Black Stork Back: Species distribution model predictions of potential habitats for Black Stork

Ciconia nigra in Sweden

Svarta storkens återkomst: Artutbredningsmodeller identifierar potentiella habitat för svart stork Ciconia nigra i Sverige

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INCREASED UNDERSTANDING of the need to save endangered and locally extinct species has led to restoration or preservation of populations through reintroductions. Reintroduction of a species is worthwhile if the prerequisites for existence at the historical location have improved. Thus, background information about the habitat requirements of a target species is important for introduction programmes to be successful. The Black Stork (Ciconia nigra) was lost as a breeding species in Sweden during the 20th century, but recent observations and reports of potential breeding indicate that habitat conditions for Black Stork in Sweden may have improved. In this study, we used species characteristics and references to identify habitats in Sweden suitable for potential reintroduction of Black Stork. We identified several suitable areas in the former distribution range of this species in southern Sweden. Seven Swedish counties contained more than 18% suitable habitat within their total area, with highest proportions in Jönköping County (25.8%), Blekinge County (23.9%), Västra Götaland County (22.1%) and Kronoberg County (20.7%). We suggest these areas to be made the primary targets for Black Stork reintroduction in Sweden.

Keywords: conservation | habitat suitability analysis | reintroduction | restoration | SDM

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Introduction

The Black Stork *Ciconia nigra* is a typical forest bird, inhabiting old, sparse forests with limited disturbance frequency (Svensson et al. 1999, Banás et al. 2019) and a high density of watercourses and stagnant water (Augutis & Sinkevičius 2005). Unlike the White Stork *C. ciconia*, which forages in open habitats, the Black Stork forages mostly in closed, isolated forests (Jiguet & Villarubias 2004). The distance between the Black Stork nesting site and the foraging area can vary from six to 40 kilometres (Tucker & Heath 1994, Chevallier et al. 2010a, Strazds 2011). Choice of the nesting tree depends on individual ability to build a nest, flyway accessibility to the tree and safety from avian and terrestrial predators, in particular White-tailed Eagle *Haliaeetus albicilla* and pine marten *Martes martes* (Strazds 2011). A Black Stork pair tends to return to the same nest tree if the breeding site is beneficial and the nest can ultimately weigh as much as 1,000 kilograms (Strazds 2003). Tree age is of less importance in the choice of nesting site (Lõhmus 2006), but a suitable nest tree must be relatively large in order to support the weight (Lõhmus & Sellis 2003, Treinys et al. 2008). The Black Stork prefers to nest in forests with a high proportion of broadleaved trees (~10–20%), or with a high proportion of aspen *Populus tremula* (~10–20%) if the proportion of other broadleaved trees is low (Treinys et al. 2009).

The global Black Stork population has dropped since the mid-1800s, especially in central and western parts of Europe, most likely due to intensified forestry and habitat degradation (Tucker & Heath 1994). However, this trend has since been reversed in many western European countries and the population is currently considered to be stable in a large proportion of the distribution range (Jiguet et al. 2011). Recent recolonisations have been documented in Denmark and Belgium (Pihl et al. 2003, Tamás 2011). Regionally, however, the trend is still negative. A dramatic population decline persists in Estonia, Latvia and Lithuania (Treinys et al. 2008). In Sweden, the oldest remnants of Black Stork are found at an excavation near Ystad in southernmost Sweden, thought to stem from a nesting female 5,000 years before present (Davner 1993). During the mid-19th century, the species was found from southern to central Sweden (Svensson et al. 1999, Lindell 2002). However, the distribution and number of Black Storks then began to decline rapidly and in the 20th century the species was lost as a regular breeding bird in Sweden (Ulfstrand 1973).

Loss of habitats and lack of suitable nesting sites adjacent to wetlands and small streams are likely reasons for Black Stork disappearance in Sweden (Artfakta 2020a). Additional reasons may be the use of pesticides (Luthin 1987, Jiguet & Villarubias 2004) and possible threats during the migration, such as illegal hunting and powerline and wind turbine accidents (Tucker & Heath 1994, Smeraldo et al. 2020). Black Storks have been observed sporadically in Sweden since the last documented nesting in 1953 (Svensson et al. 1999). In the 1990s, ornithologists and scientists suggested that it was only a matter of time before Black Stork established again in Sweden (Davner 1993), but establishment has so far failed to appear, even though Black Storks are observed annually.

A reintroduction programme requires a detailed analysis of the ecology and environmental requirements of the target species, i.e., its social behaviour, size of home range and foraging behaviour (Armstrong & Seddon 2008), but also of habitat availability at intended reintroduction sites. Species distribution models based on biological characteristics of a species and previously described habitat preferences have been used to describe the geographical distribution of species and can be a promising tool to guide the planning of species reintroductions by conservation biologists (Meggs et al. 2004, Powell et al. 2005, Poirazidis et al. 2006, Lord et al. 2020). The expected geographical distribution of a species can be predicted by defining a number of features such as vegetation, soil, or climate, which determine the environmental preferences (Powell et al. 2005). The increasing availability of digitised maps and tools in different geographic information systems (GIS) has helped to improve territory analysis and characterisation of habitats (Thatcher et al. 2006). The creation of habitat models has contributed to the development of conservation biology for species in danger of extinction at several spatial levels (Powell et al. 2005). Wintle et al. (2005) claim that, if a habitat model is applied properly, it could be a good and repeatable technique to use in identification of biodiversity values.

In order to facilitate a future reintroduction program for Black Stork in Sweden, we used species distribution models to identify areas suitable for Black Stork breed-
ing in southern and central Sweden, and integrated the
model results with practical considerations of reintroduc-
tion of Black Stork.

Material and methods

HABITAT ATTRIBUTES
The estimated habitat area for a breeding Black Stork
pair is reported to range from 5,000 to 15,000 hectares
(Tucker & Heath 1994, Jiguet & Villarubias 2004, Artfakta 2020a). However, in a study in Lithuania the
area of 2,500 hectares surrounding each of 81 nests was
described in detail, revealing that on average the hab-
itat comprised at least 13% forest cover, at least 10 km
of watercourses longer than 10 km, and less than 5.5%
disturbance objects (Treinys et al. 2008). Thus, in this
study, we used the detailed criteria identified by Trei-
neys et al. (2008) and a habitat area of 2,500 hectares
around each nest as minimum environmental require-
ments (Table 1). Watercourses in the analysis were
defined as running water including everything from
a small brook to a large river (SVAR 2011). Smaller
water bodies of stagnant water, such as flooded ditches,
were not included in the analysis, due to lack of data.
Furthermore, at least 125 hectares (5%) within 2,500
hectares of suitable habitat for Black Stork had to meet
the requirements for suitable nesting sites (Treinys et
al. 2009).

In order to model suitable nesting sites, all variables
had to be met within an area of one hectare (Table 2).
The standard error has a tendency to decrease with the
number of aggregated cells and thus the accuracy of
estimation may be improved (Næsset 2002). Data on
the maximum proportion of Norway spruce *Picea abies*
and the minimum proportions of broadleaved trees, as-
pen and Scots pine *Pinus sylvestris* were obtained from
Treinys et al. (2009), see Table 2. According to Strazds
(2011), the minimum diameter of a nesting tree is 28.0
centimetres and the average tree diameter in a stand of
nesting Black Storks is 29.3 centimetres. Therefore, we
decided to use 29 centimetres as the lower limit for tree
diameter in the GIS analysis (Table 2). A distance of
280 metres between a potential nesting site for Black
Stork and infrastructure elements is recommended
by Treinys et al. (2009). The value used in this study
was rounded to 300 metres, to give a larger margin
to disturbance objects. The geographical area used
in the analysis was limited to the historically known
distribution range of Black Stork in the southern part
of Sweden, with Dalarna and Gävleborg Counties as
northern borders (Figure 1).

MATERIAL
The input data to the models and their spatial re-
solution are described in Table 3. Stem volume of the different tree species was extracted from
the “*kNN-Sweden*” forest map (Granqvist Pahlén et
al. 2004), which is derived from satellite images
and field data from the Swedish National Forest In-
ventory and “*k Nearest Neighbour*” as described by
Franco-Lopez et al. (2001). The information in the
*kNN-Sweden* map is uncertain if the areas analysed
are too small. The standard error of the total stem
volume of tree species is 10–15% for estimates
of areas of 100 hectares (Granqvist Pahlén et
al. 2004). The basal area weighted mean diameter
(*D<sub>BA</sub>*) of the different tree
species was extracted from the Swedish forest attribute
map (Nilsson et al. 2017). Roads and railways were
selected from the National Road map, which contains
a detailed and comprehen-
sive description of Swedish

| TABLE 1. Variables used for geographic information systems (GIS) analysis of potential Black Stork *Ciconia nigra* habitats with associated foraging areas. — Variabler som användes vid GIS-analysen av möjliga habitat, inklusive områden för födosök, för svart stork *Ciconia nigra*. |
| --- |
| **Life prerequisite** | **Variable** | **Value** | **Area** |
| Safety | Proportion of disturbance objects | ≤ 5.5% | 2,500 hectares |
| Foraging | Length of watercourses | ≥ 10 km | 2,500 hectares |
| Foraging | Forest cover | ≥ 13% | 2,500 hectares |
| Nesting | Proportion of nesting sites | ≥ 5% | 2,500 hectares |
transport infrastructure. Forest data and information on watercourses and disturbance objects were extracted from the Swedish Land Cover Data (SMD; Swedish Environmental Protection Agency 2014), a refined national version based on the EU classification system CORINE Land Cover (INSPIRE Thematic Working Group Land Cover 2013). According to SMD, forests are defined as areas with trees of at least 5 metres in height and with canopy cover of more than 30 % (Ahlcrona 2003). The counties used in the GIS analysis were selected from the county map of Sweden and extracted to a new polygon layer. All input data were converted to the size of this polygon layer of counties.

**METHOD**

Habitat modelling was carried out in Arcgis 10 (Environmental Systems Research Institute, Redlands, California, USA), using a moving window approach with a window size of one hectare. A raster cell was considered a nesting site if, on average, the $D_{BW}$ value was larger than 29 cm, the proportion of Norway spruce was less than 10 %, the combined proportion of European beech $Fagus sylvatica$, other deciduous tree species, or Scots pine $Pinus sylvestris$ was at least 30 % and the Euclidian distance to infrastructure elements was more than 300 metres.

For modelling the full habitat requirements, i.e., both foraging and nesting, a similar moving window approach was used. A raster cell was considered a possible habitat if, within a 2,500-hectare window, less than 5.5 % of the area was disturbance objects, there was more than 10 km of total waterways, more than 13 % of the area was forest cover, and at least 5 % of the area was suitable nesting areas. Finally, the sum and the proportion of suitable habitat cells were calculated for each county.

**Results and discussion**

The overall modelling process involved several steps, such as conversion of data, calculations, and merging of the data layers. Based on the selected variables, suitable habitats were found in every county included in the analysis except Gotland (Table 4). Seven counties contained more than 18 % suitable habitat within their total area, while the remaining counties contained less than 10 % suitable habitat (Table 4). The highest proportion of suitable habitat in relation to total area was found in Jönköping County (25.8 %), followed by Blekinge (23.9 %), Västra Götaland (22.1 %), and Kronoberg

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**Table 2.** Variables used in geographic information systems (GIS) analysis of potential nesting trees for Black Stork *Ciconia nigra*.

| Variable | Value | Area |
|----------|-------|------|
| Nesting | Presence of large potential nest trees, basal area weighted mean diameter ($D_{BW}$) | $\geq 29$ cm | 1 hectare |
| Nesting | Presence of Norway spruce ($Picea abies$) | $\leq 10$ % | 1 hectare |
| Nesting | Presence of European oak ($Quercus robur$), European beech ($Fagus sylvatica$), other deciduous tree species, or Scots pine ($Pinus sylvestris$) | $\geq 30$ % | 1 hectare |
| Safety | Distance to infrastructure elements | $\geq 300$ m | 1 hectare |

**Table 3.** Input data used for Black Stork *Ciconia nigra* habitat modelling.

| Dataset | Raster cell size (m) or scale |
|---------|-----------------------------|
| kNN-Sweden forest map | 25 |
| Swedish forest attribute map | 12.5 |
| National road map | 1:100,000 |
| Swedish land cover data | 25 |
The results of the GIS analysis indicated extensive availability of suitable breeding habitats for reintroduction of Black Stork in Sweden. In particular, suitable areas for reintroduction were identified in the vicinity of the lakes Vänern, Vättern, and Hjälmaren, and towards the southeast in the counties of Blekinge and Kronoberg (see Figure 1). This is a reasonable finding because of the proximity to water and watersheds and the presence of a large number of restored wetlands, ponds, and dams in these areas. They also provide a mixture of arable land and forests, particularly forest with a relatively larger proportion of deciduous trees. The absence of suitable habitat patches on Gotland and in northern Dalarna seems plausible, since large parts of Dalarna are composed of near-alpine forests and have a harsh climate, unsuitable for the Black Stork. The former distribution limit of the species was near the Dalälven river (Lindell 2002). There has been speculation about whether the Baltic Sea acts as a barrier for Black Stork migration (Davner 1993), meaning that Gotland with its relatively remote location from the mainland may not be appropriate as a nesting site. However, observations of Black Stork have been made on Gotland, which indicates that Black Stork is not prevented from migrating over longer distances of open water, as suggested by Davner (1993). Nevertheless, many watercourses on Gotland have been affected by human activities such as dredging, which results in unnaturally rapid outflow during winter and dried-up watercourses during summer (Gullefors & Johanson 2007). The requirement of at least 10 kilometres of contiguous watercourses may be a reason why we did not find suitable habitats on Gotland, where watersheds are scarce. In addition to Gotland, Black Storks have also been observed in Västra Götaland and Östergötland (Artfakta 2020a). However, compared with Gotland, there were plenty of suitable habitats in both Västra Götaland and Östergötland. In our opinion, this range of findings strengthens the applicability of the results and the reliability of the variables and analyses used. Concerns would have arisen if areas everywhere had been identified as suitable habitats.

The current estimated density of breeding Black Stork pairs varies from 1.34 per 100 km² in Eastern Austria (Sackl 1985) to 10.8 per 100 km² in the Dia-dia-Lefkimi-Soufli Forest National Park in north-eastern Greece (Alexandrou et al. 2016). Thus, although it is not certain that there is an absolute need for contiguous habitat of at least 2,500 hectares for breeding Black Storks, as postulated in our models, it seems reasonable based on Sackl 1985 and Alexandrou et al. 2016 (i.e., 0.33–2.7 breeding pairs/2,500 hectares). The size of the habitat likely varies depending on the quality, assuming that the higher the quality, the smaller the area required. We suggest that habitat patches of 2,500 hectares are suitable if they are sufficiently undisturbed and contain enough large trees for nesting, since a number of studies indicate that Black Storks can fly several kilometres to forage and thus remoteness is not necessarily a limiting factor (cf. Strazds 2011).

REINTRODUCTION SUITABILITY

A core issue for a successful reintroduction programme is presence of key prerequisites in the intended reintroduction area, which requires extensive knowledge of the biology of the species in question. The reason behind the recent population declines in Estonia, Latvia and Lithuania (Treinys et al. 2008) is unclear (Zieliński 2006), but it could be due to intensified forestry and habitat degradation (Tucker & Heath 1994), predator...
avoidance (e.g. Treinys et al. 2016) and shortage of potential mates in margin populations (Konovalov et al. 2019). Rosenvald & Lõhmus (2003) point out that forestry activities are not the only factor causing population decline, but are likely to be strongly linked to a decline. Forest logging escalated in the Baltic countries after 1991 (Kurlavicius et al. 2004). This resulted in destruction of nesting habitats and contributed to impaired breeding opportunities (Lõhmus et al. 2005). More than 50% of the European population is currently distributed in Eastern Europe (Chevallier et al. 2010b), with the highest population density in the Balkan countries, northern Ukraine, Germany, north-eastern Poland, and western Russia (Lõhmus et al. 2005). The current population increase seen in Western Europe could be the result of a migrating population of Black Storks from Eastern Europe searching for new nesting sites (Chevallier et al. 2010c). On the other hand, Treinys et al. (2008) argue that an ongoing ecological change is occurring in the western and central European populations, allowing Black Storks to establish in fragmented forest areas in agricultural landscapes.

As suggested by our GIS modelling, there are several areas in southern Sweden that may be suitable for Black Stork reintroduction. There are also indications that the Black Stork is favoured by the presence of the European beaver Castor fiber (Tucker & Heath 1994, Svensson et al. 1999). Through the construction of dams and lodges, the beaver frequently causes accumulation of new water bodies, which the stork can utilise in its scavenging for food (Svensson et al. 1999). In Latvia, a positive correlation between the two species has been found, with a high density of Black Stork in areas where the beaver is most frequent (Strazds 2011). The beaver, once extinct in Sweden, was reintroduced in 1922 and the population now exceeds 100,000 individuals, with an increasing trend (Hartman 1994, Hartman 2011). Beaver observations have been reported for many areas in southern and central Sweden (Figure 2). The potential interdependence of beaver and Black Stork (e.g. Tucker & Heath 1994, Svensson et al. 1999), and the current distribution of beaver in Sweden, suggest that it may be favourable to release Black Storks in areas where the two species can coexist, in particular

| County       | Area of suitable habitat (km²) | Proportion (%) suitable habitat |
|--------------|-------------------------------|-------------------------------|
| Stockholm    | 210.2                         | 3.2                           |
| Uppsala      | 675.8                         | 8.3                           |
| Södermanland | 1,120.4                       | 18.5                          |
| Östergötland | 2,068.1                       | 19.6                          |
| Jönköping    | 2,706.3                       | 25.8                          |
| Kronoberg    | 1,747.9                       | 20.7                          |
| Kalmar       | 2,116.0                       | 18.9                          |
| Gotland      | 0.0                           | 0.0                           |
| Blekinge     | 703.7                         | 23.9                          |
| Skåne        | 1,001.0                       | 9.1                           |
| Halland      | 485.6                         | 8.9                           |
| Västra Götaland | 5,283.7                   | 22.1                          |
| Värmland     | 1,483.9                       | 8.4                           |
| Örebro       | 690.1                         | 8.1                           |
| Västmanland  | 308.2                         | 6.0                           |
| Dalarna      | 500.1                         | 1.8                           |
| Gävleborg    | 603.9                         | 3.3                           |
| **Summay**   | **21,704.9**                  |                               |

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TABLE 4. Area and proportion of suitable habitat for Black Stork Ciconia nigra in each of the 17 counties in southern and central Sweden included in the present analysis. - De län som inkluderades i analysen samt ytan och andelen lämpliga habitat för svart stork Ciconia nigra i vart och ett.
where beaver observations coincide with suitable Black Stork habitats revealed from our study.

Public attitudes can determine whether a conservation effort succeeds or fails (Bremner & Park 2007), particularly if the effort is perceived by the public as controversial, as species reintroductions may be (Jacobson & Duff 1998). However, public acceptance of captive breeding with subsequent reintroductions has increased and, consequently, the number of reintroduction projects has also increased (Seddon et al. 2007). An example is the reintroduction of the White Stork in Sweden (www.storkprojektet.se), for which the public attitude to capture and release of individuals is almost exclusively positive (Emma Ådahl, pers. comm. 2021). A similar positive attitude could be expected to reintroduction of the Black Stork, as the two species disappeared from Sweden at about the same time (Ols-son & Rogers 2009, Svensson et al. 1999).

Reintroduction can be implemented using captivity-bred or wild-caught animals (Meltofte 1987, Sarrazin & Barbault 1996). The potential for successful reintroduction is lower when the animals are bred in captivity compared with when they are caught in the wild and transported to new habitats (Griffith et al. 1989). However, the conditions for successful reintroduction of captive-bred animals improve if the animals are well managed, have sufficient amount of genetic variation a broad genetic material, and are prepared for life in the wild through self-contained behaviour in the enclosures (Kleiman 1989). For successful reintroduction in Sweden, several pairs of Black Storks are needed to reduce the risk of inbreeding and increase the gene pool (Jamieson 2011). In the case of a species which is experiencing a decrease in numbers in several countries, it may be sensible to use specimens from breeding facilities and avoid wild-caught birds. There may also be a risk of wild-caught birds returning to their original location (Oppel & Beaven 2002).

At a White Stork breeding facility, the birds must be ringed and provided with food of good quality, and the enclosures must be cleaned and in good condition. Facility employees must be trained to use techniques to prepare the animals for life in the wild, where they must be able to search for food, avoid predators, and construct nests (Kleiman 1989). The environment in enclosures can be limited and the animals may develop stress and behavioural problems over longer (Young 2003) or shorter periods (Coddington & Cree 1995). Employees in the Swedish White Stork project have not noticed any behavioural change in the birds that has resulted in reduced vitality in the wild (E. Ådahl, pers. comm.). However, the behaviour of the Black Stork is different from that of the White Stork. For instance, when there are numerous adult Black Storks in captivity, they can behave belligerently towards each other.

**FIGURE 2.** Locations of recent European beaver Castor fiber observations in Sweden (Artfakta 2020b). — Observationer av bäver Castor fiber i Sverige (Artfakta 2020b).
(Bráčko & King 2014). Two Black Stork pairs cannot live in the same enclosure at the same time without a risk of harming each other (Staffan Åkeby, pers. comm.). Thus, a system with geographically separated breeding facilities needs to be developed for Black Storks.

The climate has an effect on the survival of species and certain weather conditions or temperatures may pose obstacles for a species (Olsson 2007). The mortality rate in Black Stork chicks increases with bad weather conditions (Treinys et al. 2007), which has been suggested as an underlying cause of Black Stork disappearance in Sweden. However, over time the weather in Sweden has constantly fluctuated from warmer to colder and from drier to wetter, and vice versa, and Black Storks have been breeding in Sweden since at least 3,000 BC (Davner 1993). Moreover, the Black Stork does not seem very sensitive to climate conditions over its wide distribution from Western Europe to East Asia (Hancock et al. 1992). However, the Black Stork is sensitive to habitat requirements, especially for the choice of nesting site. If a reintroduction programme is launched, Swedish forest management must take into account the habitat requirements of Black Stork during logging and leave groups of thick, old trees of mainly European oak, European beech, aspen and Scots pine. It is also important to avoid drainage of forests, to provide wetlands for Black Stork to forage in, and potentially to regulate beaver hunting to facilitate wetland establishment. Old forests with high humidity may also be of significance for other endangered species (Berg et al. 1995) and thus restoration efforts that aim to create suitable habitats for Black Stork may also benefit other forest-dwelling species.

An additional challenge for Black Stork reintroduction is the migratory behaviour, as the European population of this species spends roughly half the year in its wintering grounds in west or east Africa, heading northwards in April for the breeding season and returning to Africa at the end of August (Lindell 2002), bypassing the eastern or western parts of Europe (Bobek et al. 2008). This may be a delicate matter to overcome, but experiences from the Swedish White Stork project and other reintroduction programmes with migratory species show that this challenge is not insurmountable. The Baltic Sea may serve as a migration barrier that has added to the disappearance of Black Stork from Sweden (Davner 1993). However, the Black Stork tends to migrate longer distances over open water than the White Stork (Bauer & Glutz von Blotzheim 1966, see Hancock et al. 1992, p. 71). Thus, a reintroduction programme in Sweden could be reinforced with spontaneous immigration of Black Storks from overseas that intermix with released birds.

Conclusions
We believe that it is worthwhile to launch an effort to restore a breeding Black Stork population in Sweden. Using species distribution modelling, we showed that the necessary habitat requirements are fulfilled in part of southern and central Sweden. A warmer climate, along with the ongoing spread of beavers that spontaneously create wetlands in forested areas, would further facilitate restoration efforts. We also believe that there would be a positive public engagement in Black Stork reintroduction, since this is a charismatic species with a specific mystique that does not impinge on other interests in areal land use. Challenges in reintroduction work include the establishment of breeding infrastructure, finding stock animals, enabling released birds to migrate and, of course, acquiring funding for the work. However, these challenges should not hinder efforts to re-establish the Black Stork in Sweden.

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Svensk sammanfattning

Att återintroducera en tidigare förekommande art kan vara en relevant och lovvärd restaureringsåtgärd givet att orsaken till dess försvinnande har hanterats och justerats. En ökad förståelse för att rådda hotade och lokalt utrotade arter har lett till omfattande restaurering och bevarande av arter genom återintroduktioner. För att en återintroduktion ska lyckas är det dock nödvändigt med bakgrundsinformation om artens specifika habitatkrafter. Svart stork Ciconia nigra betraktas som lokalt utdöd i Sverige. Upprepade, sentida observationer och till och med möjliga häckningar indikerar att förutsättningarna för svart stork som häckande art potentiellt har blivit gynnsamt igen. I denna studie använder vi oss av kunskap om arten och dess preferenser för att skapa modeller för att identifiera lämpliga habitat för återintroduktion av svart stork till Sverige. Dessa modeller påvisar flera områden i svarta storkens tidigare utbredningsområde i södra Sverige som lämpar sig för återintroduktion. Sju regioner innehöll mer än 18 % lämpliga habitat i förhållande till länets hela areal, med Jönköpings län (25.8 %) i topp, följt av Blekinge län (23.9 %), Västra Götalands län (22.1 %) och Kronobergs län (20.7 %). Vi föreslår att dessa regioner bör vara primära målområden för en återintroduktion av svart stork till Sverige.

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