

# MONITORING PROGRAMME FOR BLACK STORK *CICONIA NIGRA*

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## Range

The Black Stork is widely, but patchily, distributed throughout the Palearctic and Asia, from Portugal, Spain and France in the west to the Pacific ocean on the east (BirdLife International 2013). The European population is divided into two flyway populations – western and eastern - that migrate over Gibraltar and Bosphorus, respectively. The total global population is estimated to be between 22,360- and 43,920 individuals, with Europe holding 20,800-29,370 individuals (66-93% of the global breeding population) (Wetlands International 2013).

## Distribution in Croatia

The Black Stork occurs in the Pannonian lowlands and northern continental parts of Croatia that are bordered by the rivers Mura and Drava to the north, Danube on the east, and Kupa, Una and Sava to the south (Radović et al. 2003). It primarily breeds along large rivers (Drava, Danube, Sava) and their extensive floodplains, in old and undisturbed alluvial forests, and in the vicinity of man-made warm water fishponds (Radović et al. 2003). Small numbers breed in the vicinity of Plitvice Lake National Park, and Kupa River in Gorski Kotar (Radović et al. 2003).

The current (2012) Croatian Black Stork breeding population is estimated at 220-340 pairs (Institute of Ornithology, *unpublished*). However, no nationwide survey or monitoring programme for this species has ever been performed. Compared with previous national estimates (350-400 pairs, Radović et al. 2003) the breeding population apparently has a declining trend. Based on the results of the monitoring in Kopački rit wetlands (where out of an estimated 25 pairs, only 11 were proved), as well as the recent increasing trend of clear-cutting, fragmentation and disturbance of the alluvial old forest stands (e.g., Tucakov et al. 2006) it is very likely that the national population estimate is too high.

## Habitat

Black Storks inhabit a wide range of freshwater wetland habitats, from alluvial floodplains, extensive marshlands, shallow lakes and river systems to man-made fishponds (BirdLife International 2013, del Hoyo et al. 1992, Hancock et al. 1992). Sufficient prey availability and undisturbed breeding sites are the most important factors for breeding. They prefer old, undisturbed forests that hold large trees (well over 100 years old) that can support the large nest (Tucakov et al. 2006, Lohmus and Sellis 2003). Nests are built 4-31 m above the ground with 1-3 nests per home range, often reused year after year if not disturbed (Hancock et al. 1992, Tucakov et al. 2006).

In Croatia preferred habitat types are: for feeding: A.1 Permanent standing freshwaters, A.2.3.2 Permanent slow flowing waters, A.2.4 Channels and C.2 Central European wet meadows; for breeding: E.1 Flooded willow and poplar forests; E.2 Flooded ash, alder and common oak forests, E.5.2 Dinaric beech-fir forests (*Abieti fagetum dinaricum*) and E.7.1 *Calamagrosti-Abietion* fir forests.

Food mainly consists of fish and amphibians, but reptiles, insects, small mammals and birds are also taken (del Hoyo et al. 1992, Hancock et al. 1992).

## **Phenology and population biology**

Black storks are true migrants, occurring in Croatia from March to October, and breeding from April to July. They spend the winter from Israel southwards to sub-Saharan Africa. They start breeding in April (early pairs in late March) and the clutch size is 2-5 eggs. If not disturbed, pairs are faithful to the same nest for years (Hancock et al. 1992, Tucakov et al. 2006). Incubation lasts 32-38 days and is shared by both parents (del Hoyo et al. 1992, Hancock et al. 1992). The nestling period is 60-75 days, and fledged young birds are dependent on their parents for about 2 weeks further. They remain in family groups until autumn migration (del Hoyo et al. 1992, Hancock et al. 1992). Birds usually reach sexual maturity in their 3<sup>rd</sup> calendar year. Immature birds perform the full migration cycle.

## **Pressures and threats**

The main threats to the breeding population are related to the forestry activities (B02 Forest and Plantation management & use): logging of mature stands, habitat destruction and fragmentation (establishment of new fast-growing plantations & forest roads), as well as and hunting, fishing or collecting activities (F06). Disturbance by transport (D01 Roads, paths and railroads) and caused by works during the incubation period (foresters, hunters, mushroom and antler collectors and other recreational visitors) significantly increases nesting failure. Moreover, large river regulation schemes planned for navigation and hydro-electric dams along the Danube, Sava and Drava rivers will have serious negative impacts such as river bed incision and subsequent drainage of adjacent wetlands, posing significant threats to the existing population in Croatia (J02 Human induced changes in hydraulic conditions) (Schneider-Jacoby 2002, 2005).

## **Conservation measures**

Black Storks are strictly protected in Croatia under the Nature Protection Act (Official Gazette no. 139/08 and 57/11). Penalties for the persecution of the birds or habitat destruction are up to HKR 21,600 (2,880 EUR) per specimen. Legally binding nature protection requirements are included in forest and hunting management plans, but in practice their implementation is weak or completely ignored.

Part of the breeding population is covered by existing protected areas (e.g. Kopački rit and Lonjsko polje nature parks) and 67% of the breeding population is covered by the future NATURA 2000 network and 16 proposed SPAs.

Detailed and precise descriptions of measures needed to avoid pressures and threats are listed in Tucakov et al. 2006. At the site level, strict observance of nest protection zones (100 m of total exclusion, 300 m during the breeding season, and 3,000 m for harmful infrastructure projects), and decreasing the density and use of forest roads, are listed as the main measures in order to increase the breeding success. At the habitat level, protection of old growth alluvial forests from logging, prevention of river regulation projects and improvement/enlargement of floodplain wetlands via river restoration projects, as well as establishment of a network of strictly protected zones, dedicated for Black Stork protection, are the main measures to protect/increase the breeding population size and range.

## **Annexes of the Birds Directive**

- Annex I

## **Croatian Red List**

Vulnerable (VU) – 2010 (Croatian Red List, *in press*).

## **MONITORING PROGRAMME**

### **PRELIMINARY INFORMATION COMMON TO EACH MONITORING PROGRAMME**

The basic approach for Black Stork surveillance comprises: nest searching and mapping to establish breeding population size and range; two nest visits during the breeding season to establish breeding success; counting of individual storks at preferred feeding and migratory stop-over sites. The monitoring should be organised within the Black Stork working group scheme, led by the State Institute for Nature Protection and Institute of Ornithology.

Data should be shared in a timely manner with the State Institute for Nature Protection and Institute of Ornithology, as well as with the IUCN Stork, Ibis and Spoonbill Specialist Group (<http://www.wetlands.org/Aboutus/Specialistgroups/StorkIbisandSpoonbillSpecialistGroup/tabid/197/Default.aspx>). Data should be also supplied in a timely manner to the relevant nature protection management offices (national and nature parks, as well as county offices) and primary stakeholders (forest departments).

Since the Black Stork is a strictly protected species according the Nature Protection Act (Official gazette no. 139/08 and 57/11) a special permit for any research and monitoring purposes should be obtained from the Ministry of Environmental and Nature Protection (Article 67). Relevant nature protection management offices as well as relevant land owners and land users should be notified prior the field work.

### **DETAILED DESCRIPTION OF SYSTEMATIC DATA COLLECTION**

#### **Nest mapping**

##### Objectives

The main objective of nest mapping is to establish the number of breeding territories in order to establish breeding population size and range.

Each stork territory can hold 1-3 nests, and nest mapping is the basic requirement for the Black Stork monitoring programme. As an output of this activity, the exact position of the stork nests would be available that would allow subsequent visits to establish annual breeding success.

##### Field work instructions

*Field workers requirements:* Nest mapping is a time-consuming activity. The minimum requirement for the field workers is that they can identify Black Stork nests. This is usually not very difficult because

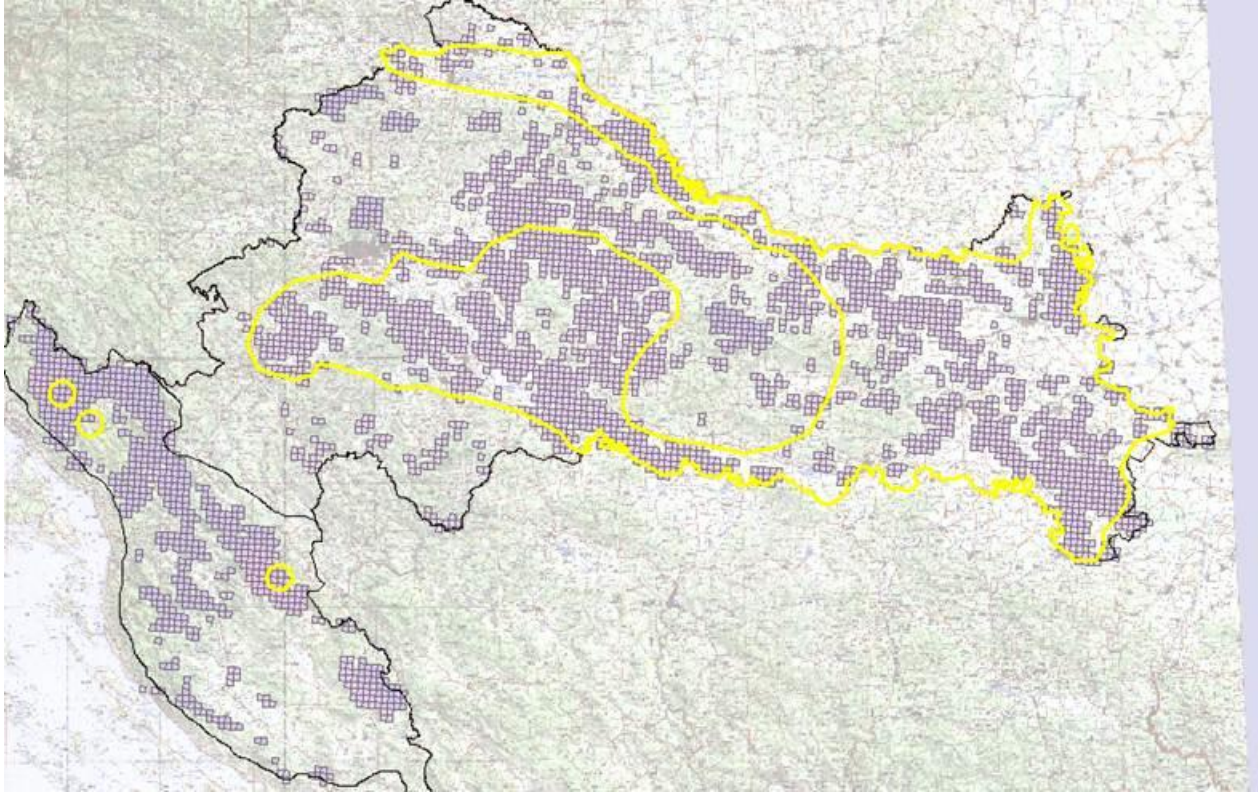
the nests are massive structures, positioned on large trees 4-31 m above the ground (Tucakov et al. 2006), which in most cases can not be easily confused with nests of other species.

*Fieldworker availability:* Due to the fact that during the period of nest mapping storks are not present on the breeding ground (they are wintering in Africa) and relative simplicity of the task, a large number of fieldworkers can be used. They can be recruited from forestry workers (particularly forest wardens responsible for a particular forest unit), birdwatchers, nature lovers, students etc.

*Equipment:* Apart from appropriate shoes/boots and clothes, fieldworkers should be supplied with binoculars (cheap types of 8x45 are adequate), GPS units, digital camera, measuring tape, nest tags and field forms.

*Fieldwork timing:* Nest mapping should take place during the winter period – from November to mid-January (or late February if no White-tailed Eagles are present in the area) – when leaves on the trees are absent and do not obstruct the visibility. Note: as a rule, hardwood trees retain their leaves longer than softwood trees. Thus, fieldwork should be undertaken earlier in softwood forests and later in hardwood forests. Fieldwork should be carried out during favourable weather conditions, preferably sunny days without rain and wind when visibility is optimal. Days with fog or rain should be avoided. Fieldwork should last from the morning until evening to maximise the working day effort.

*Methodology:* Potential stork breeding habitats (old growth forests below 800 m altitude) should be carefully searched for nests: they are usually built from 100-400 m from the forest edge. The best approach is to use a group of field workers that simultaneously search forest plots, positioned in a line 150 m apart from each other. Appropriate forest plots should be searched one by one in a systematic way. Since Black Storks need large old trees (average circumference at breast height of 258 cm) that can support the nest (Tucakov et al. 2006), in general forest plots younger than 50 years old can be considered unsuitable for breeding and effort can be concentrated on old forest stands. Forest stands (alluvial lowland *Quercus*, *Fraxinus*, *Alnus*, *Populus* and *Salix*, as well as montane mixed fir, birch and beech) more than 50 years old cover about 2,530 km<sup>2</sup> of Croatia (SINP, unpublished) (Map 1).



**Map 1: Breeding distribution of Black Storks (yellow line) overlaid on distribution of forests more than 50 years old**

When a nest is found its exact position should be recorded using the GPS. For recording data, a modified version of the official SINP Fauna form FO can be used. Supplemental information on the tree species, tree circumference at breast height (120 cm from the ground), position of the nest on the tree and photograph should be taken. The tree with nest should be marked with a small aluminium tag, nailed to the tree at breast height, bearing a unique number. The tags can aid nest location during the breeding season when the vegetation hampers the view, as well as reduce possible confusion when several nests are present in the same breeding territory. Furthermore, tags are very valuable in situations when the nest has disappeared from the tree due to natural causes (storms, winds, lack of maintenance etc.).

It is estimated that less than 10% of nests are actually mapped and geo-coded (most of them are situated in the Kopacki rit Nature Park) so a nationwide nest-mapping survey should be conducted before the start of regular monitoring activities. Initially, this survey can be based on questionnaires sent to forest departments and protected areas management offices within the breeding range and follow-up field visits. Later on, nest-mapping should continue in a systematic way to fill any gaps. If a nest cannot be located but adult storks are present during the whole breeding season, the area should be recorded as a "breeding territory".

The window of opportunity for nest-mapping is 90 days per year, and our experience is that one fieldworker can cover 1 km<sup>2</sup> of forest per day. Thus, the estimated 2,530 km<sup>2</sup> of old growth forests that need to be searched for nests would require some 2,530 field days. Consequently, given 90 days period for searches, about 26 fieldworkers would be needed for the baseline nest-mapping task. In

reality, the number of potential collaborators (recruited from forestry workers, birdwatchers, nature lovers, students etc.) is much higher and would lower the fieldwork burden for each person.

Nest-mapping should be prioritized so that alluvial forest areas in the Pannonian and Continental region are surveyed first, and later areas in higher altitudes and mountain forests (both deciduous and coniferous). Over the course of several years the nest-mapping effort should decrease due to better knowledge of previously discovered territories. Data would be missing only from the areas that are still covered by mine fields, and from territories where storks changed their nesting location. Once the stork nests are located and geo-coded the true monitoring work can commence.

#### Data forms

Data form example is included as Annex 1.

### **Nest surveillance**

#### Objectives

The purpose of nest surveillance is to establish the number of breeding pairs and their annual breeding parameters (including breeding success, brood size and number of fledged chicks).

#### Field work instructions

*Fieldworkers requirements:* Contrary to nest-mapping, where a large number of volunteers can be used, nest surveillance during the breeding season should be carried out with a few, very well trained expert observers. Due to the high sensitivity of storks to disturbance that can lead to egg cooling, egg or chick predation, nest abandonment (even during the chick rearing period) and nesting failure, expert observers should be trained to perform nest surveillance without disturbing breeding pairs.

*Fieldworkers availability:* It is estimated that given the current population estimate of 220-340 breeding pairs in Croatia, 5-10 expert observers should be enough to carry out the whole national monitoring programme. Thus, each expert observer should be responsible for monitoring up to 70 breeding pairs. Our experience is that, due to the relatively high densities of breeding pairs in preferred habitats, such as Kopacki rit or Lonjsko polje Nature Parks, it is possible to survey at least 15 nests per day. Thus, one observer can perform the complete nationwide Black Stork survey (first or second visit) during 30 working days, including travel between locations. More expert observers (5-10) can split the breeding area and decrease the field work burden per observer.

*Equipment:* Apart from appropriate shoes/boots and clothes, expert observers should be supplied with binoculars and telescopes, GPS units, digital camera, as well as field forms.

*Fieldwork timing:* To establish the breeding parameters, two nest site visits are required:

- 1) First visit to the nest should be performed during the late incubation period, for Croatia in the period from 20<sup>th</sup> April to 20<sup>th</sup> May. During this visit it is crucial to establish if the nest is occupied by the breeding pair and incubation is in progress.
- 2) Second visit to the nest should be carried out during the second half of the chick rearing period. If no ringing activities are planned, this visit should be performed from 15<sup>th</sup> June to 10<sup>th</sup> July. If ringing activities are planned, the optimal window for this is from last week in May to 20<sup>th</sup> June. During the second visit expert observers should establish the following: whether eggs hatched, number of chicks per breeding pair, and number of pairs with nesting failures.

*Methodology:* The main purpose of the first visit is to establish if the nest is occupied and incubation is in progress. However, this is the most delicate phase during the breeding season because approaching the nest, if not done in a proper way, would trigger adults to move away and unattended eggs could be prone to predation by other birds (particularly ravens and crows) or cooling. Due to these reasons, it is vital that observers are expert at performing nest surveillance without disturbing breeding pairs.

The first visit should be made on sunny, warm days, without wind. On days with low temperatures, rain, thick cloud or wind, monitoring should not take place because of higher risk of egg cooling. Usually, nests are very well hidden and foliage makes nest observation difficult, so it is necessary to get close to the nest. In such cases, the nest should be approached in a way that the incubating adult will not leave the nest, and the nest should be observed by telescope from the largest distance possible (at least 100 m) that allows a clear view of the nest. Incubating adults are usually visible in the nest, with their head and neck sticking out above the rim. Very often the other parent is nearby (on the same or neighbouring tree) increasing the chance that the observers presence would be discovered. At this phase of nest monitoring, as soon as it is established that an incubating stork is in the nest, the observer should equally carefully leave the area. All visible signs of disturbance and human activities near the nest (forestry works, game animal feeding activities, vehicle or human tracks) should be noted. If an observer flushes the stork from the nest, they should leave the area immediately in order to allow the stork to return to the nest.

The main purpose of the second visit is to establish if breeding proceeded to the chick rearing stage (or has already failed) and the number of chicks per breeding pair. In this period, both parents are usually searching for food and they are less prone to short-term disturbance and abandoning the nest with chicks. The chicks should be large enough (at least half of the size of the adults) that they are visible above the nest rim. The second visit should also be done during sunny and warm days, without wind, while cold rainy days should be avoided. Again, the nest should be approached with care. In some cases one parent can still be on the nest guarding or feeding the chicks. The number of fledglings in the nest should be established by viewing through the telescope. The observer should spend at least 15 minutes watching the nest to establish the correct number of chicks in the nest – often a few chicks are clearly visible, but the smallest one is lying down and time is needed until it shows up. When the exact number of chicks in the nests is established, it is possible to make a quick (10-minute long) survey of the area below the nest and collect food or feather remains. Collected material should be packed in separate bags and labelled (including date, nest number, location and name of the collector).

### Selection of localities

Since the Croatian Black Stork breeding population is small, with at most 340 pairs, annual monitoring of all breeding pairs (100%) is recommended. If this is not feasible for various reasons (e.g. some pairs established their territories in mine fields or the pair has changed their nesting position and the exact position of the new nest is not known yet) all efforts should be made to gather breeding data from at least 80-90% (272-306 pairs) of the breeding population. Regardless of the annual coverage of the breeding population, every known breeding territory should be visited at least once during a 3-year period to check if it is still occupied or has been abandoned for various reasons. Even abandoned territories should be monitored as long as favourable habitat exists because Black Storks tend to re-occupy former breeding sites.

### Data forms

Data form example is included as Annex 2.

## **Scientific research**

### Objectives

The main objective of the scientific research programme is to gather additional data on Black Stork biology, ecology and genetics to increase the overall knowledge of the species. This knowledge should help to improve the effectiveness of conservation efforts in the near future.

### Framework assignment

Several key questions and hypothesis should be investigated and tested. Further studies are needed on aspects of life history and biology, such as home range of adults, dispersal of immature birds, age structure and philopatry, diseases and mortality causes. From the ecological point of view, studies on habitat use and the role of Black Storks in floodplain ecosystems should be explored in detail. Studies on pesticides and pollutants are still needed to improve conservation efforts. Since 2001 Croatia has participated in the international Black Stork colour-ringing scheme that should be continued and improved using telemetry studies.

## **Non-systematic data gathering**

### Objectives

The main objective of non-systematic data gathering is to collect data on preferred feeding and stop-over sites during migration. Young storks, after leaving the nest, wander around Danube river basin in search of favourable feeding places (floodplains, fishponds, large rivers, reservoirs) and can gather in large numbers (up to 80-90 birds in a single flock). These occasions provide good opportunities to identify the most important feeding and roosting areas, as well as to collect data on colour-ringed birds and increase knowledge on their habitat use. In addition, non-systematic data gathering should cover cases of storks found injured or dead, including causes of death or injury. Such supplemental data can add to the overall knowledge of the distribution and ecology of the species, but also trigger conservation actions such as preventing collisions with power cables and wind farms.

### Field work instructions

The fieldworkers/observers should have binoculars and telescopes and field forms. Fieldwork can be carried out from March to November when the storks are present in Croatia. For each event, the observer should record the date, place and number of birds seen, basic habitat, and behaviour (feeding, roosting). All effort should be made to distinguish colour-ringed birds (though often it may not be possible due to the large distance between the bird and the observer). After an observation, the observer should immediately notify the regional coordinator about the findings via e-mail or telephone.

### Data forms

For non-systematic data gathering the normal A0 SINP data form should be used.



## Evaluation of the conservation status components

### Population size

The main population unit is one breeding pair = one breeding territory (an area that is occupied and defended by the breeding pair). Note that one pair can have more than one nest in the breeding territory. The interpretation of the data and calculation of breeding success follows the well-established method of Schutz (1999) for the White Stork surveys (Table 1):

**Table 1: Data interpretation codes for the Black Stork monitoring**

Abbreviation	Description	Number ( <i>established by monitoring</i> )
AH	Total number of breeding pairs/territories in the surveyed area (nationwide or site based)	
HO	Number of unoccupied nests = abandoned territories	
HB	Number of nests that were visited by storks but not used for breeding = 2 <sup>nd</sup> or 3 <sup>rd</sup> nest on the same territory	
HPa	Number of breeding pairs (HPa=HPm+HPo+HPx)	
HPm	Number of pairs with fledglings (successful pairs)	
HPo	Number of pairs without fledglings (unsuccessful pairs) = number of pairs with nesting failures	
HPx	Number of pairs with unknown breeding success (nests that were not visited during a second survey or where nesting success was not established with certainty)	
JZG	Number of fledged chicks	
JZ <sub>0</sub>	Number of nests with 0 chick (JZ <sub>0</sub> =HPo)	
JZ <sub>1</sub>	Number of nests with 1 chick	
JZ <sub>2</sub>	Number of nests with 2 chicks	
JZ <sub>3</sub>	Number of nests with 3 chicks	
JZ <sub>4</sub>	Number of nests with 4 chicks	
JZ <sub>5</sub>	Number of nests with 5 chicks	
JZ <sub>6</sub>	Number of nests with 6 chicks	
JZa	Average number of chicks per breeding pairs (JZG/HPa)	
JZm	Average number of chicks per successful pair (JZG/HPm)	

### Breeding distribution map and range size

For the preparation of distribution maps and range size, a Black Stork database, similar to the one developed for White-tailed Eagles under the Danubeparks project (<http://www.danubeparks.org/>), should be created. While the data entry uses exact GPS coordinates, output and maps are provided in

the 10 x 10 km UTM grid cell format, thus keeping the information on the exact nest position confidential.

### **Main pressures and threats**

This monitoring programme only covers data collection in breeding territories, and associated threat information is confined to these localities. Other possible causes of population changes or low breeding success are not monitored. However, data on breeding success can indicate foraging and breeding habitat quality in the surrounding areas. Pressures and threats that affect breeding and foraging habitat availability and quality should be determined by additional research, remote sensing (e.g., extent of old growth alluvial forests) or under other monitoring programmes designed for habitats (e.g. alluvial forests).

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