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Arguments for a narrow species concept in
Rubus* sect. *Corylifolii

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Abstract

A detailed inventory of *Rubus* sect. *Corylifolii* from the province of Halland in southwestern Sweden has been performed and the chromosome number of all distinct taxa and deviating morphotypes has been determined using flow cytometry. Once putative hybrids between *Corylifolii* and *R. caesius* or *R. idaeus* are recognized, essentially all stands of *Corylifolii* in Halland can be satisfactorily identified, including six taxa with a restricted distribution. Two of the latter have been noticed before: *R. sordiosanthus* (H. Hyl.) Ryde, found in over 100 localities and *R. cordatiformis* (Neuman) Ryde (comb. nov.) in almost 80 localities, but only in restricted areas, 23 and 7 km across. The other four have even smaller distributions (1–6 km across) and occur only in 3–15 localities. Clearly, they are local species in the terminology of Weber. Such species are currently usually left undescribed, which in the case of Halland would mean that 25% of the *Corylifolii* would remain without any name. Such a restriction leads to a number of problems: chaos in botanical collections and provincial floras, wide-spread species potentially being overlooked, red-listing becoming problematic, changes in the occurrence of local species becoming impossible to follow over time, and the *Corylifolii* treated differently from other apomictic groups. This study shows that a proper description of all local *Corylifolii* species would solve these problems. It is also argued that by doing so, the total number of Swedish species would not become particularly large, still remaining much lower than in other apomictic genera, like *Hieracium*, *Taraxacum*, and *Ranunculus*. Therefore, the four local species are here described as *R. onsalaënsis* Ryde, *R. rugulosus* Ryde, *R. polybracteatus* Ryde, and *R. soendrumensis* Ryde.

Key Words: *Rubus* sect. *Corylifolii*, chromosome numbers, local species, species concept.

Introduction

Rubus, sect. *Corylifolii* is a large group of blackberries believed to have arisen by hybridisation between dewberry (*R. caesius* L.) and various species of true blackberries (*R. sect. Rubus*). From the latter, they have inherited the capacity of forming fruits without fertilization (pseudogamy, Gustafsson 1943). Therefore, a large number of closely related forms have developed, especially in southern Scandinavia and central Europe (Kurtto et al., 2010). During the end of the 19th century and the beginning of the 20th, numerous taxa at various levels were published, making the *Corylifolii* a problematic and confusing group. Finally, it was considered “impossible” and the interest vanished during the 1960ies.

However, in 1981, Weber published a monograph of the NW European taxa, where he distinguished four types of species: wide-spread species with a largest distance between two localities exceeding 500 km, regional species, spanning 50–250 km, local species spanning less than 20 km, and individual species that occur only at a single locality. In order to get a manageable number of species, he suggested that only wide-spread and regional species should be accepted. This gave 41 species in northern Europe and 17 in Sweden. Since then, several additional species have been discovered in Sweden and it has been shown that several of the local species are in fact regional species (Weber 1982, 2008, Pedersen & Martensen 1993, Mattson & Oredsson 2010, Ryde & Werlemark 2010).

A logical consequence of this species concept is that it is not possible to give a proper name to all plants encountered in nature or in collections. This is a major disadvantage, because blackberries are often quite hard to determine, especially as dry specimens. Local species will therefore frequently be assigned to the most similar wide-spread or regional species, which leads to obscure species delimitations and incorrect pictures of their distributions. In fact, often 20–40 % of the *Corylifolii* in inventories and botanical collections of Sweden are dubiously determined, mainly owing to the occurrence of hybrids and local species (Ryde 2009).

In order to investigate how common local species are and whether it is possible to determine all stands of *Corylifolii*, a pilot study was made in the province of Halland in southwest Sweden. This province was selected because the *Corylifolii* are only moderately common there (856 occurrences have been recorded), making a nearly complete investigation possible, and also because *R. caesius* is rather uncommon, making the complication of hybrids with *R. caesius* less serious than in many other provinces.

The results of this investigation have been described in a popular form, including images and maps of all species (Ryde 2009). In this paper, the scientific implications of the investigation are discussed. In addition, the chromosome numbers of all distinct taxa and deviating morphotypes in Halland are presented and four new local species are described.

Methods

Field investigation

During the years 1999–2008, a detailed investigation of the *Corylifolii* in the province of Halland in southwest Sweden was performed. All known localities of *Corylifolii* that could be obtained from local botanists, available literature (Ahlfvengren 1924, Georgson et al. 1997, Oredsson 1973, 1974), and collected material were visited. In addition, systematic investigations of road-sides and other proper habitats were performed in the parishes where the *Corylifolii* are abundant (Söndrum, Harplinge, Steninge, Eftra, Onsala, Vallda, and Släp). All occurrences of *Corylifolii* (stands separated by more than 10 m) were registered with GPS. Representative plants and deviating morphotypes were collected (private) and many localities were visited several times until a satisfactory determination was obtained. A collection of images of all species in Halland is presented on my web pages (Ryde 2005), where the most important characters are also discussed.

Flow cytometry

Two samples from different localities of all species and all deviating morphotypes of *Corylifolii* from Halland were collected in June and July 2008. They are specified in Table 1 and vouchers for the chromosome counts are deposited in LD. The chromosome numbers were determined by flow cytometry analysis, performed by Plant Cytometry Services, JG Schijndel, The Netherlands (<http://www.PlantCytometry.nl>).

The leaves were chopped in ice-cold buffer with DAPI (Arumuganathan & Earle 1991). Flow cytometry was performed on a CyFlow ML (Partec GmbH, Münster, Germany) using iceberg lettuce (*Lactuca sativa* L.) as internal standard. Unfortunately, the quotient between the amount of DNA in the samples and the reference was reported with only two decimals, so the precision of the reported chromosome numbers is not better than ± 1 .

Results and Discussion

Field inventory

Nine wide-spread and regional *Corylifolii* species were observed: *R. camptostachys* G. Braun, *R. eluxatus* Neuman, *R. fasciculatus* P. J. Müll., *R. gothicus* Frid. & Gelert ex E. H. L. Krause, *R. hallandicus* Neuman, *R. lagerbergii* Lindeb., *R. mortensenii* Frid. & Gelert ex E. H. L. Krause, *R. norvegicus* H. E. Weber & A. Pedersen, and *R. wahlbergii* Arrh. In addition, it was demonstrated that *R. vikensis* A. Pedersen ex G. Wendt, a species that was recently described from a restricted area in the province of Skåne (southernmost Sweden, Wendt 2008), actually occurs also in two areas in Halland (Ryde 2010), i.e. it turned out to be a regional species with a disjunct distribution. The number of occurrences for each species is specified in Table 2, whereas distribution maps have been presented previously (Ryde 2009).

Most of the species appeared typical, based on morphological characters, but morphotypes of *R. eluxatus*, *R. gothicus*, and *R. wahlbergii* were observed that differed from the typical appearance in the shape of the leaves, the number and shape of the prickles, or the number of glands (Ryde 2009). However, these deviations are not considered larger than what can be accepted within a species and the variation is not systematic and uniform enough to indicate the presence of unknown taxa. *R. fasciculatus* showed a large variation that will be explained below.

Six local species were identified. One of them has earlier been described (although invalidly) as *R. sordiroanthus* (Hylander 1958a). It was found in over 100 occurrences in the inventory, with 23 km between the most distant ones (Ryde 2009) and the name was therefore recently validated (Ryde & Werlemark 2010). The other five local species will be discussed and described below.

Two series of putative hybrids were observed, one with *R. idaeus* L. and one with *R. caesius*. The *R. idaeus* hybrids are recognized by a combination of some of the following characters (although not all at the same time): seven-foliate leaves, brightly red prickles on the stem (also in shade), hairy ovaries and fruits, leaves that are densely hairy beneath, and a round stem. Specimens with these characters are usually assigned to *R. pruinosis* Arrh. However, it is clear, that the material is very polymorphic: Specimens from different localities do not have the same characters; instead they share characters with other *Corylifolii* species growing in the neighbourhood. Moreover, they occur only in single localities, instead of forming a distinct distribution. Most likely, these plants are primary hybrids with *R. idaeus*; several authors have suggested that *R. pruinosis* may be an assembly of hybrids, rather than a distinct species (Areschoug 1886, Lindman 1918, Hylander 1958b). This issue will be the subject of a future investigation using genetic methods. In Halland, such putative *R. idaeus* hybrids were found in four localities and the other parent was most likely *R. gothicus*, *R. hallandicus*, and *R. eluxatus* (the latter from two localities, where the hybrids differ in several characters (Ryde 2009)).

The putative *R. caesius* hybrids are characterised by rich and early fruits that are enclosed

by the sepals, small prickles, pruinose stems, broad stipules, and numerous glands both in the inflorescence and on the stem. Such specimens are normally assigned to *R. cyclomorphus* H. E. Weber in Sweden. However, this group is also polymorphic. They typically occur together with another *Corylifolii* species or with *R. caesius*. Normally, they lack a distinct distribution, but in some cases, they occur in a few nearby localities. Seven such hybrids were identified in Halland, six occurring in 1–3 localities and one in 16 localities (discussed below, Ryde 2009). They are interpreted as hybrids between *R. caesius* and *R. eluxatus*, *R. fasciculatus* (two different morphotypes), *R. norvegicus*, a local species, and possibly *R. lagerbergii* and *R. wahlbergii* (the latter two assignments are uncertain).

Finally, three additional taxa were found in only 1–3 localities. Two of them (the Varberg (Ryde & Werlemark 2010) and Klastorp forms) give the impression of being introduced and probably appear also outside the area, although it has not yet been possible to identify them. The third taxon is probably a derivative of the hybrid *R. caesius* · *fasciculatus*, which occurs in the neighbourhood (Lidforss (1905, 1907) has shown that progeny of *caesius* hybrids can be very polymorphic).

Apart from the latter taxa, a satisfactory identification of every stand of *Corylifolii* in Halland was reached – not a single bush had to be left out. Neither did I find any indication of hybrids between different species of *Corylifolii* or of hybrids between *Corylifolii* and species of sect. *Rubus*. This shows that the *Corylifolii* of Halland can be satisfactorily determined once a set of local species is identified. Preliminary studies have shown that similar conclusions can be drawn in other parts of Sweden as well.

Chromosome numbers

To check the conclusions based on morphological characters, the chromosome numbers of all taxa of *Corylifolii* in Halland were determined by flow cytometry. This method has successfully been used for *Rubus* before (Meng & Finn 2002). The investigated samples and the estimated chromosome numbers are gathered in Table 1. Samples of all traditional *Corylifolii* species in Halland were considered (in total 30 samples): *R. camptostachys*, *R. eluxatus*, *R. fasciculatus*, *R. gothicus*, *R. hallandicus*, *R. lagerbergii*, *R. mortensenii*, *R. norvegicus*, *R. vikensis*, and *R. wahlbergii*. All of them have $2n = 28$, except *R. lagerbergii*, *R. wahlbergii*, and *R. vikensis*, for which $2n = 35$ (Gustafsson 1943, Ryde 2010). Samples of the cultivar *R. 'Bedford Giant'* with $2n = 42$ (Oredsson 2005) and the hybrid *R. caesius* × *idaeus* with $2n = 21$ were also included, giving an excellent calibration line, with a mean absolute deviation (MAD) from the expected chromosome number of 0.6 and a maximum deviation of 2.0.

In addition, 52 samples of interesting taxa and deviating morphotypes were tested. They are also included in Table 1. The estimated chromosome numbers were precise with a MAD of 0.7 from the closest polyploidy level. Only in a single case was the determination ambiguous, with an estimated number of 31.2 (*R. eluxatus* × *idaeus* from Apelviken). The deviating morphotypes of *R. eluxatus*, *R. gothicus*, and *R. wahlbergii*, mentioned above (4 + 3 + 2 samples), turned out to have the expected chromosome number ($2n = 28$ for *R. eluxatus* and *R. gothicus*, and $2n = 35$ for *R. wahlbergii*). This confirms the conclusion based on morphology that they fall within the normal variation of these species.

However, all the tested deviating forms of *R. fasciculatus* (five samples, called “*R. caesius* × *fasciculatus*, weak type” in Table 1) turned out to be hexaploids with $2n = 42$. This is the chromosome number expected for hybrids with *R. caesius*, which are supposed to arise from the fertilization of unreduced egg cells of the *Corylifolii* (typically with $2n = 28$) by reduced pollen from *R. caesius* (with $n = 14$, Gustafsson 1943). This interpretation is also supported by morphological characters (rich and early fruits that are enclosed by the sepals, broader and less hairy leaves, more glands, broader stipules, smaller and more dense prickles). Back in nature, it could be concluded that more than half of the occurrences of

putative *R. fasciculatus* in Halland actually was this hybrid and that the two taxa followed each other throughout the parishes of Släp and Onsala (Ryde 2009). Sometimes, the hybrid was found together with *R. fasciculatus*, sometimes with *R. caesius*, but never with both. After the identification of this hybrid, what remains of *R. fasciculatus* in Halland (14 occurrences, one of which was in Värö, 18 km S of the other localities) is uniform and easily identified.

Likewise, most of the other taxa that were interpreted as hybrids with *R. caesius* were also found to have $2n = 42$ (10 samples). For some of these, the *Corylifolii* parent was obvious, because it grew in the neighbourhood and was morphologically similar, e.g. hybrids with *R. eluxatus*, *R. norvegicus*, and the local species *R. polybracteatus*. However, in three cases, the interpretation was less clear, because there was no *Corylifolii* in the neighbourhood or the morphological characters did not suggest any convincing interpretation. Therefore, the suggestions in Table 2 should be considered only tentative (as is indicated by question marks in Table 2).

Interestingly, three of the putative hybrids with *R. caesius* gave unexpected chromosome numbers. This was the case for *R. caesius* \times *fasciculatus* (weak type) from a single locality ($2n = 35$), *R. caesius* \times *eluxatus* from one of its two localities (also $2n = 35$; separately collected samples from both these two localities were investigated twice by flow cytometry), and the tentative *R. caesius* \times *wahlbergii* hybrid ($2n = 28$). All three taxa show clear morphological hybrid characters. It is notable that Gustafsson (1943) also reported these two chromosome numbers for hybrids with *R. caesius*.

Most of the hybrids with *R. caesius* occur on only a single locality. However, the *R. caesius* \times *eluxatus* hybrid occurs in two nearby localities, one type of the putative *R. caesius* \times *fasciculatus* hybrid (the “vigorous type” in Table 1) occurs in three localities along a newly constructed road, whereas the other type of *R. caesius* \times *fasciculatus*, discussed above, occurs in no less than 16 localities spanning 15 km. This may indicate that some of these hybrids are fertile with some dispersion ability, although it is likely that the second hybrid has been spread vegetatively during the construction of the road. An alternative interpretation is that the hybrids have arisen several times. This is most likely the case for *R. caesius* \times *eluxatus*, which (although the localities are only 600 m apart) had a different chromosome number in the two localities.

However, the interpretation of the weak type of *R. caesius* \times *fasciculatus* is less clear. The fact that it follows *R. fasciculatus* in its distribution, that it always grows together with one of its parents, and that it has somewhat varying appearance (and even a differing chromosome number in one locality) indicates that *R. caesius* \times *fasciculatus* is a hybrid that easily can arise as soon as the parents meet. On the other hand, this is not the case in other parts of Sweden: For example, in Skåne, where both *R. fasciculatus* and *R. caesius* are more common than in Halland, the hybrid occurs, but only in isolated localities and never with such a high frequency as in Halland.

All the putative *R. idaeus* hybrids (from four localities) were pentaploids with $2n = 35$. This is the expected number, because these hybrids are supposed to arise from reduced pollen of *R. idaeus* (with $n = 7$) that fertilizes unreduced egg cells of the *Corylifolii* (with $2n = 28$, Gustafsson 1943). This supports the interpretation of them as hybrids.

Finally, the six local species were found to have either $2n = 28$ (*R. sordiroanthus* (Ryde 2009, Ryde & Werlemark 2010), *R. polybracteatus* Ryde, *R. rugulosus* Ryde, and *R. soendrumensis* Ryde) or 35 (*R. cordatiformis* (Neuman) Ryde and *R. onsalaënsis* Ryde). The latter number indicates that those two species probably have arisen through hybridisation with *R. idaeus*. This is also supported by the morphological characters, which are partly the same as for the *R. idaeus* hybrids (as well as for *R. pruinus*): red prickles, rounded stems, and hairy ovaries. However, the two local species differ from the hybrids with *R. idaeus* in that they have several nearby occurrences (70 and 7, respectively) and have a distribution of their own, independent of their putative parent species.

Interestingly, for the hybrids with *R. idaeus*, for *R. cordatiformis* and *R. onsalaënsis*, as

well as for *R. lagerbergii*, which probably also have arisen by hybridisation with *R. idaeus* (it also has hairy ovaries and leaves that are white tomentose beneath), the chromosome number estimated by flow cytometry was consistently slightly lower than the expected 35, typically 33.3. Similarly, the estimated chromosome number of the *R. caesius* × *idaeus* hybrid in the calibration set, 19.8, was lower than the expected 21. This indicates that *R. idaeus* has a slightly smaller DNA content than *R. caesius* and the *Corylifolii*. This shows the power and precision of the flow cytometry, and indicates that more information can be extracted from the measured DNA content than only the polyploidy level.

This is also the reason why I assign a chromosome number of 35 to the ambiguous sample with an estimated chromosome number of 31.2, even if it is actually closer to 28. It is also notable that the other two species with $2n = 35$, *R. wahlbergii* and *R. vikensis*, have an average estimated chromosome number of 35.3. Therefore, these species seem to have a different origin than the other pentaploid species (i.e. not involving *R. idaeus*).

Finally, the three unclear taxa (the Kläppa, Klastorp, and Varberg forms) turned out to be tetraploids with $2n = 28$.

The species concept

The morphological studies, together with the chromosome counts, give a quite clear picture of the *Corylifolii* in the province of Halland. After identifying ten recognized species, six local species with 4–100 occurrences, three hybrids with *R. idaeus*, and seven hybrids with *R. caesius*, only three taxa remain, two of which (known from 1 or 3 localities) give the impression of being introduced, whereas the last one (from a single locality) probably is a derivative of *R. caesius* × *fasciculatus*. Thus, it has been possible to arrive at a satisfactory interpretation of every studied stand of *Corylifolii* in this province.

The crucial step to this aim, was the identification of the hybrids with *R. idaeus* and *R. caesius*. In fact, the latter seem to constitute the main problem of the *Corylifolii* in Sweden, forming a large and polymorphic group. This applies even more to other provinces, e.g. Öland (Burén 2009) and Skåne, where both *R. caesius* and the *Corylifolii* are more common. Among ~50 unclear forms identified during the inventory in Skåne (Tyler et al. 2007), ~70% have been identified as putative *R. caesius* hybrids (disregarding one local species; Ryde, work in progress).

This indicates that with a modest increase in the number of species, we may obtain a complete understanding of the *Corylifolii* in Sweden. Thus, in Sweden, there is no need for the special species concept that is currently used for the *Corylifolii*, based on the distribution. On the contrary, this species concept leads to several theoretical and practical problems:

- Local species are ignored. This is very unfortunate, because the local species actually occur in nature, often quite frequently. In fact, about one fourth of the *Corylifolii* in Halland are local species (based on the number of the occurrences in Table 2), and in two areas they are dominating. If they are not described, botanist will typically tend to identify them as one of the wide-spread species, leading to the chaos that often is observed in botanical museums and provincial floras.
- Wide-spread species may be overlooked if they occur in several disjunct areas and therefore are taken as local species. This is illustrated by *R. vikensis*, which has previously been taken as two local species, one related to *R. tiliaster* H. E. Weber in Skåne and one related to *R. norvegicus* in Halland. Only after it was recognized and described in Skåne, it could be realised that it actually is a wide-spread species, although with a disjunct distribution (Ryde 2010).
- It becomes very important to decide whether taxa occurring in different areas really are the same species and not only morphologically similar taxa. This is often quite hard to decide, without the help of costly genetic methods. Again, *R. vikensis* provides a good example (Ryde 2010).

- It is questionable whether a species becomes more interesting if it occurs over a larger area. For example, 103 of the occurrences of *R. sordiosanthus* are within 6 km. Does the species become much more interesting only because it has been introduced in a single outlying locality (a former refuse tip), which increases the distribution to 23 km? Likewise, it is questionable if a species with few localities over large area is more interesting than a species with many localities in a small area.
- Even more serious problems arise in the red-listing of *Corylifolii*: Only rather common taxa, i.e. those with a distribution of more than 20–50 km, can be red-listed. However, if a red-listed species becomes rarer, the distribution will at some point decrease below 20 km, in which case it will cease to be a species and become uninteresting, unless a historical aspect is introduced into the red-listing. Of course, this is most inappropriate.
- Conversely, it becomes impossible to document positive changes in the distribution, e.g. a local species that tends to become a regional species, if it is not recognized and distinguished by a separate name.
- Finally, it is highly unsatisfactory that the species concept used for the *Corylifolii* is distinct from the one used for other apomictic groups, e.g. *Taraxacum*, *Hieracium*, and *Ranunculus*, which often are richer in species. This makes it harder to compare the diversity, for example.

It is thus important and desirable to describe all local species of *Corylifolii* in Sweden. Consequently, descriptions of the five remaining local species known from Halland are given below (*R. sordiosanthus* has recently been published, Ryde & Werlemark 2010). It is possible that describing all local species is not the optimal solution for all countries, although similar arguments have been presented for Germany (Loos 2008). However, this does not mean that we should refrain from describing the species occurring in Sweden, thereby bringing order to this group here.

***R. cordatiformis* (Neuman) Ryde, comb. et stat. nov.**

Basionym: *Rubus rosanthus* Lindeb. β *cordatiformis* Neuman, Sveriges flora: 392 (1901). – *R. rosanthus* var. *cordatiformis* (Neuman) C. E. Gustafsson in N. Hylander, Förteckn. Skand. Växter. 1. Kärlev.: 70 (1941).

Lectotype: Halland, Stensjö, Bruksvägen, 21.VIII.1888, L. M. Neuman (LD, '*R. eluxatus* ssp. *cordatoides*'), selected by Weber, Sonderb. Naturwiss. Ver. Hamburg 4: (1981).

Description: The stem is procumbent, more or less rounded, 5–6 mm, usually glabrous with none to many glands, and often with many small prickles. The internodes are ~10 cm. The prickles are patent to recurved, prominently dark purple, also in the shade, ~18 per 5 cm (but occasionally much more), 5–6 mm, with a base of 3–5 mm. The stipules are 0.5–1 mm wide. The leaves are 18–24 cm long, with 4–5 leaflets, dark green. The leaf stalk is 7–8 cm, with 3–7 prickles that are 3–4 mm and falcate. The terminal leaflet is cordate, 9–12 · 7–11 cm, widest above the middle and sparsely hairy on both sides; its petiolule is 3–4 cm, with 3–7 prickles. The serration is simple with teeth of equal size. The leaf apex is mucronate, ~1 cm. The lateral leaflets are 8–9 cm long and the petiolule is ~8 mm. The basal leaflets are 5–6 cm long and the petiolule is 0.5–2 mm. The rachis is felted with few glands and with prickles that are patent to recurved, 2–3 mm. The pedicels are 9–17 mm with 3–4 prickles that are 1–2 mm and patent. Upper leaves are integer or lobed and green to grey beneath. The flowers are big (2–3 cm). The petals and filaments are deep pink. The styles are greenish or slightly pink-based. The sepals are grey-green with white margins, typically with prickles and glands, and finally erect. The flowers are often monstrous. The young carpels are densely hairy, but soon become glabrous. The stamens exceed the styles and the anthers are glabrous.

In “Sveriges flora” (the flora of Sweden) from 1901, Neuman described a new variety, *R.*

rosanthus var. *cordatiformis*, from Stensjö in Eftra, Halland. It was said to differ from the main variety by glabrous leaves that are green beneath, glabrous ovaries, and sepals that are partly patent, partly deflexed in fruit. Neuman apparently was somewhat ambivalent, because on some exsiccatae he instead used the name *R. eluxatus* ssp. *cordatoides*.

In an unpublished manuscript, Hylander (1958b) discussed this taxon thoroughly. He considered it closely related to *R. eluxatus* and suggested that it is what he called the *pruinusus*-form of this species, i.e. that it had probably arisen from the hybrid between *R. eluxatus* and *idaeus*. It was said to share the following characters with *R. eluxatus*: pink flowers, leaves that are glabrous and glossy above, and mainly tripartite, as well as a zigzag-shaped inflorescence. On the other hand, Weber (1981) considered it as a local species, known from only two nearby localities.

My inventory showed that this species is much more common than was previously known: It is found in ~70 occurrences in a restricted area in the parishes of Steninge and Eftra, from Stensjö and Undarsmosse in the south to east of Eftra church in the north. The distance between the outermost localities is 8 km. The original localities, known by Neuman and Hylander are at the southern end of the distribution. The main distribution is around the village Ugglarp, where it is the most common *Corylifolii* species. In the same area, *R. eluxatus*, *R. hallandicus*, *R. mortensenii*, *R. wahlbergii*, and *R. sordirosanthus* also occur (Ryde 2009, Ryde & Werlemark 2010).

R. cordatiformis is a quite vigorous plant with dark green leaves and big, deeply pink flowers (Figure 1). In particular, the filaments are brightly pink, a character that it does not share with any other Swedish *Corylifolii* species. The ovaries are densely hairy when young, but the hairs soon fall off. The terminal leaflets are broadly heart-shaped, nearly glabrous above and sparsely hairy below. The stems have straight, prominently dark purple prickles, which typically are quite dense. The stipules are narrow, less than 1 mm wide.

The species is different from the hybrid *R. eluxatus* × *idaeus*, which occurs in two localities around Varberg, e.g. by the pink filaments. Neither is it related to *R. rosanthus* (that probably has arisen from the hybrid *R. idaeus* × *norvegicus*), which has pink to red styles and does not occur in the province of Halland.

Close to Skipås farm, there is a form with green prickles and pale filaments, but otherwise conforming to *R. cordatiformis*. Its chromosome number is $2n = 35$, so it is probably still *R. cordatiformis*, or possibly a primary hybrid between *R. eluxatus* and *R. idaeus*.

R. cordatiformis has often been mistaken for other species. For example, in Georgson et al. 1997, it occurs under three names besides *R. rosanthus* var. *cordatiformis*: *R. pruinusus*, *R. lagerbergii*, and *R. norvegicus*.

***R. onsalaënsis* Ryde sp. nov.**

Type: Halland, Onsala: W side of the road at the bus stop Valldahemmet, Swedish Grid RT90 6374528 1177923, leg. U. Ryde., 30.VI. 2009 (holotype: LD, isotypes: GB, S, UPS).

Latin diagnosis: *Aculei conspicue rubri, erecti vel subobliqui; folia saepe tri-foliolata; petioli folii intermediarii potius longi, foliolis basalibus longior; foliola cordata, laete viridia, subtus parce pilosa, margine simplici-serrata; petiolulus folioli terminali longus sed pauciaculeatus; inflorescentia parce pilosa, glandulosa, insignis frondosa; petala parva albida; ovaria glabra sed receptaculum sparse longi-pilosum; fructus abortivus.*

Description: The stem is procumbent, bluntly angled, 5–6 mm, typically green, glabrous and with no or occasional glands. The internodes are ~10 cm. The prickles are patent to recurved, prominently red, also in the shade, ~13 per 5 cm, 3–5 mm, with a base of 3–4 mm. The stipules are 1–2 mm wide. The leaves are 20–22 cm long, with 3–5 leaflets, purely green. The leaf stalk is 7–9 cm, with 10–15 prickles that are 2–3 mm with a curved tip. The terminal leaflets are cordate, 8–10 · 8–10 cm, widest below the middle, and sparsely hairy on both

sides; its petiolule is 3–4 cm, with ~4 prickles. The serration is simple with teeth of unequal size. The leaf apex is rather short, ~1 cm. The lateral leaflets are 8–9 cm long with a petiolule of 3–5 mm. The basal leaflets are 5–6 cm long with a petiolule of ~2 mm. The rachis is conspicuously leafy, sparsely hairy, and with rather few glands. The prickles in the inflorescence are recurved and 2–3 mm. The pedicels are 5–13 mm with ~3 prickles of ~1 mm that are recurved to slightly curved. The upper leaves are mostly three-lobed, coarsely serrate and grey beneath. The flowers are rather small, ~2 cm. The petals are purely white, also in the buds. The filaments and styles are white. The sepals are grey-green with a white margin and sessile glands. They have short tips and are erect in the fruit. The hypanthium is sparsely hairy. The carpels are glabrous. The stamens exceed the styles and the anthers are glabrous. The fruits are usually aborted.

This species is found in 7 occurrences around the village Buera in the parish of Onsala, northern Halland, with a spread of 2 km. All of them are on road sides and several of the stands are quite large (>20 m²). The species is characterised by brightly red, small and slender prickles on green stems (Figure 2). The flowers are small and white. The leaves are lively green and sparsely hairy below, and the terminal leaflets are heart-shaped. The rachis has conspicuously few hairs.

It is evident that this species has arisen from a hybrid with *R. idaeus*, but it is hard to decide the other parent. In the neighbourhood, *R. fasciculatus*, *R. gothicus*, *R. vikensis*, and *R. wahlbergii* occur, as well as the local species *R. polybracteatus* (see below). However, none of them is particularly similar to *R. onsalaënsis*. Instead, *R. onsalaënsis* shares the colour of the leaves and the sparsely hairy inflorescence with *R. lagerbergii*, which occurs 7 km to the north. On the other hand, *R. lagerbergii* has the same chromosome number as *R. onsalaënsis*, $2n = 35$.

This species does not seem to have been collected before, but some of the localities were noted by Oredsson (1974, as *R. Corylifolii* coll.) during his inventory of blackberries in southern Sweden.

***R. soendrumensis* Ryde sp. nov.**

Type: Halland, Söndrum: Tylösand, Flaggberget, in a shallow cleft in cliff terrain close to the sea, Swedish Grid RT90 6283501 1311305, leg. U. Ryde, 4. VII. 2009 (holotype: LD, isotypes: GB, S, UPS).

Latin diagnosis: *R. eluxato similis sed primocanna aculeis pluribus at minoribus praedita; stipulae latae (3–12 mm); foliola duplicato-serrata; inflorescentia glandulis multis obsita; flores minores.*

Description: The stem is procumbent, angled, 5–6 mm, with occasional hairs and few glands. The internodes are 7–9 cm. The prickles are bent in the tip, ~8–13 per 5 cm, 4–5 mm, with a base of 3–4 mm. The stipules are wide, 3–12 mm. The leaves are 17–22 cm long, normally with only 3 leaflets, often yellowish green and rather thin. The leaf stalk is 6–8 cm, with 8–19 prickles, 1–2 mm, falcate. The terminal leaflet is narrowly ovate with a weakly cordate base, 9–12 · 6–10 cm, widest around the middle, sparsely hairy above and with hairs only on nerves below, and with a green colour below; its petiolule is 2–3 cm, with 3–6 prickles. The serration is periodical and the leaf apex is mucronate. The lateral leaflets are 9–11 cm with a petiolule of 2–4 mm. The inflorescence is rather short and the rachis is densely hairy with quite numerous stalked glands. The prickles in the inflorescence are ~2 mm and bent. The pedicels are ~1 cm with ~3 prickles of ~0.6 mm that are falcate. The upper leaves are integer or three-lobed and grey-green beneath. The flowers are rather small (~2 cm). The petals are mostly white, but pale pink in the buds. The filaments and styles are white. The sepals are grey-green with a white margin and numerous short-stalked glands, but without prickles; they often have elongated tips and are patent in the fruit. The stamens exceed the

styles and the anthers are glabrous. The fruits are usually aborted.

This local species is found in four occurrences in the parish of Söndrum. It is rather similar to *R. eluxatus* (which does not occur in this parish): For example, both have leaves with mainly three leaflets that are green and almost glabrous below. However, the flowers are smaller and not pink, except in bud (Figure 3). Moreover, the serrature is fine and periodic, the stipules are much wider (>3 mm, compared to <1 mm for *R. eluxatus*), and there are many glands in the inflorescence. The shape of the terminal leaflet is also different and its tip is marked.

This species in several ways gives the impression of being the hybrid between *R. caesius* and *R. eluxatus*, e.g. the wide stipules, the small and slightly bent prickles, the sometimes pruinose stem, the whitish flowers, and the many glands. However, this is not supported by the chromosome number, which is found to be $2n = 28$, the same as for *R. eluxatus* and *R. caesius*, and not $2n = 42$, as is expected for the hybrid. Moreover, neither of the two species is found in the neighbourhood. However, it is possible that it is derived from this hybrid.

It is found in three nearby occurrences around Bäckagård nursing home, as well as at Flaggberget in Tylösand, ~4 km to the west. The former occurrences are on road-sides and other urban areas, whereas the latter is in a natural habitat, a shallow cleft (dike) in cliff terrain close to the sea. Two of the stands are small (a few m²), whereas the other two (including that in Tylösand) are larger, but none of them is larger than 20–30 m². It is the rarest of the new species described in this paper.

This species does not seem to have been noticed before, but it has been collected at least once: Halland, Söndrum 1888 (L. M. Neuman in S, as *R. eluxatus*), although the locality was not mentioned by Neuman when he published *R. eluxatus* the same year. Nevertheless, the collection is probably the basis for the report of *R. eluxatus* from Söndrum in Ahlfgvengren (1924).

***R. rugulosus* Ryde sp. nov.**

Type: Halland, Onsala: The parking lot of Rydet sports field on the western side in the middle, Swedish Grid RT90 6369897 1271104, leg. U. Ryde, 30.VI.2009 (holotype: LD, isotypes: GB, S, UPS).

Latin diagnosis: *R. norvegico similis sed caulis sulcatus; foliola bullata admodum brevipetiolulata; sepala fructifera saepe accrescentia erecta, glandulis stipitatis multis obsita; styli albi ad leviter rosei.*

Description: The stem is low-arched, with distinctly furrowed sides, 4–7 mm, glabrous and with occasional to rather many glands. The internodes are 7–11 cm. The prickles are bent in the tip, 9–19 per 5 cm, 3–5 mm, with a base of 3–5 mm. The stipules are 1–2 mm with many glands. The leaves are 16–22 cm long, with 3–5 leaflets, purely green. The leaf stalk is 5–8 cm, with 5–12 prickles that are ~2 mm and falcate. The terminal leaflet is cordate, 8–11 · 7–11 cm, widest below the middle, sparsely hairy on both sides, grey-green below, with a tendency to hairs pectinately arranged on the veins; its petiolule is 2–4 cm, with 3–8 prickles. The serration is weakly periodic and fine. The leaf apex is acuminate, 11–17 mm. The surface of the leaves is bullate with impressed veins. The lateral leaflets are 7–10 cm long with a petiolule of 2–7 mm. The basal leaflets are 4–7 cm long and sessile. The rachis is densely hairy with many glands. The prickles of the inflorescence are 2–4 mm and bent in the tip. The pedicels are 1–2 cm with 3–10 prickles of 1–2 mm that are bent. 1–6 of the upper leaves are integer, coarsely serrated, and grey below. The flowers are big (2–3 cm), rarely monstrous. The petals are palely pink. The filaments are white and the styles are white or often palely pink at the base. The sepals are often elongated and erect to patent in the fruit, normally with many stalked glands. The hypanthium is densely hairy. The carpels are glabrous. The stamens exceed the styles and the anthers are glabrous. The fruits are mostly aborted.

This species is somewhat similar to *R. norvegicus*. It has heart-shaped leaves that have a characteristic bullate upper surface and are green below (Figure 4). The stem is deeply furrowed. The inflorescence is long, narrow and leafless terminally. The flowers are pale pink and even the styles may be pale pink. The sepals are often erect and elongated after flowering.

It is known from 7 occurrences around Rydet in Onsala, but with only 1.3 km between the most distant ones. Four of them are located on the edge of the road Håcklehagsvägen, whereas two are around the parking lot of Rydet sports field, and one at Mårtagården bus stop. Most of the stands are large (up to 100 m²) and rich in individuals.

The chromosome number is $2n = 28$. Thus, it is most likely not a primary hybrid. The species does not appear to have been observed before. The Latin epithet is referring to the characteristic bullate upper side of the leaves.

***R. polybracteatus* Ryde sp. nov.**

Type: Halland, Onsala, E road side at the house S of Stora Siken, Swedish Grid RT90 6370583 1268632, leg. U. Ryde, 30.VI.2009 (holotype: LD, isotypes: GB, S, UPS).

Latin diagnosis: *Dense aculeatus; caulis saepe rubro-viridis marmoratus, glandulis sat numerosis, aculeis densis sed parvis; stipulae 1–3 mm latae; folia saepe trifoliolata, subtus virida et parce pilosa; petiolulus folioli terminali 9–16-aculeatus; foliolum terminale angustum, ellipticum, saepe angulosum, saepe pallide viride, duplicato-serratum, basi truncata vadosae cordata, apice potius longo; inflorescentia insignis frondosa; bracteae multae simplices, subtus aliquot viridae; sepala longi-acuminata, glandulosa; tepala alba, sed in alabastro conspicue rosea, saepe monstrosa; fructificatio praecox abundans sed mericarpiis pauca.*

Description: The stem is procumbent, angled to furrowed, 4–8 mm, often characteristically speckled in red and green, with occasional hairs and very few glands. The internodes are 6–12 cm. The prickles are bent in the tip, dense (20–50 per 5 cm), 3–6 mm, with a base of 1–4 mm. The stipules are 1–3 mm with many glands. The leaves are 15–23 cm long, with 4–5 leaflets, often pale green and thin. The leaf stalk is 6–9 cm, with 15–30 prickles, ~2 mm and falcate. The terminal leaflet is narrowly elliptic with a weakly cordate to almost straight base and often with corners, 8–11 · 6–9 cm, widest around the middle, sparsely hairy on both sides and green below; its petiolule is 19–36 mm, with 9–16 prickles. The serration is periodic and the leaf apex is 9–14 mm. The lateral leaflets are 7–10 cm long with ~3 mm petiolule. The basal leaflets are 5–7 cm and sessile. The rachis is densely hairy with rather many glands. The prickles of the inflorescence are 2–4 mm and recurved to slightly bent. The pedicels are 8–20 mm with 5–17 prickles of ~1 mm that are bent. The upper leaves are many, 5–10, integer, coarsely serrated, and grey below. The flowers are 1.8–2.9 cm, often monstrous. The petals are pale pink, at least in the bud. The flowering and fruiting are early. The filaments and styles are white. The sepals are grey-white, with occasional prickles, few to rather many stalked glands, and short tips. The direction of the sepals is varying, but they are often clasping the fruit. The hypanthium is hairy. The carpels have occasional hairs. The stamens exceed the styles and the anthers are glabrous. The fruits are well developed, but with only ~10 drupelets.

This local species from Onsala is less characteristic. It mixes characters from *R. hallandicus*, *R. gothicus*, and *R. fasciculatus*, which all occur in the same area. The prickles are dense as in *R. hallandicus*, but the leaf-shape is more like that of *R. gothicus* and the inflorescence is more like that of *R. fasciculatus* (Figure 5). The leaves are sparsely hairy on both sides. The stems are often characteristically striped in red and green. Moreover, the inflorescence has numerous (5–10) entire upper leaves and the fruit is early and rich, but with

only a few mericarps. In the same area, *R. norvegicus*, *R. wahlbergii*, and *R. vikensis* are also found.

The distribution consists of three small locality groups, all in the parish of Onsala in northern Halland: three occurrences around the farm Västra Hagen, eleven occurrences on road-sides and pastures around Stora Siken, 2–3 km to the south, and three more scattered occurrences between Rydet and Runås, ~3 km to the south-east. The longest distance between the localities is almost 6 km. Some of the stands are quite large ($> 25 \text{ m}^2$), in particular those around Stora Siken.

This species has only recently been recognized and is sometimes hard to identify, especially when growing in shade. The chromosome number, determined to $2n = 28$ from five localities, talks against that it could be a primary hybrid. I have not been able to find any previous specimens of this species in the herbaria, but it is quite hard to recognize when dried. In one locality south of Västra Hagen, a deviating morphotype with yellow-green leaves and more pink flowers has been observed together with the main type.

In one locality south of Stora Siken, the hybrid with *R. caesius* was found. It grows close to typical *R. polybracteatus*. In this plant, the stem has lots of glands and small prickles. The leaves have often three leaflets and are light or yellowish green, with a short point. The stipules are wide (~4 mm). The prickles are bent. The inflorescence is short and the prickles on the petioles are straight. However, the fruits are not enclosed by the sepals, as normally is observed for hybrids with *R. caesius*, but the fruits are well developed with many mericarps. The chromosome number, $2n = 42$, confirms that it is a hybrid.

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Table 1. *Rubus* samples studied by flow cytometry. Coordinates are in Swedish Grid, RT90. $2n_{est}$ is the chromosome number estimated from the calibration line.

Species	Parish	Locality	Coordinates	$2n_{est}$
Wide-spread and regional species				
Bedford Giant	Halmstad	Between Högelid and Jönköpingsvägen	6288123 1319597	41.6
<i>caesius</i> × <i>idaeus</i>	Släp	Algutsred, Dalslyckevägen, W side	6382472 1270299	19.8
<i>camptostachys</i>	Tvååker	Sik, at the W side of Kustvägen	6324374 1290925	28.1
<i>camptostachys</i>	Veinge	Genevad, just N of the railway	6275360 1329006	28.1
<i>eluxatus</i>	Steninge	Steninge strand, at the parking lot	6297600 1306000	28.1
<i>eluxatus</i>	Träslöv	Apelviken, 150 m S the railway overpass	6334963 1284381	27.0
<i>fasciculatus</i>	Släp	Blixered, ca 800 m NW Jordbro	6380889 1273485	28.1
<i>fasciculatus</i>	Värö	N Korpakullen, N road side	6353425 1280166	29.1
<i>fasciculatus</i>	Onsala	N of Runås	6368125 1270850	28.1
<i>fasciculatus</i>	Onsala	Godhem	6367570 1270947	28.1
<i>gothicus</i>	Onsala	Lunnavägen, 10 m W of Smedvägen	6371595 1270313	28.1
<i>gothicus</i>	Onsala	On the road to Knastås	6368025 1270714	29.1
<i>hallandicus</i>	Söndrum	Frösakull, Erik Staels väg	6287800 1311300	27.0
<i>hallandicus</i>	Fjärås	Gravel pit at Fjärås bräcka	6374887 1282551	28.1
<i>hallandicus</i>	Onsala	Mårtagåden	6369219 1270691	28.1
<i>lagerbergii</i>	Släp	Kullavik, Sandlyckansväg	6387046 1269553	33.3
<i>lagerbergii</i>	Kungsbacka	The road to Svinkroken Marin	6377355 1275580	33.3
<i>mortensenii</i>	Steninge	Skipås, 20 m N the parking lot at Kustvägen	6299100 1305300	28.1
<i>mortensenii</i>	Vinberg	SE road side between Tröingeberg and Vinberg	6315000 1300400	28.1
<i>norvegicus</i>	Onsala	Knastås, 500 m SSE Häckelhagen	6367261 1269623	26.0
<i>norvegicus</i>	Släp	Gundal, N road side, opposite to Gundalsvägen	6388175 1271326	28.1
<i>vikensis</i>	Trönninge	450 m SW of the church	6280569 1323531	35.4
<i>vikensis</i>	Vallda	Hästakärrsvägen, NW corner	6374559 1267609	35.4
<i>vikensis</i>	Onsala	Crossing Godhemvägen and Vässingsövägen	6367415 1270872	34.3
<i>wahlbergii</i>	Trönninge	Pilsgården, E road side	6339171 1289850	35.4
<i>wahlbergii</i>	Onsala	V Hagenvägen 16	6373650 1267530	35.4
<i>wahlbergii</i>	Onsala	Rösan, end of the track	6379281 1271613	35.4
<i>wahlbergii</i>	Onsala	Mariedal, Lunnavägen, 10 m W of Smedvägen	6371595 1270313	35.4
<i>wahlbergii</i>	Eftra	Road crossing 150 m NW Örkne	6305600 1307000	36.4
<i>wahlbergii</i>	Eftra	Kustvägen outside Rödabergsvägen 1	6299972 1305551	35.4
<i>wahlbergii</i>	Släp	Kullavik, at the freeway junction	6386953 1270412	35.4
Deviating morphotypes				
<i>eluxatus</i> morphotype	Steninge	150 m SSE of the church	6299300 1308800	27.0
<i>eluxatus</i> morphotype	Värö	crossing Ö Sanddammsvägen and Linneslättsvägen	6349950 1279730	25.0
<i>eluxatus</i> morphotype	Träslöv	Apelviken, at Sanatorievägen	6334966 1284429	28.1
<i>eluxatus</i> morphotype	Eftra	Kustvägen opposite to Rödabergsvägen 1	6309933 1305557	27.0
<i>gothicus</i> morphotype	Onsala	Onsala, the road to Boklunden	6370248 1272014	28.1
<i>gothicus</i> morphotype	Onsala	Mariedal in the crossing	6370837 1270483	28.1
<i>gothicus</i> morphotype	Vallda	At the bike path close to Hästakärrsvägen	6374618 1267649	28.1
<i>wahlbergii</i> morphotype	Lindeberg	Trönninge, race track at Kroksberg	6341626 1286718	34.3
<i>wahlbergii</i> morphotype	Spannarp	50–150 m N the crossing S of Noregård	6333180 1292919	35.4
Local species				
<i>cordatiformis</i>	Eftra	The road towards Nyttäppet	6301309 1306541	33.3
<i>cordatiformis</i>	Eftra	Skällentorp	6306210 1307400	33.3
<i>cordatiformis</i>	Steninge	Skipås farm	6300461 1306794	33.3
morphotype				
<i>polybracteatus</i>	Onsala	Ledet, W road side	6368824 1270916	27.0
<i>polybracteatus</i>	Onsala	800 m W of Hagaholm	6372924 1267723	28.1
<i>polybracteatus</i>	Onsala	V Hagen	6372842 1267708	28.1
<i>polybracteatus</i>	Onsala	St Siken	6370569 1268620	28.1
<i>polybracteatus</i>	Onsala	Gravel pit at V Hagenvägen	6372605 1267702	28.1
<i>polybracteatus</i>	Onsala	Vässingsövägen, bus stop	6369714 1271460	28.1
<i>polybracteatus</i>	Onsala	Gravel pit at V Hagenvägen	6372605 1267702	28.1
morphotype				
<i>onsalaënsis</i>	Onsala	850 m OSO Hagaholm	6372656 1267653	33.3
<i>onsalaënsis</i>	Onsala	V Hagenvägen	6373702 1267679	33.3
<i>rugulosus</i>	Onsala	Parking lot of Rydet sports field	6369897 1271104	28.1

<i>rugulosus</i>	Onsala	Häcklehagsvägen, close to Rydetvägen	6370007 1270808	28.1
<i>soendrumensis</i>	Söndrum	Bäckagårds nursing home	6285791 1314539	27.0
<i>soendrumensis</i>	Söndrum	Tylösand, W side of Flaggberget	6283501 1311305	27.0
<i>sordirosanthus</i>	Steninge	Kustvägen, at the parking lot	6299100 1305300	28.1
<i>sordirosanthus</i>	Steninge	Gamla vägen at the bus stop	6298069 1305858	28.1
<i>sordirosanthus</i>	Halmstad	Gustavsfält	6286180 1322050	28.1
<i>caesius</i> hybrids				
<i>caesius</i> × <i>lagerbergii</i> ?	Släp	Bukärr, V Särövägen at Särö Lundväg	6383754 1269509	42.6
<i>caesius</i> × <i>lagerbergii</i> ?	Släp	500 m NE of Särö church, 30 m W of the bridge	6382488 1268802	41.6
<i>caesius</i> × <i>eluxatus</i>	Träslöv	Subbeberget at a ditch at the forest edge	6334315 1284316	34.3, 35.4 ^a
<i>caesius</i> × <i>eluxatus</i>	Träslöv	Subbeberget below the lighthouse	6334657 1283828	41.6
<i>caesius</i> × <i>fasciculatus</i> ^b	Onsala	Vässingsö, S road side	6367063 1270883	42.6
<i>caesius</i> × <i>fasciculatus</i> ^b	Släp	N of country road SW of Högås	6381255 1271833	41.6
<i>caesius</i> × <i>fasciculatus</i> ^b	Släp	N of country road 500 m W of Blixered	6380811 1272213	41.6
<i>caesius</i> × <i>fasciculatus</i> ^b	Släp	Klev, N road side	6381800 1269900	35.3, 34.3 ^a
<i>caesius</i> × <i>fasciculatus</i> ^b	Släp	Släp Fiskarstig	6381220 1271843	41.6
<i>caesius</i> × <i>fasciculatus</i> ^c	Vallda	Hamra golfbana, 100 m N of the parking lot	6380480 1271380	42.6
<i>caesius</i> × <i>fasciculatus</i> ^c	Släp	Crossing S Stockenvägen and country road	6381235 1270976	42.6
<i>caesius</i> × <i>polybracteatus</i>	Onsala	St Siken	6370467 1268624	42.6
<i>caesius</i> × <i>norvegicus</i>	Släp	Kullaviks harbour at the bus stop	6386742 1267704	41.6
<i>caesius</i> × <i>wahlbergii</i> ?	Släp	Blixered, Brogrens väg	6381066 1272716	28.1
<i>idaeus</i> hybrids				
<i>eluxatus</i> × <i>idaeus</i>	Träslöv	Apelviken at the parking lot	6334915 1284269	31.2
<i>eluxatus</i> × <i>idaeus</i>	Värö	Änga, E of highway E6	6350864 1283912	33.3
<i>gothicus</i> × <i>idaeus</i>	Onsala	Parking lot of Rydet sports field	6369919 1271128	33.3
<i>hallandicus</i> × <i>idaeus</i>	Slöinge	S of Berte mill	6306100 1309406	33.3
Unclear taxa				
<i>Kläppa form</i>	Släp	30 m E of the houses in Kläppa	6381992 1270247	28.1
<i>Klastorp form</i>	Trönninge	25–150 m E Klastorp	6338933 1290756	28.1
<i>Varberg form</i>	Varberg	Getterön	6338993 1285123	28.1
<i>Varberg form</i>	Träslöv	Ås, 20 m S of the junction to Gamla Köpstad	6330400 1287733	28.1

^a Two independent samples were measured.

^b Weak type.

^c Vigorous type.

Table 2. Number of occurrences (stands separated by more than 10 m) for taxa of *Rubus* sect. *Corylifolii* encountered in the inventory in Halland. The total number of occurrences is 856.

Species	# occurrences
Wide-spread and regional species	
<i>R. camptostachys</i>	8
<i>R. eluxatus</i>	93
<i>R. fasciculatus</i>	14
<i>R. gothicus</i>	41
<i>R. hallandicus</i>	146
<i>R. lagerbergii</i>	23
<i>R. mortensenii</i>	108
<i>R. norvegicus</i>	21
<i>R. vikensis</i>	48
<i>R. wahlbergii</i>	109
Local species	
<i>R. cordatiformis</i>	71
<i>R. polybracteatus</i>	15
<i>R. onsalaënsis</i>	7
<i>R. rugulosus</i>	7
<i>R. soendrumensis</i>	4
<i>R. sordirosanthus</i>	104
caesius hybrids	
<i>R. caesius</i> × <i>eluxatus</i>	2
<i>R. caesius</i> × <i>fasciculatus</i> weak type	16
<i>R. caesius</i> × <i>fasciculatus</i> (?) vigorous type	3
<i>R. caesius</i> × <i>lagerbergii</i> (?)	2
<i>R. caesius</i> × <i>polybracteatus</i>	2
<i>R. caesius</i> × <i>norvegicus</i>	1
<i>R. caesius</i> × <i>wahlbergii</i> (?)	1
idaeus hybrids	
<i>R. eluxatus</i> × <i>idaeus</i>	2
<i>R. idaeus</i> × <i>gothicus</i>	1
<i>R. idaeus</i> × <i>hallandicus</i>	1
Unclear taxa	
Klastorp form (introduced?)	1
Kläppa form (<i>R. caesius</i> × <i>fasciculatus</i> derivative?)	1
Varberg form (introduced?)	3

Figure 1. *R. cordatiformis*. Upper and lower side of leaves, inflorescence, flower bud, flower from above and dissected, young fruit, and stem.



Figure 2. *R. onsalaënsis*. Upper and lower side of leaves, inflorescence, flower buds, flower from above and dissected, and stem.

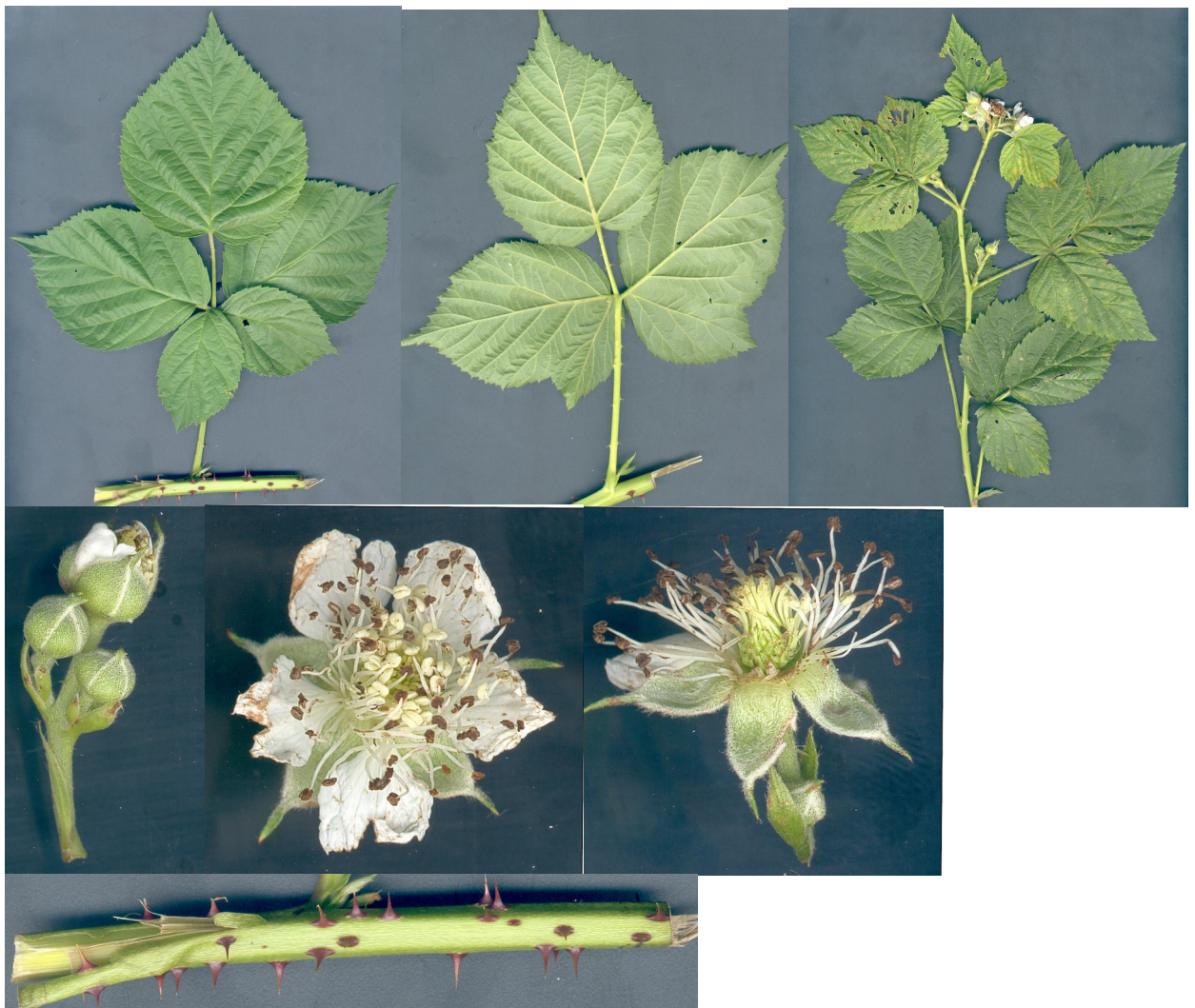


Figure 3. *R. soendrumensis*. Upper and lower side of leaves, inflorescence, flower bud, flower from above, fruit, and stem.



Figure 4. *R. rugulosus*. Upper and lower side of leaves, inflorescence during and after flowering, flower buds, flower from above and dissected, stem, and cross section of stem.



Figure 5. *R. polybracteatus*: Upper and lower side of leaves, inflorescence during and after flowering, flower buds, flower from above and dissected, fruit, and stem.



Appendix. Known occurrences for the five new species in the province of Halland. Coordinates are GPS Swedish Grid RT90 and they go from south to north in each parish. All occurrences were visited 2000–2008.

R. cordatiformis (all in Eftra or Steninge)

Undarsmosse, E side of the ditch, 6300135 1307335; Skipås above the farm, 6300466 1306802; Skipås above the farm, 6300519 1306833; 150 m NW St Stensjö, 6300600 1305300; Stensjö, 300 m NE St Stensjö, 6300700 1305700; Stensjö, 300 m SE of the harbour, 6300700 1305100; Undarsmosse, W side of the ditch, 6300870 1307327; Undarsmosse, in the forest, 6300931 1307334; Undarsmosse, W side of the ditch, 6300933 1307323; Kustvägen, E side, 6301278 1305740; towards Nytäppet, S side of the road, 6301299 1306599; towards Nytäppet, S side of the road, 6301309 1306541; S side of the road to Nytäppet, 6301329 1306328; 400 m SW of Nytäppet, 6301500 1306800; Ugglarps kvarn, 6301863 1304752; Ugglarps kvarn, 6301940 1304910; road to Ugglarps kvarn, 6301980 1305350; road to Ugglarps kvarn, 6301990 1305300; Kustvägen, 6302040 1305430; Kustvägen W side, 6302122 1305500; Kustvägen W side, 6302169 1305521; Kustvägen E side, 6302185 1305531; Kustvägen W side, 6302340 1305590; Kustvägen W side, 6302451 1305650; Lassegårdsvägen, 6302485 1305400; Kustvägen W side, 6302513 1305701; Kustvägen E side, 6302516 1305707; Lassegårdsvägen, 6302551 1305691; Kustvägen E side, 6302556 1305762; Kustvägen E side, 6302567 1305730; Lassegårdsvägen, 6302568 1305469; Spanarevägen, 6302582 1305553; N of Ugglarps kvarn, 6302590 1305620; Kustvägen E side, 6302888 1305575; Vassvik, N side, 6303083 1305454; N of Vassviksvägen, 6303105 1305490; N of Vassviksvägen, 6303109 1305532; towards Vassvik, N side of the road, 6303110 1305435; towards Vassvik, N side of the road, 6303134 1305440; Road into Ugglarp, 6303207 1305884; Road into Ugglarp, 6303247 1305872; Ugglarpsvägen, 6303351 1305310; Ugglarpsvägen, 6303373 1305371; Ugglarpsvägen, 6303389 1305549; Ugglarps grönt 6303441 1305380; Ugglarps grönt, 6303452 1305409; Ugglarp, S side the road to Sallesbjär, 6303500 1305700; The road to Sallesbjär, 6303578 1305789; Kustvägen, W side, 6303599 1305918; Båtmansvägen, both sides of the road, 6303612 1305942; Kustvägen, W side, 6303652 1305937; Kustvägen, W side, 6303706 1305929; Kustvägen, W side, 6303781 1305919; Kustvägen, W side, 6303837 1305898; Ugglarp, Grosslanvägen, 200 m N of Kil, 6303900 1305400; Grosslevägen E side, 6304022 1305633; S of Grosslan, 6304030 1305244; Grosslevägen both sides, 6304041 1305602; Grosslevägen W side, 6304064 1305543; 50 m N of the nature reserve at Ullarp, 6304722 1306932; Örkne, 6305494 1306993; W side of Kustvägen, 6305892 1307172; E side of Kustvägen, 6305931 1307196; S of Bergagård, 6305960 1307140; S of Bergagård, 6305977 1307260; Both sides of the road, 6306162 1307326; Both sides of the road, 6306233 1307376; Kustvägen S of Bergagård, 6306490 1307620; S of Bergagård, 6306520 1307590; 400 m SSW Bergagård, 6307400 1306300; At the old bridge over Suseån E of Eftra church, 6308150 1308240

R. onsalaënsis (all in Onsala)

850 m ESE Hagaholm, 6372656 1267653; W road side E of V Hagen, 6372989 1267791; Opposite to Munkebäcksvägen, 6373531 1267585; Approach to V Hagen, 6373702 1267679; Buera, E side of Valldavägen, 6373986 1267744; Buera, E road side, 20 m N Sörgårdesvägen W, 6374240 1267700; Buera, W of Bäckavägen, 6374290 1267700; Bus stop Valldahemmet, 6374448 1267682

R. soendrumensis (all in Söndrum)

Tylösand, W side of Flaggberget, 6283501 1311305; Bäckagårds nursing home, 6285713 1314522; Bäckagårds nursing home, 6285747 1314497; SW corner of Bäckagårds nursing home, 6285791 1314539.

R. rugulosus (all in Onsala)

Häcklehagsvägen, 6369179 1269982; Häcklehagsvägen, 6369229 1270060; Häcklehagsvägen, 6369239 1270076; parking lot of Rydet sports field in W in the centre, 6369897 1271104; Mårtagårdens bus stop, N side the road, 6369974 1271045; Häcklehagsvägen, 300 m towards Oreviken, 6370007 1270808.

R. polybracteatus (all in Onsala)

N of Runås, 6368159 1270868; Ledet, on the W side of the road, 6368824 1270916; Onsala, S side of the road at the bus stop, 6369720 1271454; St Siken, E side of the road, 6370369 1268683; St Siken, E side of the road, 6370411 1268642; St Siken, E side the road, 6370416 1268639; St Siken, 6370467 1268624; St Siken at the house, 6370510 1268624; St Siken at the house, 6370539 1268629; St Siken, W side of the road, 6370569 1268620; St Siken at the house, 6370597 1268626; St Siken between two sites, 6370644 1268641; Svanehallavägen at the dump, 6370774 1268390; Border between two pasturelands, 6370879 1268786; Dump S of V Hagen, 6372603 1267701; At V Hagen, 6372842 1267708; N of V Hagen, 6372929 1267710.