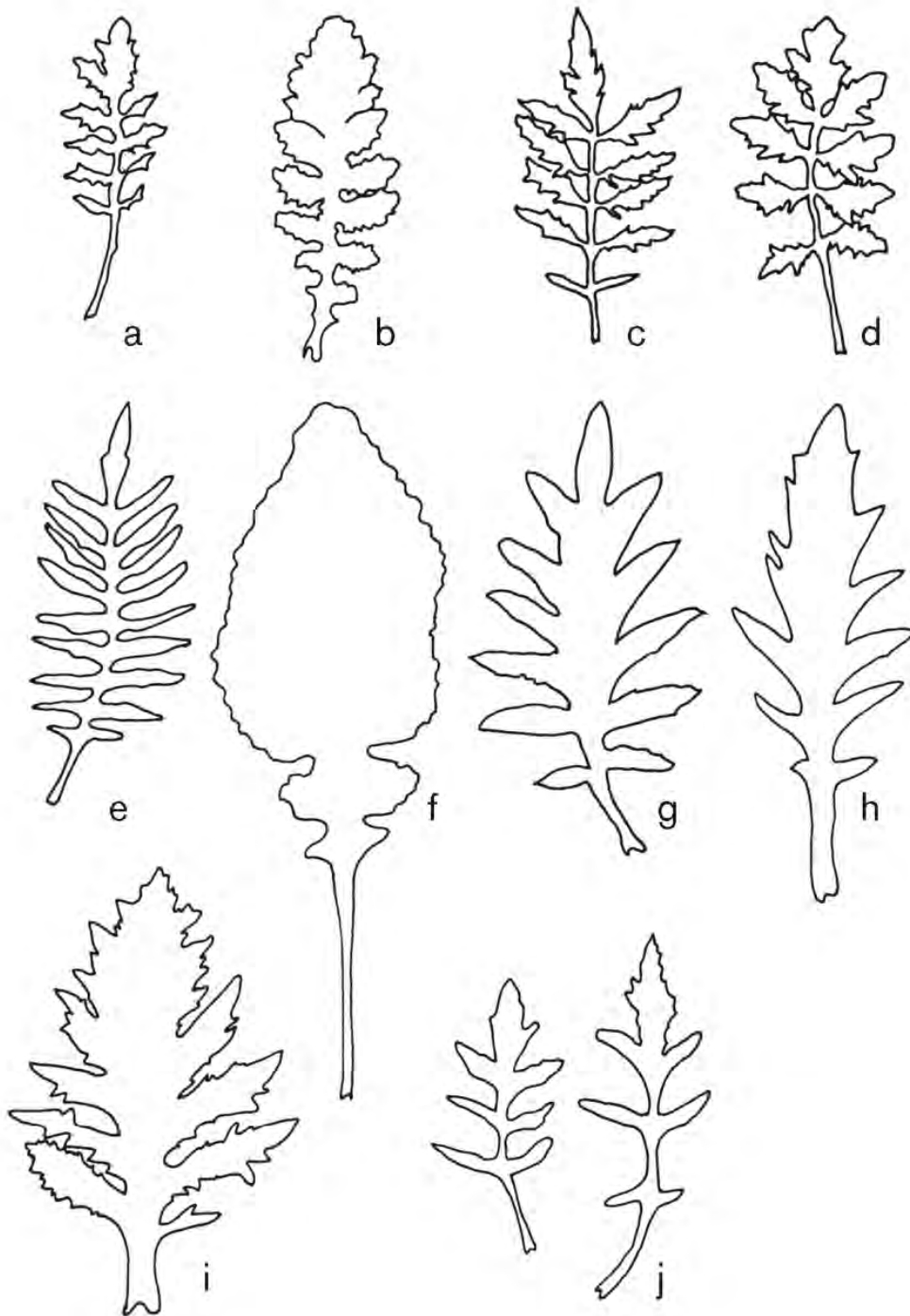


Figure 13. *Rorippa sylvestris*, part of inflorescence with poorly developed fruits. Drawing : Kalle Forss.

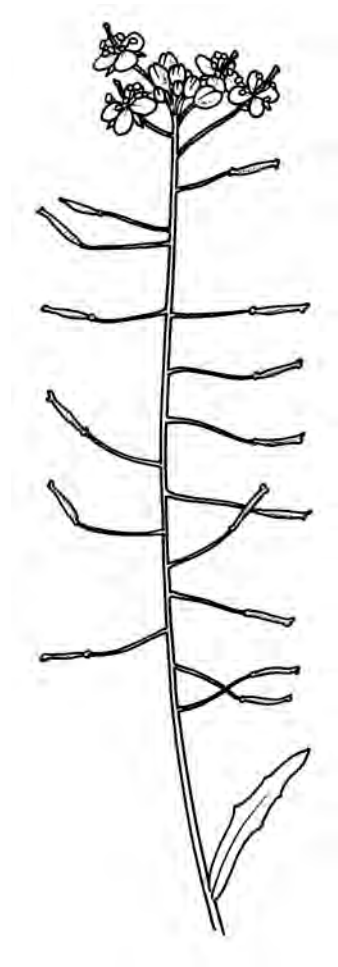


Figure 14. *Rorippa sylvestris*. – Lund, Skåne, 10 June 2013. Photo: Jan Thomas Johansson.



Figure 15. *Rorippa sylvestris*, ripe fruit. Drawing : Kalle Forss.

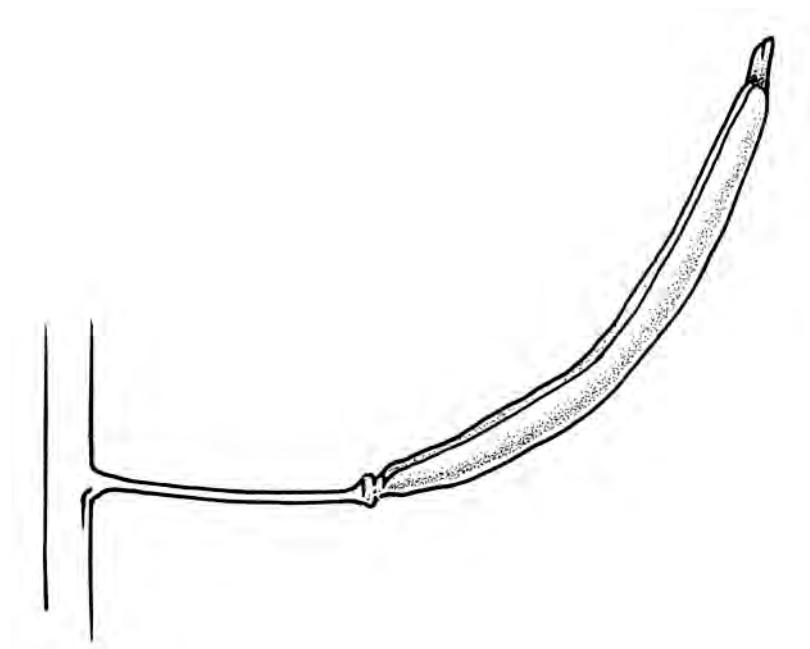


Figure 16. *Rorippa amphibia*. – Lund, Skåne, 25 May 2014. Photo: Jan Thomas Johansson.



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Figure 17. *Rorippa amphibia*, infructescence, section with ripe and dehiscent fruits. Drawing : Kalle Forss.

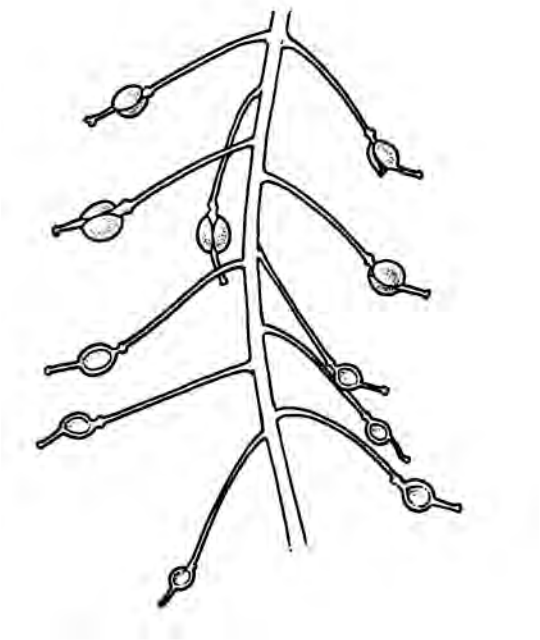


Figure 18. *Rorippa xanceps* from Svensk Botanik, vol. 11.

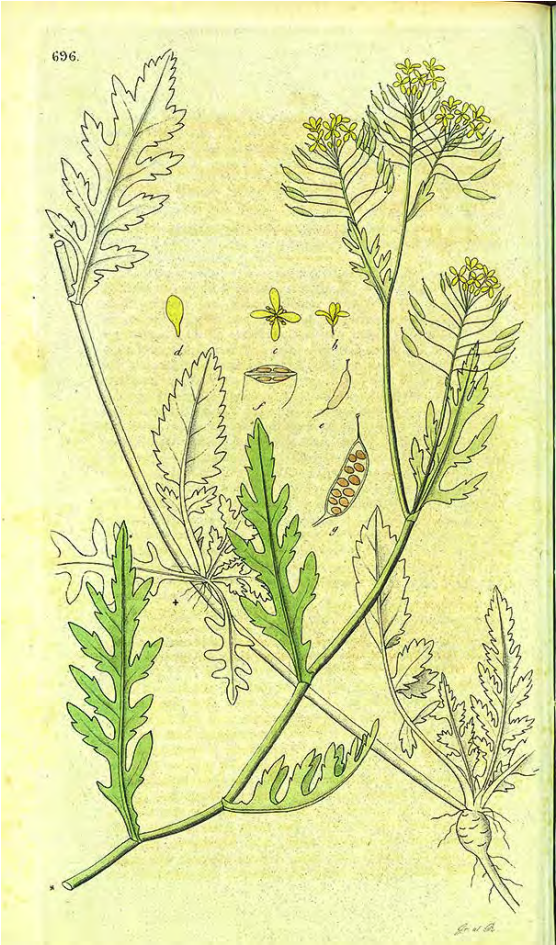


Figure 19. *Rorippa ×anceps*, part of infructescence. Drawing: Kalle Forss.



Figure 20. *Rorippa austriaca*, stem with leaf and distinct auricles. Drawing: Kalle Forss.

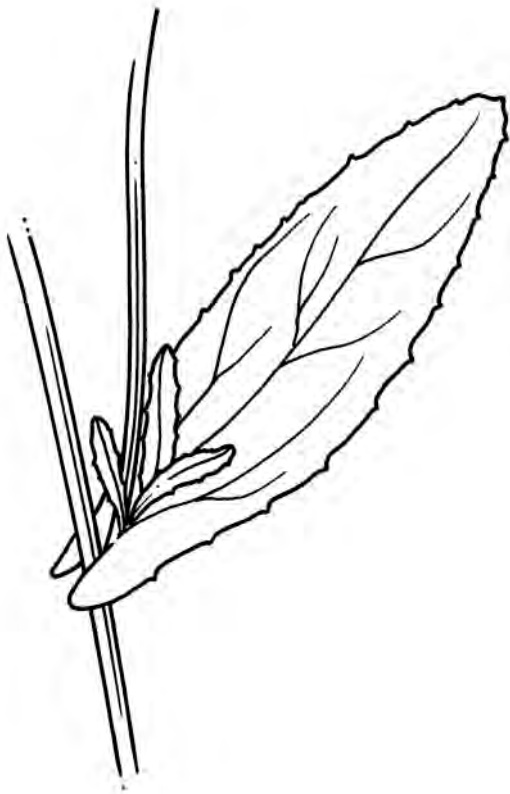


Figure 21. *Rorippa austriaca*. – Helsingborg, Skåne, 4 June 2014. Photo: Jan Thomas Johansson.



Figure 22. *Rorippa austriaca*, infructescence and a fruit. Drawing: Kalle Forss.

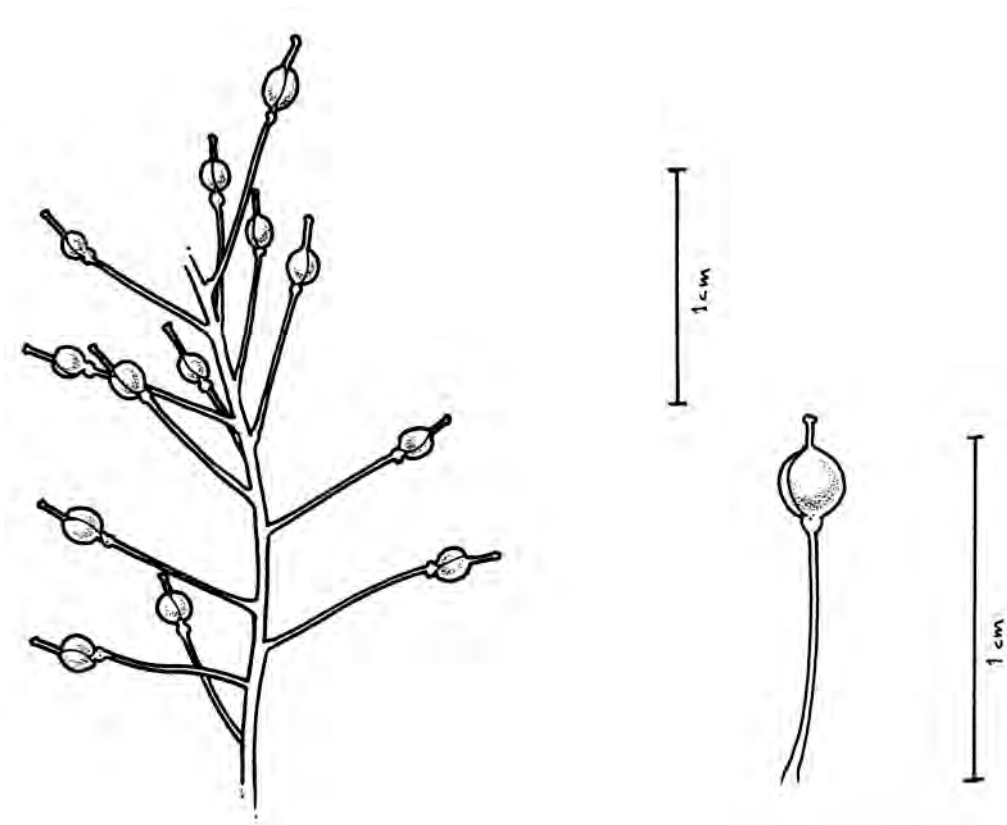
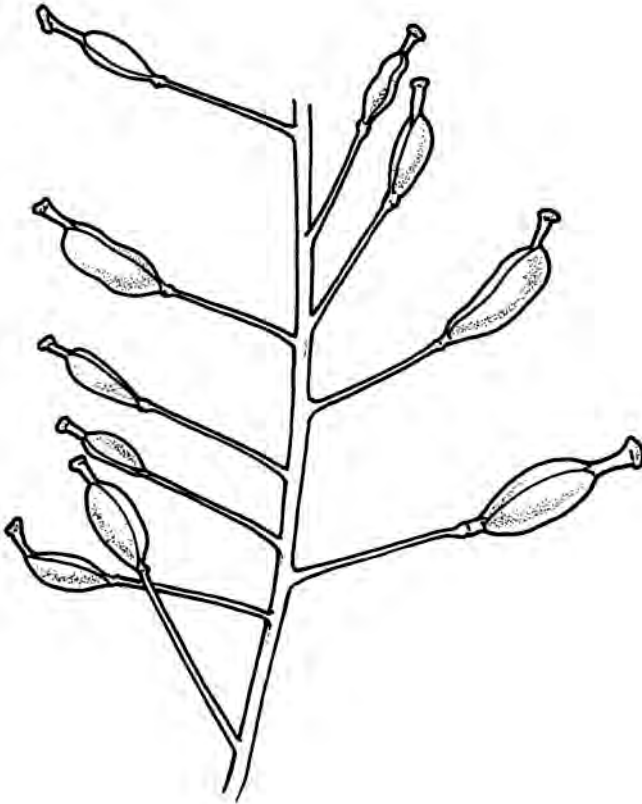


Figure 23. *Rorippa ×armoracioides*, specimen from Denmark, Jylland, Hejls. Drawing: J. Induss.

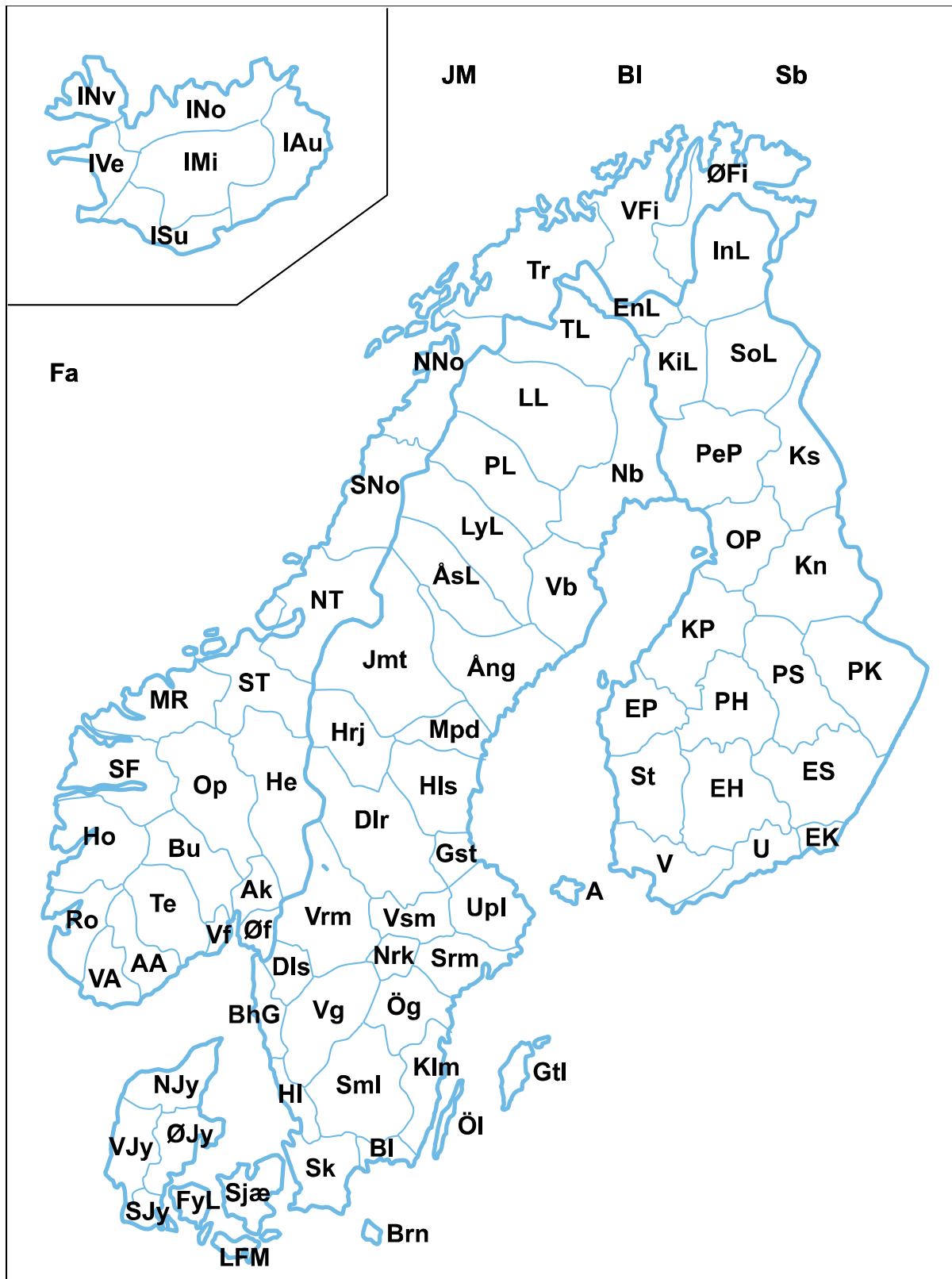


Figure 24. *Rorippa ×armoracioides*, part of infructescence. Drawing: Kalle Forss.



Maps

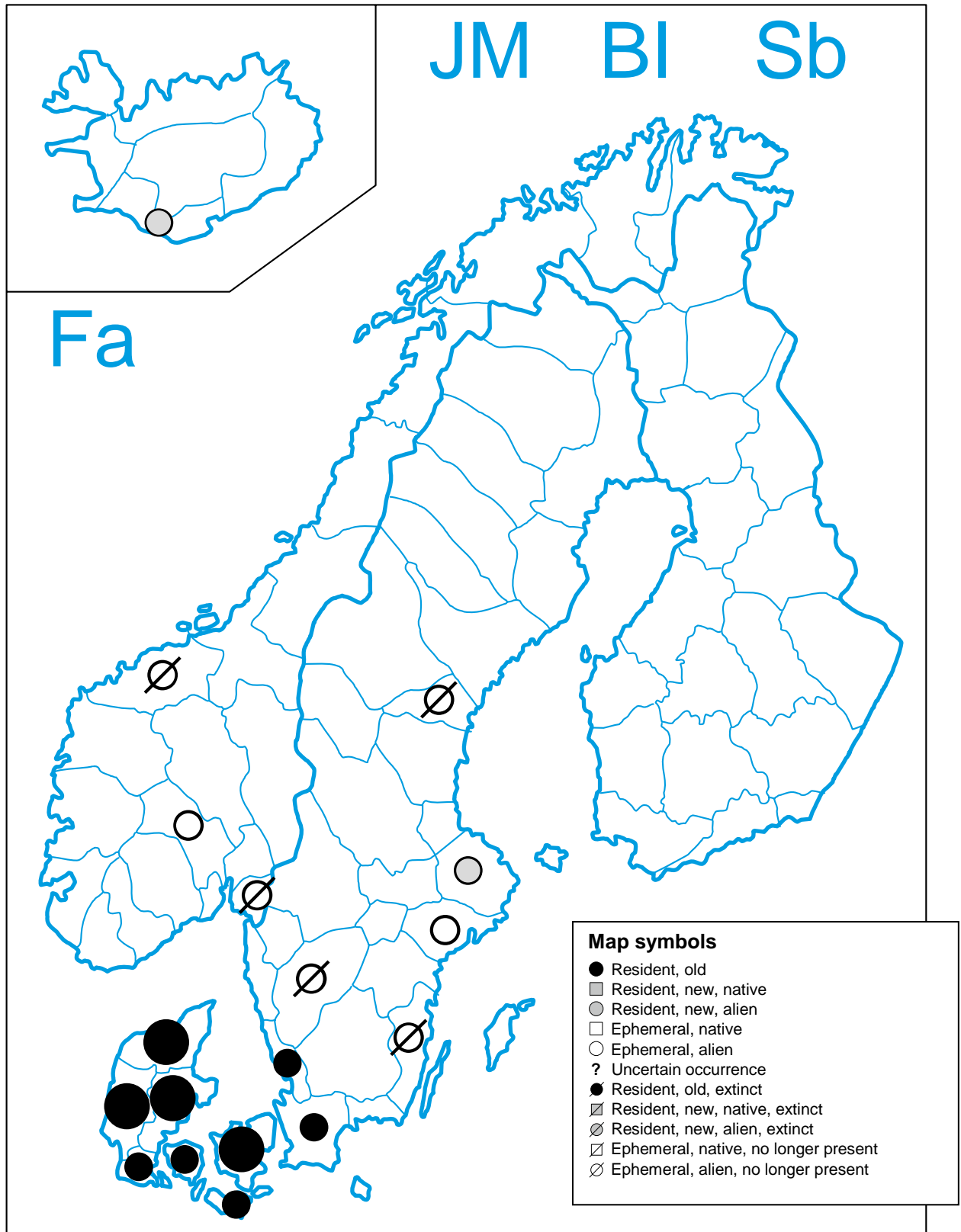
Map 1. Map of the geographical subdivisions used in Flora Nordica and abbreviations of the province names.



Map 2. *Nasturtium officinale*.

Nasturtium officinale

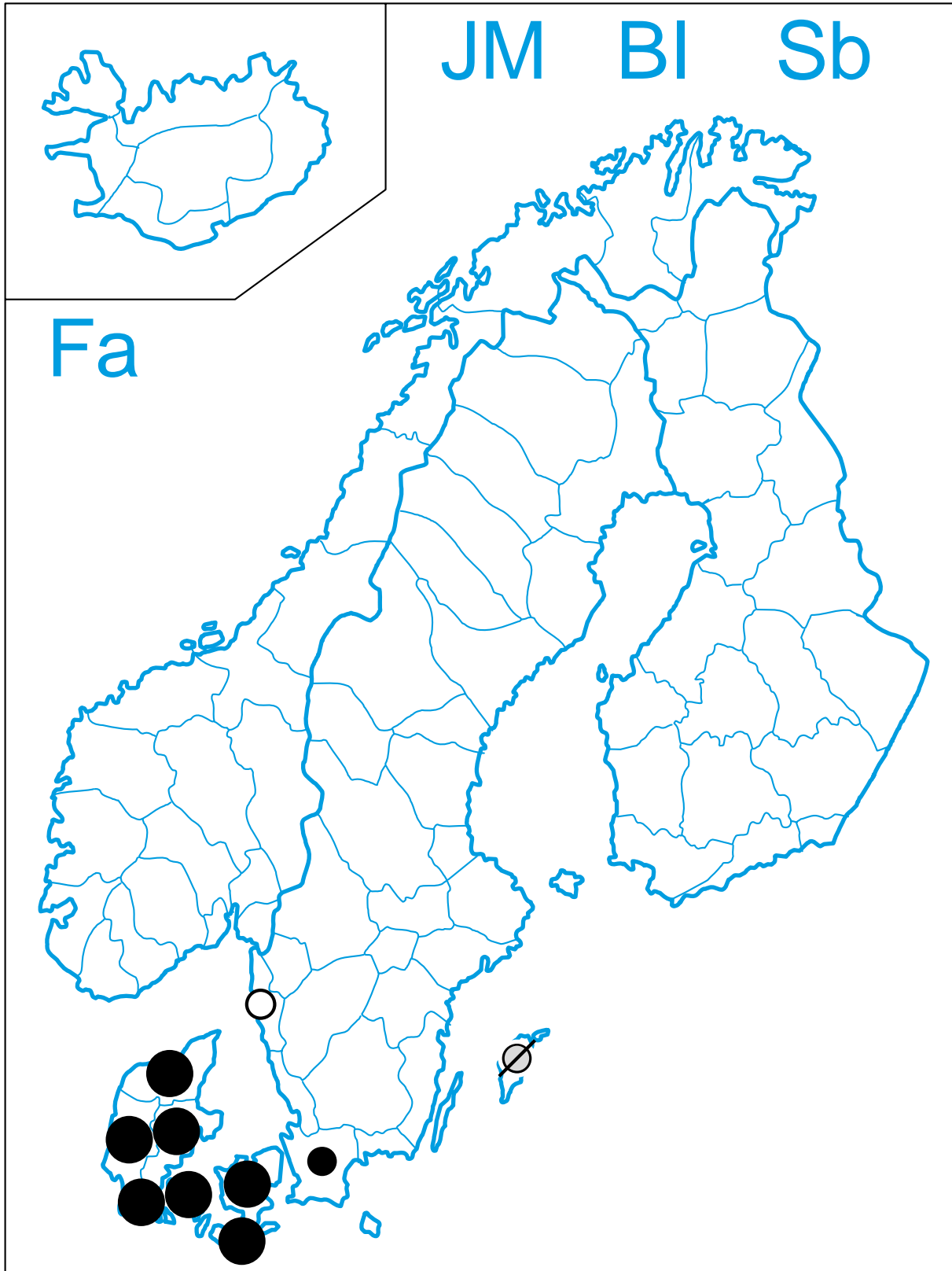
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Map 3. *Nasturtium microphyllum*.

Nasturtium microphyllum

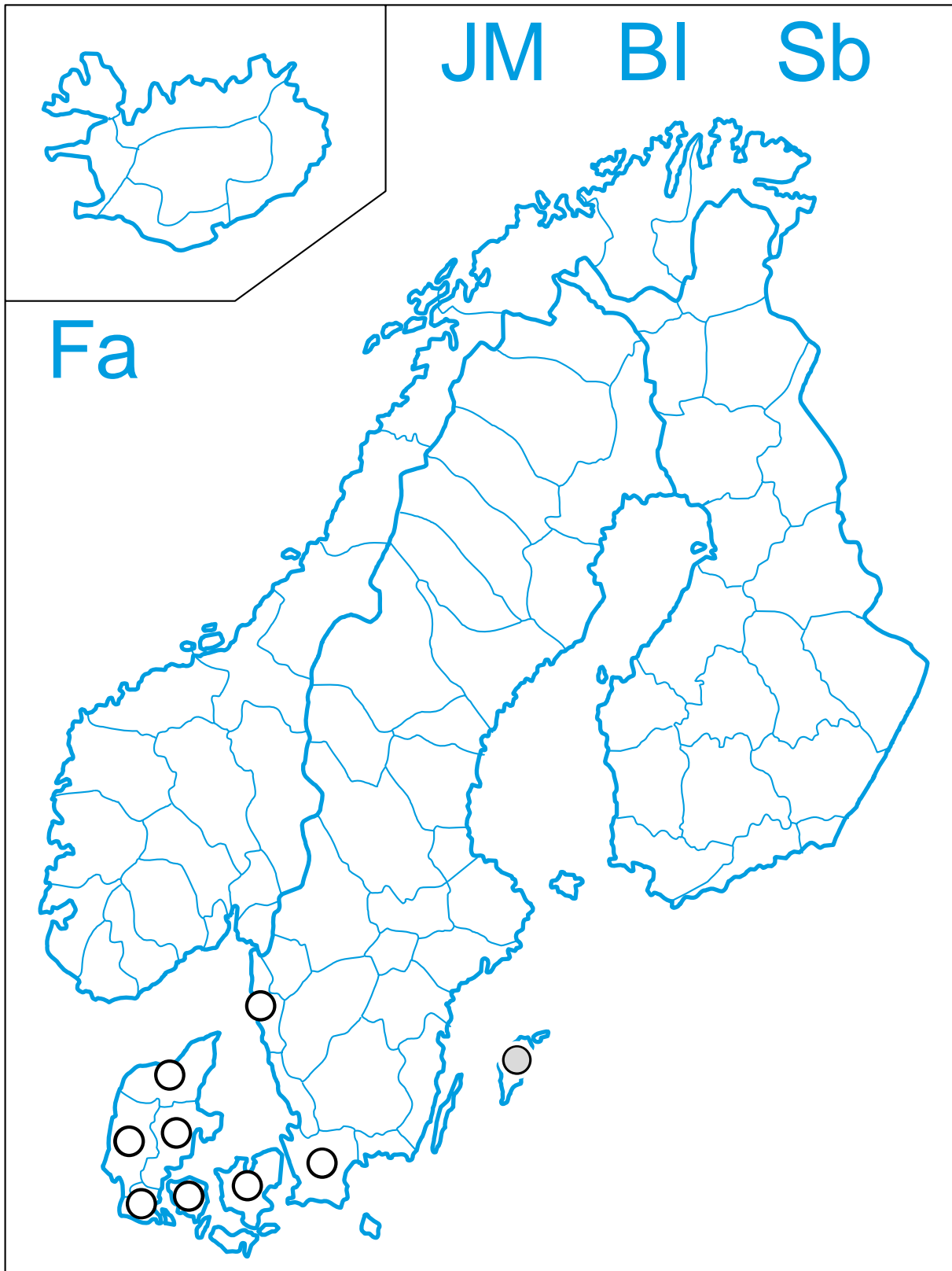
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Map 4. *Nasturtium* ×sterile.

Nasturtium x sterile

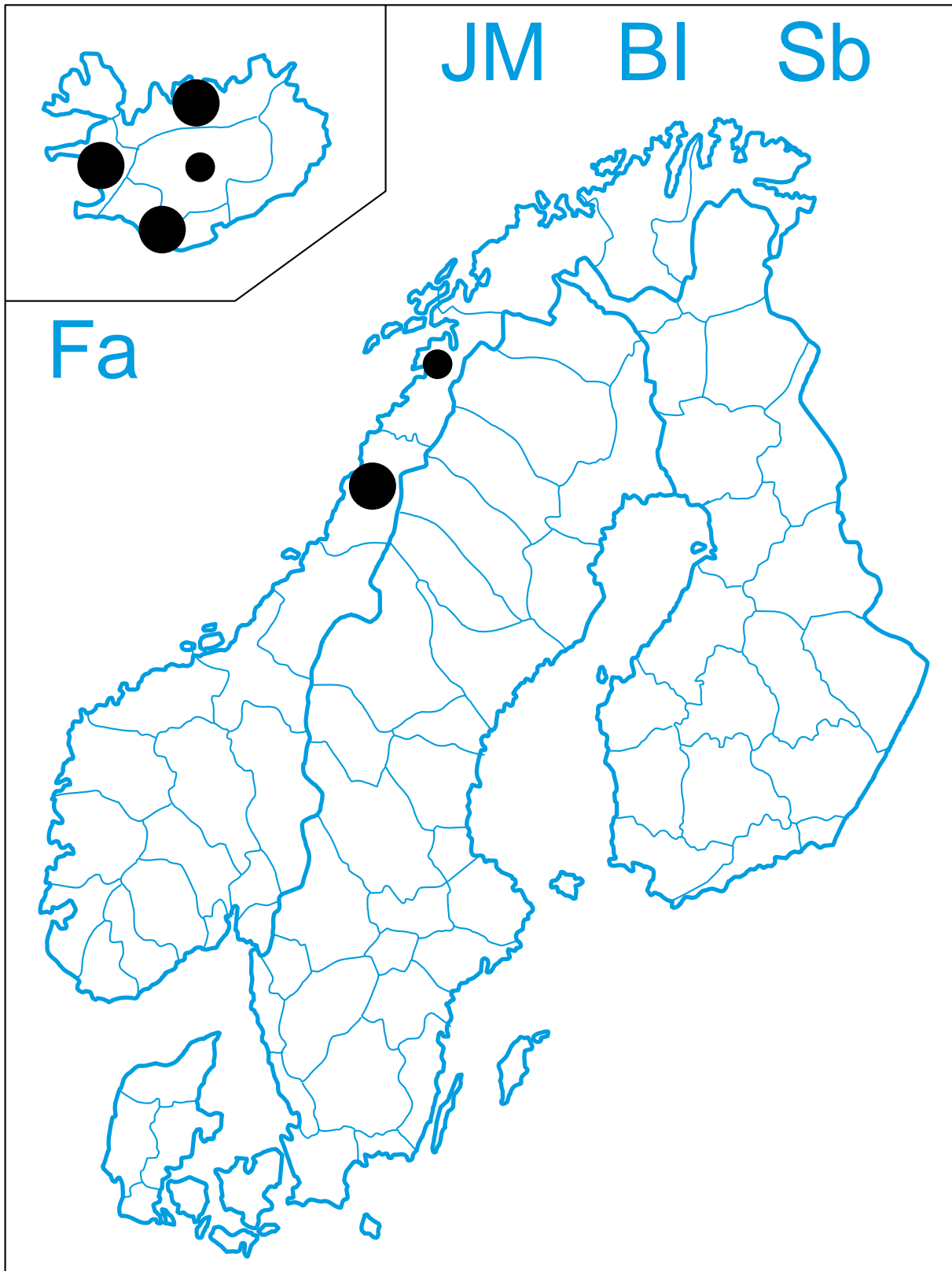
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Map 5. *Rorippa islandica*.

Rorippa islandica

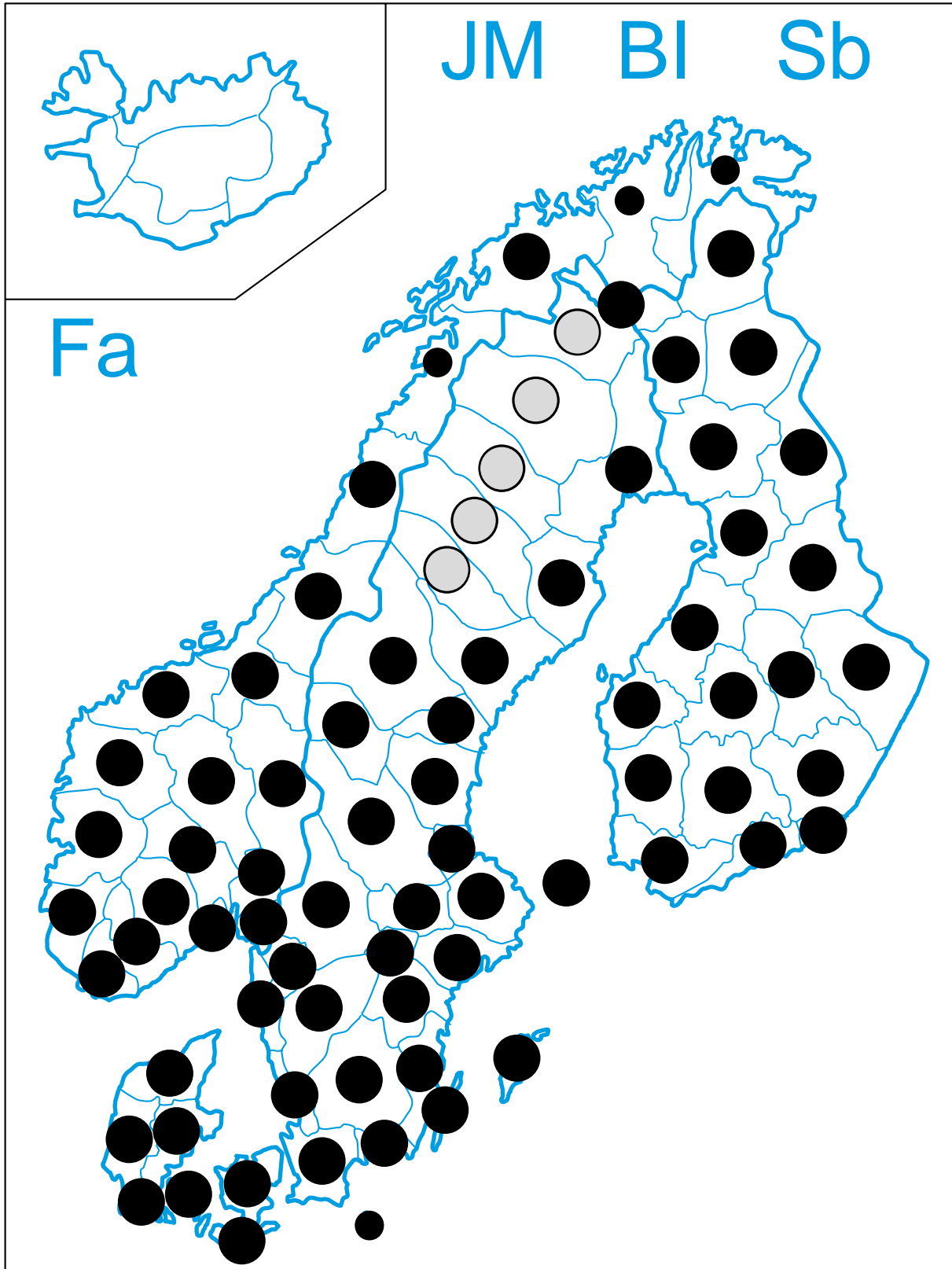
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Map 6. *Rorippa palustris*.

Rorippa palustris

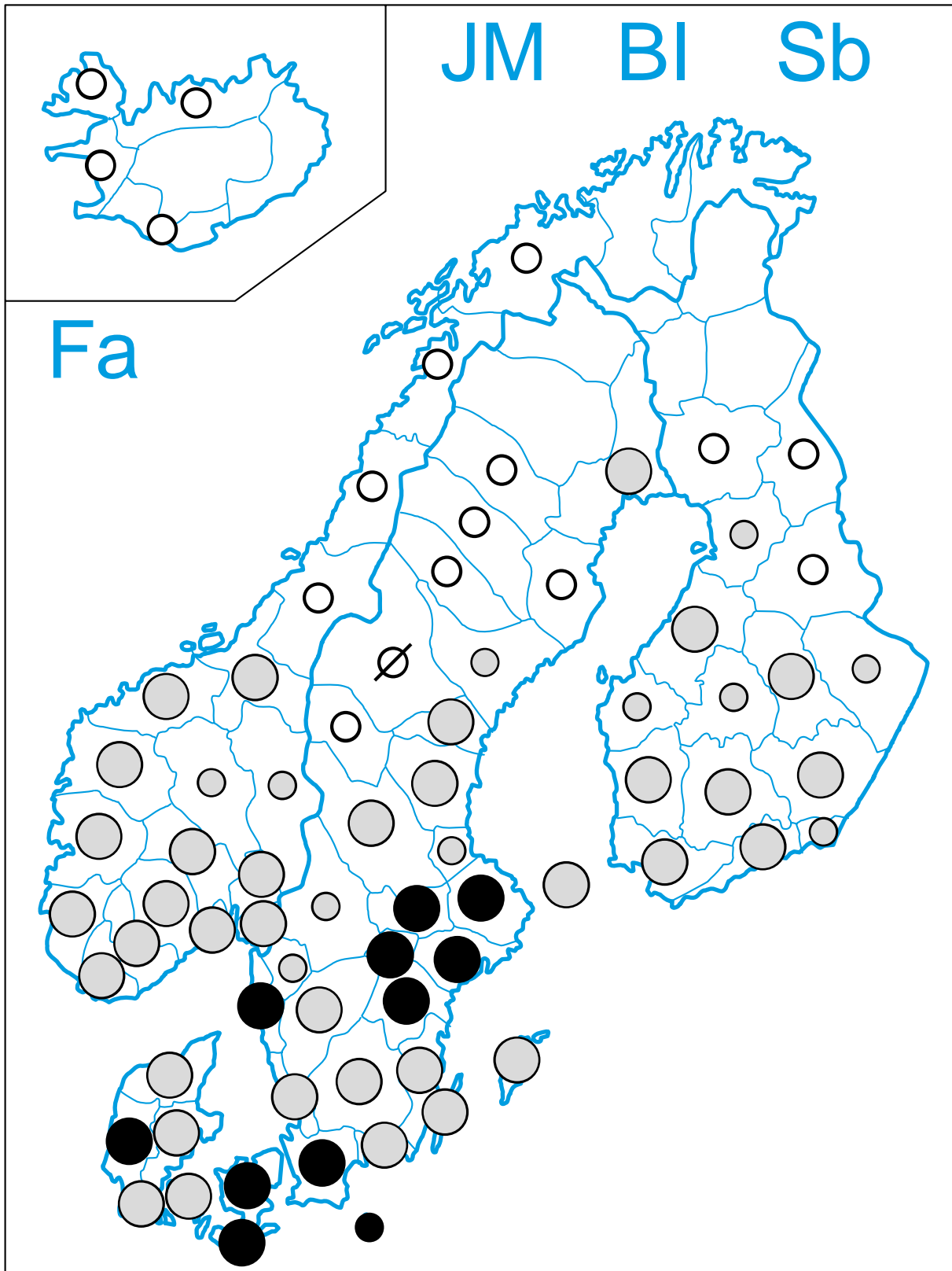
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Map 7. *Rorippa sylvestris*.

Rorippa sylvestris

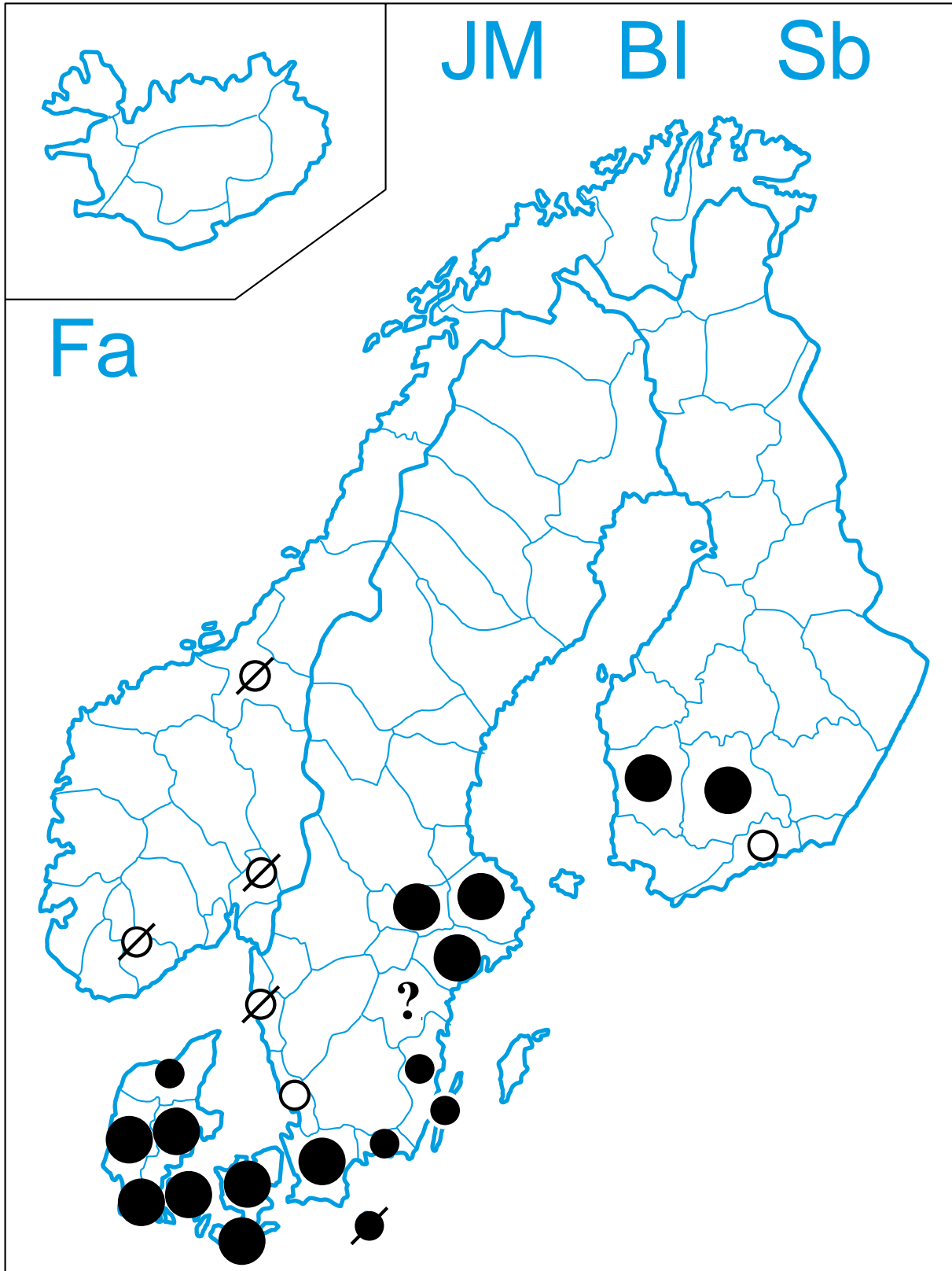
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Map 8. *Rorippa amphibia*.

Rorippa amphibia

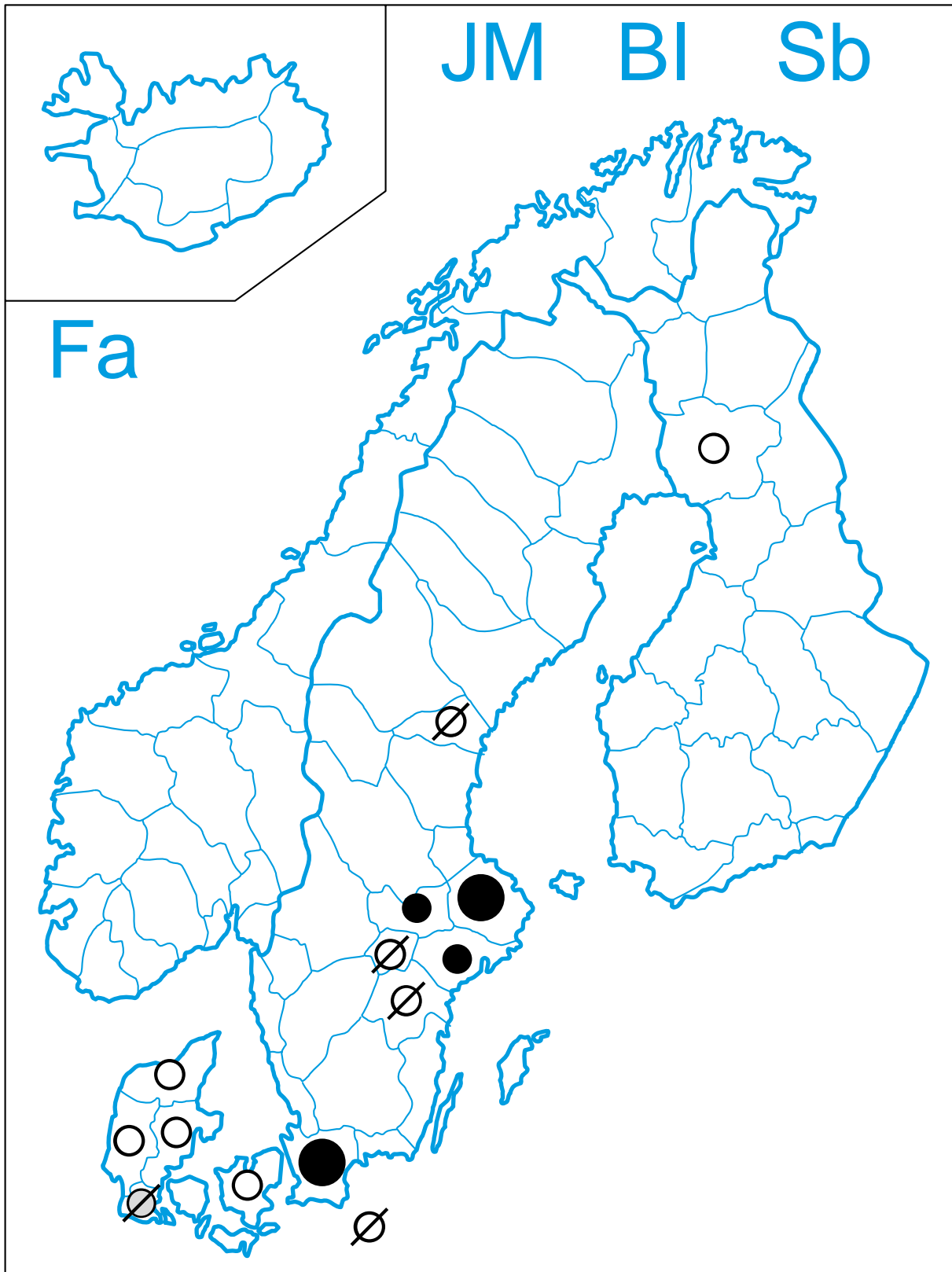
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Map 9. *Rorippa* × *anceps*.

Rorippa x anceps

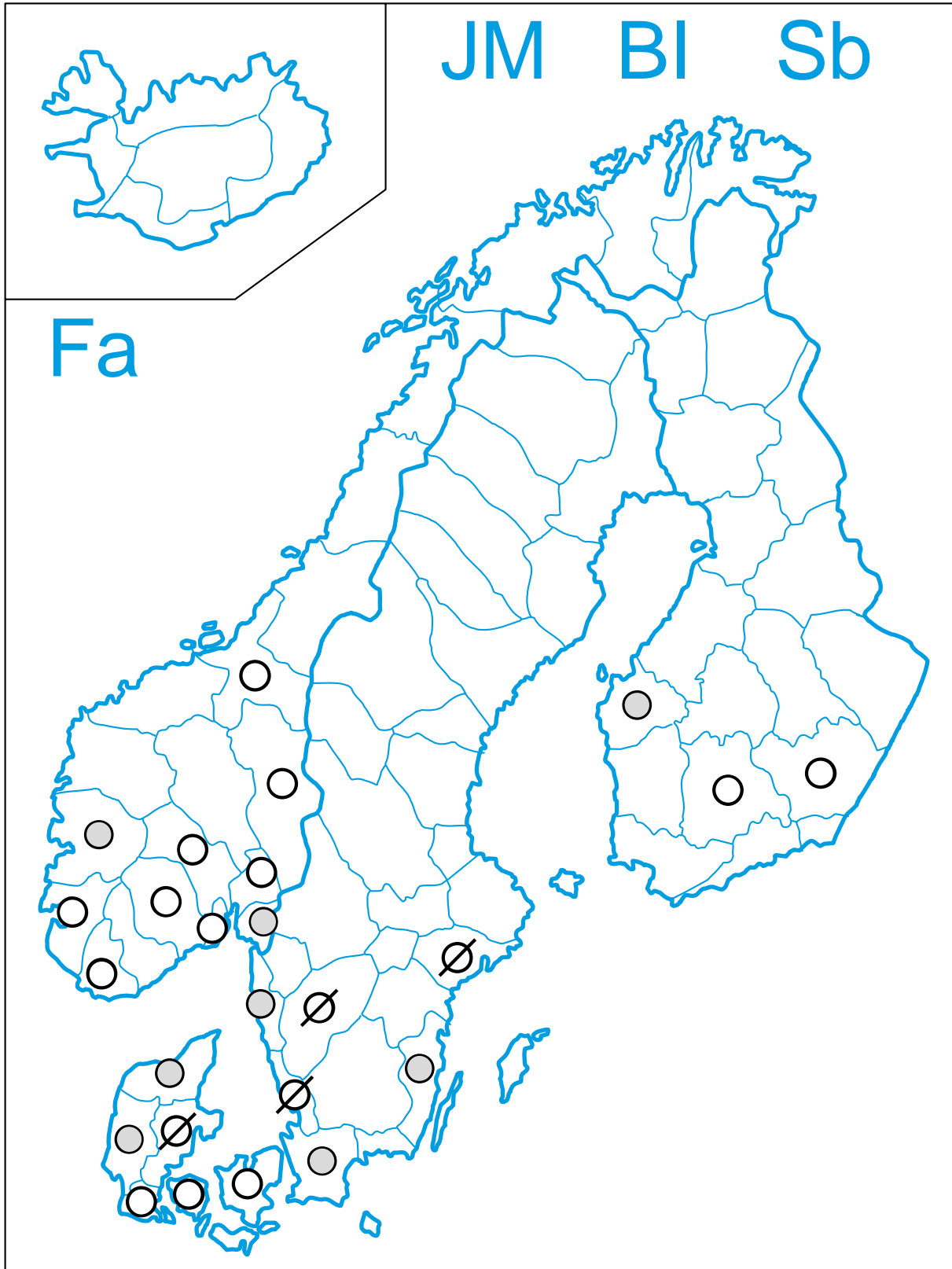
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Map 10. *Rorippa austriaca*.

Rorippa austriaca

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Map 11. *Rorippa* × *armoracioides*.

Rorippa x armoracioides

2017-04-22

