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RESEARCH PAPER

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Densities of Eurasian Three-toed Woodpecker *Picoides tridactylus* and sap trees correlate across a latitudinal gradient in Sweden

Tretåiga hackspettens Picoides tridactylus *och savträdens tätheter samvarierar över en latitudinell gradient i Sverige*

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MAPPING OF SAP ROWS on trees has been proposed to detect the easily overlooked Eurasian Three-toed Woodpecker *Picoides tridactylus* in boreal forests. Sap rows have a distinct appearance that can be detected in the bark for many years. While it is well-established that Eurasian Three-toed Woodpeckers make sap rows on coniferous trees, it is uncertain whether they also make sap rows on deciduous trees, such as birches (*Betula* sp.), or if these are made by other woodpecker species. We collated data on woodpecker abundance from the Swedish Bird Survey's fixed route monitoring scheme and correlated this with data on sap tree abundance from systematic searches in three different parts of Sweden. Assuming that species-specific woodpecker behaviours are similar across Sweden, we suggest that Eurasian Three-toed Woodpeckers are responsible for the majority of sap rows on birches in the central and northern parts of Sweden, while Great Spotted Woodpeckers *Dendrocopos major* made the few sap rows found in southern Sweden and likely some of those further north. With that caveat in mind, our findings might be used to develop a more efficient method of mapping Eurasian Three-toed Woodpecker abundance in Sweden.

Keywords: bird surveying | methodology | forestry | sap row | Picidae

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Introduction

It is well known that several species of woodpeckers make rows of small holes in tree trunks, so-called sap rows, to access the nutrient-rich sap that rises in the trees at the beginning of the growing season for plants (Winkler & Christie 2002). In North America, this behaviour is most common among different species of sapsuckers, where the Yellow-bellied Sapsucker *Sphyrapicus varius* is the best-known example. In fact, this species can receive up to 20% of its annual nutrient intake from sap, and during certain periods feeds almost exclusively on sap (Walters *et al.* 2002). Another example from North America is the American Three-toed Woodpecker *Picoides dorsalis*, that frequently make sap rows on birch (*Betula* sp.) trees (Bailey 2008). Apart from providing a food source for the woodpecker that made the holes, sap rows can be used by other birds. For instance, sap rows made by White-fronted Woodpeckers *Melanerpes cactorum* in South America have been shown to support foraging by as many as 46 other bird species (Núñez Montellano *et al.* 2019).

European woodpeckers also make sap rows, but the behaviour seems less common than in North America (Turček 1954). Among the woodpecker species in Europe there is information from the United Kingdom about Great Spotted Woodpecker *Dendrocopus major* making sap rows (Gibbs 1983), and from Eastern Europe, in the Carpathians, there are descriptions of Great Spotted Woodpecker, Black Woodpecker *Dryocopus martius*, European Green Woodpecker *Picus viridis* (hereafter Green Woodpecker) and Eurasian Three-toed Woodpecker *Picoides tridactylus* (hereafter Three-toed Woodpecker) making sap rows on several different tree species (Turček 1954). A recent study from Poland also shows that the Great Spotted Woodpecker occasionally makes sap holes and drinks sap (Stański *et al.* 2023). It has been suggested that the behaviour of making sap rows is more common in the central parts of Europe compared to the northern parts (Cramp 1985, Winkler & Christie 2002).

Documentation of which woodpecker species make sap rows, on which trees and to what extent they do so are few from northern Europe. Pakkala *et al.* (2018) found that Three-toed Woodpeckers in southern Finland spent up to 33% of their foraging time on sap rows on conifers during the pre-nesting season. Moreover, in the same study it was found that Great Spotted Woodpeckers occasionally made sap rows on deciduous trees, and that Black Woodpeckers sometimes visited sap rows on Scots pine trees *Pinus sylvestris* made by Three-toed Woodpeckers (Pakkala *et al.* 2018). In a book on Nordic birds, Holmström *et al.* (1944) state that Three-toed Woodpeckers regularly make sap rows, mainly on Norway spruce *Picea abies* and Scots pine, but that other woodpecker species do so very rarely. Braestrup *et al.* (1960) described that both Three-toed Woodpeckers and Great Spotted Woodpeckers sometimes make holes in living birches to feed on sap or cambium, and Ullman (1985) described observations of Great Spotted Woodpeckers making sap rows on linden *Tilia cordata* in southern Sweden. There are also observations of Middle Spotted Woodpecker *Dendrocoptes medius* drinking sap from maple trees *Acer platanoides* in southern Sweden in the late 1970s (Pettersson 1983). However, the last known breeding attempt in Sweden was in 1980, which means that Middle Spotted Woodpeckers cannot be responsible for sap rows found in Sweden today. We have not found any sources describing sap rows made by Lesser Spotted Woodpecker *Dryobates minor*, White-backed Woodpecker *Dendrocopos leucotos*, Grey-headed Woodpecker *Picus canus*, Eurasian Wryneck *Jynx torquilla*, or the Syrian Woodpecker *Dendrocopos syriacus*.

The consensus among field ornithologists in Sweden is that Three-toed Woodpeckers almost exclusively are responsible for sap rows on trees. This is also reflected in the information provided by the Swedish Species Information Center (SLU Artdatabankens Artfakta) that states that sap rows on Norway spruce and Scots pine are very strong indicators of breeding Three-toed Woodpeckers in an area (Artdatabanken 2019). We have recently suggested that systematic mapping of sap rows could be an efficient method for surveying the presence of Three-toed Woodpeckers (Ferry *et al.* 2021). However, as exemplified above, sap rows can also be found on deciduous trees, and other species than Three-toed Woodpeckers can—at least occasionally—make sap rows. To what extent the Three-toed Woodpecker is responsible for sap rows on deciduous trees, especially birches, or if any other woodpecker frequently makes such sap rows in Sweden, have not been quantified. Here we address this question by systematically searching for sap rows in three regions of Sweden where Three-toed Woodpeckers range from rare visitor

(southern Sweden) to fairly common breeding species (northern Sweden). The quantifications of sap rows are in turn compared to measures of abundance of different species of breeding woodpeckers, using data from the Swedish Bird Survey.

Methods

The Swedish Bird Survey studies changes in the Swedish bird fauna over time. Since the 1970s, volunteer ornithologists have been counting the number of birds at various times of the year and at more than a thousand locations throughout Sweden. As the counts are carried out in the same way every year, one can track how the number of birds changes over time. The project is run by the Department of Biology, Lund University, as part of the Environmental Monitoring Programme of the Swedish Environmental Protection Agency and the County Administrative Boards. In the present study, we used the fixed route survey, which contains data from 716 routes systematically distributed over Sweden. The distance between the routes is 25 km in both north-south and west-east directions. Each route consists of eight 1 km line transects along a 2×2 km square (8 km in total), and eight point counts of 5 min at each full km where all observed (seen or heard) birds are counted. Line and point counts are two separate samples of the same routes. The route starts and ends in the southwest corner and is surveyed clockwise. The routes are surveyed once a year during a three-week period, adapted to local conditions, when the activity of breeding bird species is expected to be as high as possible (Green *et al.* 2021). A major benefit of the fixed routes is that they are completely systematically distributed and therefore cover all major habitats proportionally.

To record the presence of trees with sap rows we divided the country into three regions corresponding to known differences in densities of Three-toed Woodpeckers (Ottosson *et al.* 2012). We selected 10 routes in southern Sweden where there is no regular occurrence of Three-toed Woodpeckers, 10 routes in central Sweden where the species occurs regularly but at low density, and 17 routes in northern Sweden which is the main breeding area for Three-toed Woodpeckers in Sweden and where densities are higher (Figure 1, Appendix 1).

On each route, we looked for sap rows on the first (the southwestern most) line count of the route whenever possible (25 of 37 routes). If the terrain did not allow the observer to cover the first kilometre of the route, or if it consisted mainly of habitats other than forest, we chose the next line that satisfied the condition. During the line counts, the observer walked slowly and looked for sap rows within about 10 m in both directions from the route. When the full kilometre line count was done, the observer turned around and went back the same way, repeating the survey. With this setup, we covered an area of about 2 ha per route (20×1,000 m) and covering each route took about 1.5–2 h. The observer only used eyesight, no equipment such as binoculars or ladders, to detect sap rows. We examined the tree trunks up to about 8 m in height. All fieldwork was carried out in the autumn of 2020 and in April 2021 by a single observer (BF). Data was recorded in a smartphone application in ArcGIS Collector. A map application was used to collect geodata in the field. When a tree with sap holes was found, the following information was recorded: tree species, estimated age of sap rows, number of sap rows, and the GPS coordinate of the tree.

To guide our estimate of sap row ages, we calibrated appearance of sap row holes by making cross section of three sap rows on a test tree and counting the growth rings (Figure 2). Fresh sap rows have just small incisions, but with time these becomes larger and get more conspicuous in appearance (Figure 2). Using this information, we categorized the age of recorded sap rows in three classes based on the shape of the sap holes: < 3 years, 3–7 years and > 7 years old.

A benefit of using the fixed route data is that for each route surveyed for sap rows there is corresponding data on woodpecker abundance, for all woodpecker species. We therefore compared the number of sap trees per kilometre and region with the number of observed woodpeckers per kilometre from the line transects from the fixed routes in the same regions. Since the sap rows are visible for at least ten years (even if they are not reopened), we chose bird data from the period 2011–2020 for comparisons.

Results

We found a total of 381 trees with sap rows on the 37 surveyed routes. There was a clear latitudinal trend,

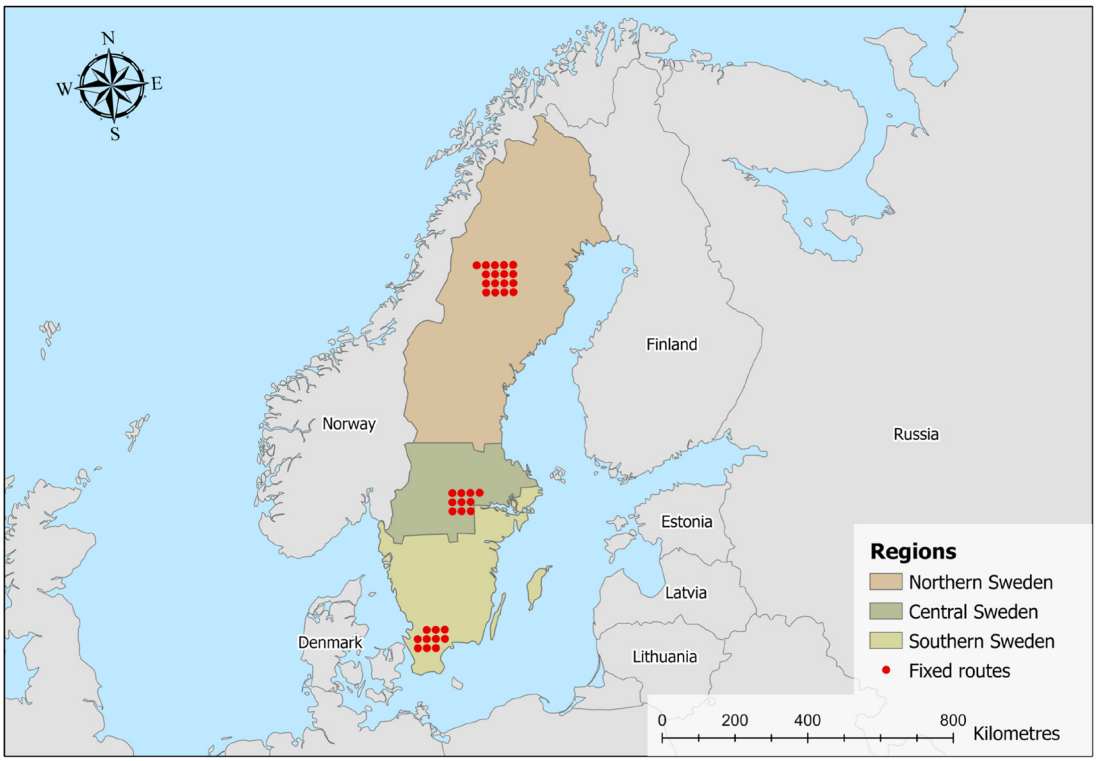

FIGURE 1. Map with the three different parts of Sweden used in our analysis: southern, central, and northern Sweden. Red dots show the location of fixed routes surveyed for sap rows.
— Karta med de tre olika delarna av Sverige som används i vår analys: södra, mellersta och norra Sverige. Röda punkter indikerar de standardrutter som inventerades för förekomst av savrader.

where the average number of trees with sap rows was 0.4 per km in southern Sweden, 6.2 per km in central Sweden and 18.5 per km in northern Sweden. Of the recorded sap trees, 366 were birches and 15 conifers (Scots pine and Norway spruce); all sap rows on conifers were found in northern Sweden.

Data on woodpecker abundance was available for six species, of which Great Spotted Woodpecker, Black Woodpecker, Lesser Spotted Woodpecker and Green Woodpecker showed the opposite distribution of recorded birds per km on the fixed routes compared to sap trees abundance (Table 1). These four species had the highest observed densities in southern Sweden, lower densities in central Sweden (most prominently so for Lesser Spotted and Green Woodpeckers) and the lowest recorded densities in northern Sweden (Figure 3).

Of the remaining two species, the Grey-headed Woodpecker showed a pattern where it is very rare in southern Sweden (none has been observed on any fixed route in this region) but is found in low numbers in central and northern Sweden. The observed occurrence of Grey-headed Woodpeckers did not correlate with sap trees, except for the general finding that the species is found in the parts of Sweden where sap trees are more common than in the southernmost part (Figure 3).

Observed densities of Three-toed Woodpecker showed a very similar pattern as with recorded densities of sap trees along the fixed routes. The species was not observed at all in southern Sweden, but was found in low densities in central Sweden. In northern Sweden it was recorded with more than four times higher densities than in central Sweden (Figure 3).

FIGURE 2. Evaluation of sap row ages. Top panels show the appearance of sap row holes, and lower panels show the corresponding cross sections of the sap rows, where tree growth rings can be used to determine age of the sap rows. The left column shows a fresh sap row (< 1 year), the central column a 6-year-old sap row, and the right column an 11-year-old sap row.
— Savrader (övre raden) och samma savrader i genomskärning (nedre raden). Vänstra kolumnen visar en färsk savrad (<1 år), mellersta kolumnen en sex år gammal savrad och högra kolumnen en elva år gammal savrad.

TABLE 1. Correlations between observed woodpeckers and sap trees found per region along surveyed fixed routes.
— Korrelationer mellan observerade hackspettar och savträd per region längs inventerade standardrutter.

Species *Art*			n	r	p
Eurasian Three-toed Woodpecker	Tretåig hackspett	*Picoides tridactylus*	3	0.99	0.08
Lesser Spotted Woodpecker	Mindre hackspett	*Dryobates minor*	3	–0.98	0.13
Great Spotted Woodpecker	Större hackspett	*Dendrocopos major*	3	–0.99	0.10
Black Woodpecker	Spillkråka	*Dryocopus martius*	3	–0.98	0.13
European Green Woodpecker	Gröngöling	*Picus viridis*	3	–0.98	0.13
Grey-headed Woodpecker	Gråspett	*Picus canus*	3	0.75	0.46

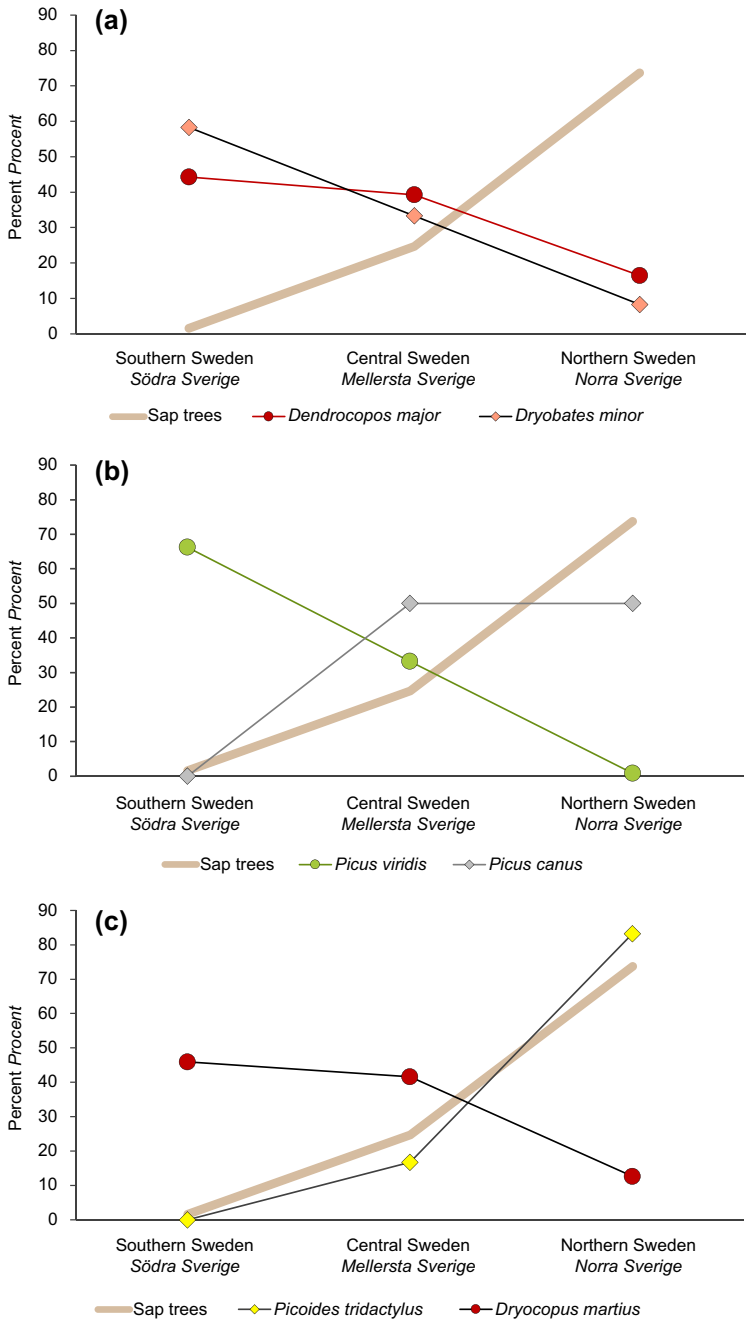

FIGURE 3. The distribution of found sap trees and observed woodpeckers along surveyed fixed routes, normalized by surveyed kilometer: (**a**) Great Spotted Woodpecker *Dendrocopos major* and Lesser Spotted Woodpecker *Dryobates minor*, (**b**) European Green Woodpecker *Picus viridis* and Grey-headed Woodpecker *Picus canus*, and (**c**) Three-toed Woodpecker *Picoides tridactylus* and Black Woodpecker *Dryocopus martius*. Woodpecker data from 2011–2020.

*— Fördelningen av savträd och observerade hackspettindivider längs inventerade standardrutter, normaliserade per inventerad kilometer: (**a**) större hackspett* Dendrocopos major *och mindre hackspett* Dryobates minor, *(**b**) gröngöling* Picus viridis *och gråspett* Picus canus*, samt (**c**) tretåig hackspett* Picoides tridactylus *och spillkråka* Dryocopus martius*.* Hackspettdata från 2011–2020.

Discussion

Along the studied latitudinal gradient, there was a clear pattern in the number of detected trees with sap rows, with only 0.4 per km in southern Sweden, compared to 6.2 and 18.5 per km in central and northern Sweden, respectively. Interestingly, nearly all sap rows were detected on birch trees, with only few on coniferous trees. Contrasting the values on sap row abundance with woodpecker species abundance from ten years of fixed route surveys in the same areas gave rise to varying trends. Four species—Lesser Spotted Woodpecker, Great Spotted Woodpecker, Green Woodpecker and Black Woodpecker—decreased in abundance with latitude, thereby showing opposite trends to that of sap trees. The remaining two species, Three-toed Woodpecker and Grey-headed Woodpecker, showed clear northward increase in abundance, of which the pattern for Three-toed Woodpecker was clearest (Figure 3, Table 1). In southern Sweden, Three-toed Woodpeckers are generally rare and sporadic in occurrence, and there has been no observation of the species in any of the fixed routes in this area since the start of the surveys in 1996. In central Sweden, Three-toed Woodpeckers are breeding, but at low densities, while the main part (>90%) of the Swedish population is found in the northern two thirds of the country where also the densities are higher (Ottosson *et al.* 2012). The Grey-headed Woodpecker is also found in central and northern Sweden, but not in southern Sweden. This species, however, feeds to a large extent on ants (Rolstad & Rolstad 1995) and we have not found any source that suggests that Grey-headed Woodpeckers make sap rows, although it probably will take sap from natural wounds in trees and sap rows made by other woodpeckers (Gorman 2016). Thus, assuming that all woodpeckers have the same propensity to make sap rows irrespective of where in Sweden they occur, the results clearly indicate that sap rows detected on birches are primarily done by Three-toed Woodpeckers. Although none of the correlations reach statistical significance, the correlation between observed Three-toed Woodpeckers and trees with sap rows is the closest to being significant. However, due to the small sample size of only three different regions, it is almost impossible to reach statistical significance.

It is well known and described repeatedly in the literature that Three-toed Woodpeckers make sap rows on conifers (Ruge 1968, Glutz von Blotzheim & Bauer 1980, Hess 1983, Cramp 1985, Pakkala *et al.* 2018). Our results from Sweden do however indicate that birch is by far the most used sap tree species (Ferry *et al.* 2021, this study). The only study showing intensive use of birches for sap drinking by Three-toed Woodpeckers comes from North America, involving the sister species *Picoides dorsalis* (Bailey 2008), earlier considered conspecific with the Eurasian *P. tridactylus*. We have also found one older Finnish source that briefly mentions that both Three-toed Woodpeckers and Great Spotted Woodpeckers sometimes make sap rows on birches (Braestrup *et al.* 1960). Apart from these publications we have only encountered anecdotal information and 'common knowledge' from birdwatchers and ornithologists that Three-toed Woodpeckers make sap rows on birches. An exception is the mountain birch forest in the county of Västerbotten (Ammarnäs), where Three-toed Woodpeckers have been recorded occasionally making sap rows on birches (Figure 4).

Additional support for this hypothesis could potentially be found in the nature of the sap rows, in their alignment, distance between holes and general appearance. The sap rows in our study had usual distances of 5–15 mm between sap holes, which is in the range reported for American Three-toed Woodpeckers (11 mm; Bailey 2008). Pakkala *et al.* (2018) observed differences in depth, size, distance, and irregularities between the sap holes made by Great Spotted Woodpeckers on deciduous trees and sap holes made by Three-toed Woodpeckers on conifers, where sap holes made by Great Spotted Woodpeckers were made at a distance of 30–45 mm from each other. In our study we did not observe any clear differences between different sap rows or between different parts of the country in our study. The differences in distance between sap holes in our studies mainly seem to depend on the age of the sap row itself, as the distance between the holes increases as the tree grows (Figure 2).

Given the results of this study, the apparent lack of publications on sap rows on birch trees by woodpecker may simply be an effect of underreporting. We wanted to qualitatively assess this possibility, and searched for films of sap row behaviour on the media repository YouTube (www.youtube.com). We used the search terms Great Spotted Woodpeckers and Three-toed Woodpeckers in different languages (Latin, English,

FIGURE 4. A Eurasian Tree-toed Woodpecker *Picoides tridactylus* feeding from sap rows on a birch tree (*Betula* sp.), Ammarnäs, Sweden. Photo: Åke Lindström.
— *En tretåig hackspett* Picoides tridactylus *födosöker från en savrad på en björk (*Betula *sp.) i Ammarnäs. Foto: Åke Lindström.*

Swedish, Finnish, German and Russian) and watched all resulting media for occurrence of sap row behaviour. Out of a large number of media we found only two of Great Spotted Woodpeckers making sap rows, one on what looks like a maple (https://tinyurl.com/5evysy69) and one on birch (https://tinyurl.com/ykdyj8y2), both from the Netherlands. We also found two clips where Three-toed Woodpeckers make sap rows and drink sap on Norway spruce, one from Finland (https://tinyurl.com/pdxeps22) and one from the Czech Republic (https://tinyurl.com/mtwbp4ku). The movies align with the general picture from the literature that Great Spotted Woodpeckers can display this behaviour in continental Europe. However, we noticed that the sap rows looked slightly more irregular, with holes at more varying levels than the neat rows we have found in Sweden where all the holes along the same row are more or less horizontal. The behavior of the Great Spotted Woodpeckers in the film clips looked like a combination of both eating cambium and drinking from the sap holes.

Turček (1954) claimed that Great Spotted Woodpeckers is the species making most sap rows in Central Europe. Still, we found the lowest occurrence of sap trees in the southern part of Sweden where Great Spotted Woodpecker is the dominating species. In fact, they are twice as common as all other woodpeckers put together in southern Sweden (Ottoson *et al.* 2012). Could it be that Great Spotted Woodpecker behaviour differs between different parts of the country? Are they more likely to make sap rows on birches in the north than in the south? Great Spotted Woodpeckers are usually resident, but in years with poor food supplies (most often Norway spruce seeds) birds may migrate in large numbers, causing irruptive patterns with peak years followed by years with little movements. Ring recovery data have established connectivity of Great Spotted Woodpeckers in Sweden with breeding populations in Scandinavia and Russia (Fransson *et al.* 2008). This would suggest that in Sweden, Great Spotted Woodpeckers show evidence of population mixing and that behaviours have the possibilities to spread, would they arise. On the other hand, it could be possible that the need for energy-rich birch sap is higher further north, due to generally colder climate and lower food availability, and that Great Spotted Woodpeckers behave differently in different parts of Sweden. A complicating factor is that a fairly large proportion of sap trees in this study came from areas where Three-toed Woodpeckers are rarely observed, for example in Scots pine-dominated middle-aged production forests. This could either mean that the Three-toed Woodpecker uses these types of forests more frequently than previously known, possibly due to a lack of suitable habitats that drives changes in behavior. However, it is also possible that the Great Spotted Woodpecker is the one making the sap holes in those forests since they are often seen there.

Could the distribution of tree species in Sweden in some way explain the found patterns? Two main birch species are occurring in Sweden, Downy Birch *Betula pubescens* and Silver Birch *Betula pendula*. We did not differentiate between them in this study or in our previous study (Ferry *et al.* 2021). Downy Birch is more common in northern Sweden but it accounts for about half of all birches also in southern and central Sweden (Eriksson *et al.* 1996), so we do not think that differences in distribution and occurrence of the two birch species can explain the regional differences in the number of found sap trees in our study, and we know

that Silver Birch also is used as a sap tree in Central Europe, Eastern Europe and Finland (Turček 1954, Pakkala 2018).

Thus, even if we find it unlikely that the behavior would differ significantly between different parts of the country within a single species, we cannot rule it out completely. It is clear in the literature that Great Spotted Woodpeckers do make sap rows, and it may well be Great Spotted Woodpeckers that made the few sap rows on birches found by us in southern Sweden. At the same time, we cannot completely rule out that it may be Three-toed Woodpeckers on temporary visits that made the sap rows also there. Observations of Three-toed Woodpeckers in the far south are very rare. However, in the web-based Artportalen (www.artportalen.se) a species observation system for voluntary reporting of observations of species in Sweden there has been five observations of Three-toed Woodpeckers in the last decade in the southernmost provinces in Sweden (Skåne, Halland, Blekinge and Kronoberg). So, it is not impossible that Three-toed Woodpeckers are responsible also for the few sap trees that we found in the southernmost part of the country.

In northern Sweden, it may seem strange that it is so common with sap trees, while it is rather rare to see a Three-toed Woodpecker in the forest. This in itself could be seen as support for that also Great Spotted Woodpeckers are involved. However, since the sap rows are visible for at least ten years, and that the Three-toed Woodpecker is secretive and easily overlooked (Amcoff & Eriksson 1996), even low usage of sap trees in areas with fairly low densities could result in presence of sap rows.

We admit that our results are correlative and somewhat circumstantial. To know for sure who makes the sap rows on birches (and other trees), detailed studies of the behavior of the birds themselves are needed. We hope that this report will spur the interest for investigating this issue further. It would be particularly interesting to do a similar study in Finland, to see if the distribution of woodpeckers and sap trees there are in line with our findings. At present, our data indicate that it is the Three-toed Woodpecker that is responsible for the majority of sap rows on birches in central and northern Sweden. However, the fact that so many of the sap trees were found in areas where Three-toed Woodpeckers are rarely observed, and that Great Spotted Woodpeckers are known to make sap rows in other parts of Europe means that we are not convinced about that this is the full story. Still, surveys of sap rows can be a simple and quick method to assess the possible occurrence and densities of Three-toed Woodpeckers in Sweden, which would be valuable for both nature conservation and forestry.

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Svensk sammanfattning

Vi har nyligen föreslagit att systematisk inventering av så kallade savrader kan vara en effektiv metod för att kartlägga förekomsten av tretåig hackspett i Sverige (Ferry *et al.* 2021). Den art som oftast kopplas till savrader eller ”ringade” träd i Sverige är just tretåig hackspett. Enligt SLU Artdatabanken är savrader på gran *Picea abies* ett tecken på att tretåig hackspett har häckat i närheten (Artdatabanken 2019). Vi vet dock inte med säkerhet i vilken utsträckning som tretåig hackspett är ansvarig för savrader även på björk i Sverige, eller om någon annan hackspett i Sverige gör sådana rader på björk.

Från litteraturen vet vi att olika hackspettarter runt om i världen gör savrader för att komma åt den energirika saven som stiger i träd främst under våren (Turček 1954, Gibbs 1983, Cramp 1985, Winkler & Christie 2002, Núñez Montellano *et al.* 2019, Walters *et al.* 2020). Från norra Europa finns det dock få observationer av vilka arter som gör savrader, på vilka träd och i vilken utsträckning de gör det. Pakkala *et al.* (2018) fann att tretåiga hackspettar i södra Finland använde upp till 33% av sin födosökstid under tiden precis före häckning till att göra och nyttja savrader på barrträd. De observerade också att större hackspett emellanåt gjorde savrader på lövträd och att spillkråka ibland besökte savrader på tallar *Pinus sylvestris* som tidigare gjorts av tretåig hackspett (Pakkala *et al.* 2018).

Holmström *et al.* (1944) rapporterar att tretåig hackspett gör savrader, främst på gran och tall, och att andra hackspettarter också gör det i mycket sällsynta fall. Braestrup *et al.* (1960) beskriver att både tretåig hackspett och större hackspett ibland gör hål i levande björkar för att få i sig sav eller kambium. Ullman (1985) beskrev att större hackspett gör savrader på lind *Tilia cordata* i södra Sverige. Mellanspetten *Dendrocoptes medius* har observerats dricka sav från lönnträd *Acer platanoides* i slutet av 1970-talet (Pettersson 1983), men mellanspetten är numera bara en mycket sällsynt besökare i Sverige, senast kända häckning 1980, senaste observationer från tidigare häckningsområde 1982, så mellanspetten kan inte vara ansvarig för de savrader som finns i Sverige idag. Vi har inte hittat några uppgifter om att mindre hackspett *Dryobates minor* eller gråspett *Picus canus* skulle göra savrader, vare sig på björk eller på några andra träd. Sammantaget verkar det hittills finnas begränsad kunskap om i vilken utsträckning olika arter gör savrader på björkar i norra Europa.

Genom att systematiskt söka efter savrader på Svensk fågeltaxerings fasta standardrutter i södra, mellersta och norra Sverige (figur 1) och sedan jämföra antalet träd med savrader med observationer av hackspettar från rutterna, försöker vi kartlägga vilken eller vilka hackspettarter som gör savrader i Sverige.

Vi inventerade savrader under hösten 2020 och i april 2021 på 37 av de totalt 716 standardrutterna (Green *et al.* 2021). På varje rutt gick vi en kilometer och tittade efter savrader ca 10 m åt båda håll, utan andra hjälpmedel än synen. När vi gått en kilometer vände vi och gick samma väg tillbaka. Samtliga påträffade träd med savrader noterades i en app i telefonen tillsammans med uppgift om trädslag och skattad ålder på de funna savraderna. För att uppskatta savrader nas ålder sågade vi ett tvärsnitt av tre savrader på ett testträd och räknade årsringarna från märkena, som visade sig vara från en ny savrad, en sexårig savrad och en elva år gammal savrad (figur 2). Med den informationen kategoriserade vi sedan åldern på savraderna i tre klasser baserat på formen på savhålen: <3 år, 3–7 år och >7 år gamla. Dessutom registrerades trädets position med telefonens GPS. Vi jämförde sedan antalet savträd per kilometer och region med antalet observerade hackspettar per kilometer från linjetransekterna från de fasta standardrutterna i södra, mellersta och norra Sverige. Eftersom savraderna är synliga i minst tio år även om de inte öppnas igen, valde vi fågeldata från standardrutterna från perioden 2011–2020.

Vi hittade totalt 381 träd med savrader på de 37 inventerade rutterna. Genomsnittligt antal träd med savrader (savträd) var 0,4 per km i södra Sverige, 6,2 per km i mellersta Sverige och 18,5 per km i norra Sverige. 366 savträd var björkar och 15 barrträd, alla savrader på barrträd hittades i norra Sverige.

Fyra av de sex hackspettarterna (större hackspett, spillkråka, mindre hackspett och gröngöling) visade ett motsatt geografiskt mönster jämfört med hittade savträd (tabell 1). Dessa fyra arter hade de högsta observerade tätheterna i södra Sverige, lägre tätheter i mellersta Sverige (mest framträdande för mindre hackspett och gröngöling) och de lägsta registrerade tätheterna i norra Sverige (figur 3).

Gråspett förekommer i princip inte i södra Sverige, och har inte observerats på någon standardrutt i denna region, men finns i låga antal i mellersta och norra Sverige. Den observerade förekomsten av gråspett överensstämmer inte på något tydligt sätt med hittade savträd, förutom att den allmänt sett förekommer i de delar av Sverige där savträd är vanligare (figur 3).

Observerade tätheter hos tretåig hackspett överensstämde dock väl med registrerade tätheter av savträd längs standardrutterna. Arten observerades inte alls i södra Sverige, men den fanns i relativt låga tätheter i mellersta Sverige, och i norra Sverige var tätheterna för tretåig hackspett mer än fyra gånger högre än i mellersta Sverige (figur 3).

Om vi antar att alla hackspettar har samma benägenhet att göra savrader oavsett var i Sverige de förekommer, är resultaten tydliga. Fördelningen av savträd i de olika delarna av Sverige överensstämmer väl med fördelningen av observerade tretåiga hackspettar på standardrutterna, medan andra hackspettarter visar mycket svagt eller i de flesta fall inget samband alls med savträdens utbredning (figur 3, tabell 1).

Det är välkänt, och beskrivs upprepade gånger i litteraturen, att tretåiga hackspettar gör savrader på barrträd (Ruge 1968, Glutz von Blotzheim & Bauer 1980, Hess 1983, Cramp 1985, Pakkala *et al.* 2018). Våra resultat från Sverige tyder dock på att björk är den överlägset mest nyttjade savträdsarten (Ferry *et al.* 2021, denna studie), vilket är något förbryllande. Vi har bara hittat en publikation som visar intensiv användning av björk för att dricka sav av tretåig hackspett, i detta fall den nordamerikanska arten *Picoides dorsalis* (Bailey 2008), som tidigare ansågs vara samma art som den eurasiska *P. tridactylus*. Vi har också hittat en äldre källa som kortfattat nämner att både tretåig hackspett och större hackspett ibland gör savrader på björkar (Braestrup *et al.* 1960). Det finns också observationer från fjällbjörkskogen i Västerbottens län (Ammarnäs) av tretåig hackspett som gör savrader på björkar (figur 4), men förutom dessa publikationer och observationer har vi bara stött på anekdotisk information om att tretåiga hackspettar gör savrader på björkar i Sverige.

Intressant nog överensstämmer de avstånd vi hittade mellan savhål i denna studie (5–15 mm) med de Bailey (2008) fann i Nordamerika (11 mm). Pakkala *et al.* (2018) observerade skillnader i djup, storlek, avstånd och regelbundenhet mellan savhålen som gjordes av större hackspett på lövträd och savhål gjorda av tretåig hackspett på barrträd. Savhål gjorda av större hackspett hade exempelvis ett längre avstånd mellan sig (3–4,5 cm). Vi observerade dock inte sådana skillnader mellan olika savrader och inte heller mellan olika delar av landet. Skillnaderna i avstånd mellan savhålen vi hittat beror främst på savhålens ålder, eftersom avståndet mellan hålen ökar i takt med att trädet växer (figur 2).

En sak som gör oss något tveksamma till att tretåig hackspett är ansvarig för majoriteten av savraderna är att vi hittade en ganska stor andel av savträden i områden där tretåig hackspett sällan observeras, till exempel i talldominerade medelålders produktionsskogar.

Turček (1954) hävdade att större hackspett är den art som oftast gör savrader i Centraleuropa. Ändå hittade vi den lägsta förekomsten av savträd i södra delen av Sverige där större hackspett är vanligast. De är faktiskt dubbelt så vanliga som alla andra hackspettar tillsammans i södra Sverige (Ottosson 2012). Kan det vara så att den större hackspettens beteende skiljer sig åt mellan olika delar av landet? Är det mer troligt att den gör savrader (på björkar) i norr än i söder? Vi vet inte, men vi tror inte det. Om så är fallet bör det finnas ”nordliga” och ”sydliga” större hackspettar med olika beteenden och detta verkar relativt osannolikt. Vi vet från ringmärkning att svenska större hackspettar vanligtvis är stationära, men att åtminstone unga fåglar ganska ofta flyttar över stora områden på grund av varierande födotillgång (oftast granfrö). Därför kan ett stort utbyte av fåglar mellan olika delar av landet förväntas, vilket borde förhindra utvecklingen av specifika nordliga eller sydliga fåglar eller beteenden. Större hackspettar ringmärkta i Sverige har också hittats i Ryssland, Italien, Norge och Finland (Fransson *et al.* 2008), vilket visar att långväga rörelser förekommer även i större skala än den nationella.

Å andra sidan kan det vara möjligt att behovet av att använda den energirika björksaven är högre längre norrut på grund av det allmänt kallare klimatet och den lägre födotillgången. Om det är så skulle samma större hackspett kunna uppföra sig på olika sätt i olika delar av Sverige även om det inte finns några specifika ”nordliga” eller ”sydliga” fåglar.

Kan utbredningen av trädslag i Sverige på något sätt förklara de hittade mönstren? Det finns huvudsakligen två björkarter som förekommer i Sverige, glasbjörk *Betula pubescens* och vårtbjörk *Betula pendula*. Vi skilde inte mellan dessa i denna eller i vår tidigare studie (Ferry *et al.* 2021). Glasbjörk är vanligare i norra Sverige men den står för ungefär hälften av alla björkar även i södra och mellersta Sverige (Eriksson *et al.* 1996), så vi tror inte att skillnader i utbredning och förekomst av de två björkarterna kan förklara den regionala skillnaden i antalet hittade savträd, och vi vet dessutom att vårtbjörk också används som savträd i Centraleuropa, Östeuropa och Finland (Turček 1954, Pakkala 2018).

Således, även om vi finner det osannolikt att beteendet skulle skilja sig betydligt mellan olika delar av landet inom en enda art, kan vi inte utesluta det helt. Det är framgår klart i litteraturen att större hackspett gör savrader, och det kan mycket väl vara större hackspett som gjort de få savrader på björkar som vi hittade i södra Sverige. Samtidigt kan vi inte utesluta att det kan ha varit tretåig hackspett på tillfälligt besök som gjort savraderna där också.

Observationer av tretåig hackspett längst i söder är mycket sällsynta. I det webbaserade rapporteringssystemet Artportalen har det registrerats fem observationer av tretåig hackspett under det senaste decenniet i de sydligaste länen i Sverige (Skåne, Halland, Blekinge och Kronoberg). Så det är inte omöjligt att tretåig hackspett är ansvarig också för de få savträd som vi hittade i landets sydligaste del.

Vi är medvetna om att vi i denna studie i huvudsak bygger vårt resonemang på indicier, där antalet savträd och antalet observerade hackspettar kan höra ihop. För att säkert veta vilken eller vilka arter som gör savrader på björkar och andra träd behövs detaljerade studier av själva fåglarnas beteende. Vi hoppas kunna öka nyfikenheten och intresset för att utreda denna fråga ytterligare. Det skulle vara särskilt intressant om någon gjorde en liknande studie i Finland för att se om fördelningen av hackspettar och savträd där stämmer överens med våra resultat.

Just nu indikerar våra data att det är tretåig hackspett som är ansvarig för de allra flesta savrader på björkar i åtminstone mellersta och norra Sverige.

Men det faktum att så många savträd hittades i områden där tretåig hackspett sällan observeras, och att större hackspett uppenbarligen gör savrader i andra delar av Europa innebär att vi inte är övertygade om att det här är hela historien. Trots detta kan inventeringar av savrader vara en enkel och snabb metod för att bedöma möjlig förekomst och täthet av tretåig hackspett i Sverige, vilket skulle vara värdefullt både för naturvård och skogsbruk.

Appendix 1. Surveyed routes (index boxes; Lantmäteriet)

Southern Sweden *Södra Sverige*	Central Sweden *Mellersta Sverige*	Northern Sweden *Norra Sverige*
03C2H	10E7H	22G7H
03C7H	10F7C	22H7C
03D2C	10F7H	22H7H
03D2H	11E2H	22I7C
03D7C	11E7H	23G2H
03D7H	11F2C	23G7H
03E7C	11F2H	23H2C
04D2C	11F7C	23H2H
04D2H	11F7H	23H7C
04E2C	11G7C	23H7H
		23I2C
		23I7C
		24G2C
		24H2C
		24G2H
		24H2H
		24I2C

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