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MAIN CAUSE FOR ADMITTANCE OF WHITE STORKS IN WILDLIFE REHABILITATION AND BREEDING CENTRE IN BULGARIA

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Abstract

The White Stork (Ciconia ciconia) is one of the only two taxa representatives of the Family Ciconiidae (Storks) that nest in Bulgaria. The species is protected both on the territory of the country and the EU, and is included in the subject and conservation objectives of many SPAs in the country, part of the European ecological network NATURA 2000. In this paper we present the number, etiology, condition and treatment outcome of over 2,900 specimens of the species accepted for treatment in the period 1999 - 2021. These are patients of the Green Balkans Wildlife Rescue Center in Stara Zagora, which is leading unit for ex-situ conservation of wildlife protected and rare bird species not only in the country but also on the Balkan Peninsula. The outcome of the treatment of all white storks is presented in 4 main categories – returned to nature, housed for aviary breeding, redirected to other ex-situ structurers, as well as lethal outcome. We evaluated the influence of different etiological factors, age and season on the treatment outcome.

Key words*: ex-situ conservation, protected and rare birds, wildlife*

INTRODUCTION

In the early 2000s, the European White Stork (*Ciconia ciconia* Linnaeus, 1758) breeding population was estimated at between 180,000–220,000 breeding pairs (BirdLife International, 2004). White storks from western Europe migrate through Iberia and via the Strait of Gibraltar to get to their winter fields either in flood plains of large rivers south of the Sahara desert in Western Africa or on the Iberian peninsula (Tortosa et al., 1995). Its international protected status is Least Concern (BirdLife International, 2012). In Bulgaria the breeding population counted 4818 pairs in 2004, which was raised by 14.7% compared to 1994, but it is still listed as a “vulnerable” bird in the Bulgarian Red Data Book (Golemanski, 2011). Through Bulgaria passes one of the busiest migrating routes of the White Stork, which is its way to Africa and back to Europe. Nearly 80 percent of the white stork world population passes through the country (Gerdzikov et al., 2014). White Storks usually build their vast observable nests near to human settlements (Daniluk et al., 2006). White Stork more often choose various agricultural areas, villages, settlements, and even suburbs of larger towns or abandoned and active farms in which they build their nests. Single trees and tree groups, power lines, and water towers in agricultural landscapes were examined in detail as common White Stork nest sites (Vaitkuviene & Dagys, 2015). In our country, a huge part of their nests are located on risky facilities such as electric poles, old roofs, chimneys, various buildings and even churches (Golemanski, 2011; Cheshmedzhiev et al., 2016). So far, the white stork is one of the best known and closest to people birds in Europe and is an object of interest to children (Schüz, 1959).

White Stork is considered as a typical species of the present agricultural landscape and it is a good indicator of sustainable and eco-friendly agriculture (Kosicki & Indykiewicz, 2011). The diet of the White Storks as an opportunistic carnivore is well studied and it includes variety of small vertebrates (such as mammals and amphibians) and larger invertebrates (insects and earthworms) in predominantly open areas and wetlands (Pinowska & Pinowski, 1985). In Bulgaria, it observes the same ecological niches, expressed mainly in visiting pastures and wetlands and uses insects for its main food - mainly grasshoppers and beetles. Typical aquatic inhabitants are an exception in the diet. The white stork's primary way of foraging is by roaming mesophytic grasslands (abandoned

arable fields and overgrown grasslands with low, moderately humid, vegetation) and locating its prey (Milchev et al., 2013). Therefore, essential for the existence and reproductive success of the White Stork is the presence of grazing animals, a high number of insect populations, mainly large dung beetles, a reduction in the use of chemical agents in agriculture (fertilisers and pesticides) and the presence of small wetlands (Janiszewski et al., 2013). Birds are increasingly settling on overhead power line poles, and the share of tree-nesting pairs is gradually decreasing. It should be noted that in recent years, overhead power poles have increased dramatically, leading to an increase in nesting on power poles. This is most likely a consequence of a gradual change in nesting behaviour of the white stork due to the growing population, on the other hand there is a lack of traditional nesting sites (on trees and on building roofs) that are either already occupied by birds, or are not suitable due to various factors (e.g. poor maintenance) (Vaitkuviene & Dagys, 2015). The inaccessibility of such nests compared to those built on trees and roofs provides them with protection from predatory mammals, therefore increasing the breeding success of white storks (Tryjanowski et al., 2009). On the other hand, these nests are unstable and dangerous, due to their close proximity to wires, they pose serious threats to breeding birds and their young (Kaługa et al., 2011). Other factors, such as a change in the range of the species and the environmental climatic conditions of the wintering grounds, probably contribute to a change in the population size of the white stork (Schaub et al., 2005). Due to the closeness of the White Stork's habitat range to humans, they are among the bird species that often suffer from accidents caused by anthropogenic factors, but are also the most likely to be provided with care and protection in the event of accidents, injuries and disabilities. Today's reports of injured storks make up the largest proportion of all interventions reported to wildlife NGOs. The main objective of the present study is to identify the leading causes of accidents and admissions of white storks to a rehabilitation centre.

MATERIALS AND METHODS

A retrospective analysis was made of the white storks admitted during the period 1999-2020 to the Wildlife Rehabilitation and Breeding Centre (WRBC) Green Balkans - Stara Zagora, using the database for recording original medical records, through authorised personal access.

When analysing the database of the WRBC Green Balkans - Stara Zagora, we divided the patients according to the reasons for admission, forming two main groups - natural causes and anthropogenic causes leading to wildlife incidents. We separated the two main groups of causes into subcategories, according to the established etiological factors of a native character (for natural causes) and the result of human actions (for anthropogenic causes). Categories and subcategories of reasons for admission were classified based on data from history (location information and information about people who reported the animal in distress), initial diagnosis (injuries, specific signs, clinical examinations) and etiology of the harmful factor (Molina-Lopez et al., 2011). The subcategories of anthropogenic causes were grouped as follows - Electrocution and collision with power line, Confiscated, Gunshot, Collision with vehicles and Other anthropogenic factors. We divided subcategories to natural causes as - Fallen from a nest, Extreme weather, Infection disease, Rivalry.

With regard to the environmental protection status of the patients of the WRBC Green Balkans - Stara Zagora, it is necessary to clarify that all species of wild fauna, including protected, rare and vulnerable, fall under the management of the Ministry of Environment and Water (MOEW), which is the competent authority in the Republic of Bulgaria for the protection of wildlife. The MOEW and the regional subdivisions - Regional Inspectorate of Environment and Water (RIEW), which at the local level take care of the wildlife's protection, including receiving and referring for therapy of discovered injured or distressed specimens, directly apply the provisions of the Biological Diversity Act (BDA). In addition, patients are also referred to WRBC Green Balkans - Stara Zagora for treatment by other

organisations and private entities - private persons or companies, non-governmental organisations, zoos, private veterinary clinics and private veterinarians, municipal employees, as well as employees of the Ministry of Agriculture, Food and Forestry (MAFF), national or natural parks, etc.

For the purpose of tracking the trends in the change of the number of patients and the reasons for their admission, we analysed the frequency distribution of patients in the period from 1995 to 2019, as well as their fluctuations during the different months of the year.

Variations in the number of incidents were investigated for different age groups: Egg - when, for various reasons, the eggs were taken from the nest and subsequently placed in an incubator and possibly reared in the WRBC; Juvenile - birds with only down plumage or with initial growing feathers, as well as birds with grown plumage with narrow feathers and a black beak, before making their first flight; Immaturus - change of feathers has begun - narrower (characteristic of a young bird) and wider (characteristic of an adult bird), light-red beak with a dark tip and plumage characteristic of an adult bird (broad feathers) are found; Adultus – fully broad feathers and dark red beak (Svensson et al., 2009).

After accepting a live bird for treatment, four different outcomes can follow: 1) Euthanasia, which is humanely assisted death applied to animals with a poor prognosis and whose continued existence is accompanied by pain and suffering that cannot be alleviated; 2) Lethal outcome in animals for which treatment fails and complications occur leading to death; 3) Release into the wild, of successfully cured individuals with good prospects for adaptation in the wild, and 4) Captivity, for animals that cannot be released and have been kept permanently in captivity due to their poor prognosis for survival in the wild. Such animals are directed to zoos or rescue centres and/or are included in breeding programs. Regarding the birds that were found dead and sent to the WRBC for all of them a diagnosis after examination and cause of death were determined.

The data were processed with IBM SPSS Statistics (SPSS-Inc., 2019, SPSS Reference Guide 26 SPSS, Chicago, USA) using descriptive statistics with frequency distribution tables. The correlation between different variables was investigated with the Pearson correlation coefficient. All categorical data were organised in 2×2 cross-tables.

RESULTS AND DISCUSSIONS

Data was analysed for 2,963 White Storks (*Ciconia ciconia*) that passed through the WRBC. The main reason for admission of the species to the rescue centre is of a native character (48.8%), followed by unknown reasons for 42.8%, with the smallest share of 8.3% for anthropogenic factors (fig. 1).

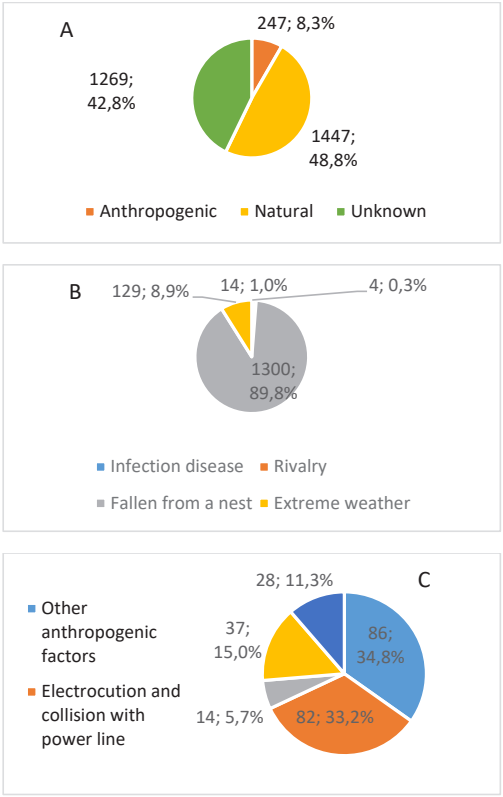

Figure 1. Primary causes for admission:
A) Proportion of anthropogenic and natural causes;
B) Etiological factors of a native character;
C) Etiological factors of anthropogenic character

Due to natural causes, accidents most often occur with young birds when the chances of survival of young birds is lower (Kanyamibwa et al., 1993). This statement coincides with the findings of other studies, which showed that species living in urban and surrounding areas

are most often admitted to rescue centres and most of them are juveniles presumed to be abandoned or orphaned (Wimberger & Downs, 2010). The White Stork *Ciconia ciconia* can vary the period of its migration in response to current weather conditions on breeding grounds, but cannot respond to extreme weather events. Due to the increasing frequency of extreme weather events caused by climate change, an occasional accident or a natural disaster, most often associated with sudden temperature changes (extreme weather) are the second most common cause of a natural cause for incidents of the species (8.9%, n=129) (Tobolka et al., 2015). Infectious diseases in the species are not a common reason for admission, they present only 0.3% of natural causes and here it refers mostly to viral diseases, such as Avian influenza and West Nile fever. A small percentage (1.0%) of birds being injured and needing treatment due to intraspecies strife, mostly during breeding and searching for nesting territories, as well as interspecies aggression, is reported. The high mortality rate among storks also appears to be a result of their behaviour, such as using electric poles as a place to rest and to avoid the possibility of encounters with terrestrial predators. The large number of birds looking for a resting place inaccessible to terrestrial predators can cause interspecies conflicts, due to the limited space on the poles, this in turn predisposes to collision with power lines (Demerdzhiev, 2014). When analysing the cause of bird trauma, the results show that 42.8% of the cases remain of unclear etiology (lack of information about the circumstances of the trauma or accident). This high percentage coincides with the ratio of total number of admitted patients of WRBC with the same etiology from our previous study (Lazarova, 2022), as well as in other centres in Europe (Molina-Lopez et al., 2017). Despite the relatively low percentage of anthropogenic factors, leading to wild bird casualties, we consider them in detail because of the impact of human activity on the species. In this category, the leading share in accidents is caused by electrocution and collision with power lines - 33.2%. Power lines are one of the main sources of human-caused mortality in birds due to electrocution or collision, but many species use power poles as a nesting structure. The white stork increasingly nests on poles located near landfills, surrounded by a large proportion of grassland and when close to sources of freshwater (water body or river) and other occupied pylons, further greatly increasing the electrocution rate of individuals (Burdett et al., 2022). One of the most common reasons for admission of protected species to rehabilitation centres is their illegal ownership by private individuals (Molina-Lopez et al., 2017). Despite legislation on protected species in Europe (Nikolova, 2010), the illegal capture and retention of wild birds is still a serious problem, having a negative impact, especially on songbirds (BirdLife International, 2011) and reptiles (Perez et al., 2004). Unlike other countries, where the capture of stork species is widespread (Singh & Chanratanak, 2012), in Bulgaria, although these birds are not used for entertainment, meals, etc., due to the fact that the species habitat is close to people it makes the etiological factor "confiscated" a frequent (5.7%) anthropogenic cause of capture for patients of WRBC. Illegal hunting continues to be a serious problem in the country, for both migratory and native species. Although, the scale of this type of crime cannot be compared to that in Lebanon, for example, where about two and a half million birds are killed illegally every year (Raine et al., 2021), 15% of the anthropogenic causes of incidents with White Stork (*Ciconia ciconia*) are due to illegal shooting.

Although it is difficult to determine the exact number of birds injured by vehicle collisions, it is estimated that 2 to 9 million birds are killed on the road in Europe annually, with numbers varying between countries (Vidal-Vallés, 2018). In Bulgaria, 11.3% of human-related reasons for admission of injured storks are the result of a collision with vehicles.

Other anthropogenic factors include causes with a very small number of cases, but significant from the point of view of the impact of human activity, such as poisoning, entanglement in a nylon string or fence, falling into machine oil, collision with a wind turbine, or a destroyed nest due to repair work.

A thorough analysis of the accidents with the admitted White Storks (*Ciconia ciconia*) by month shows that the highest percentage of

incidents occur in the months of June, July and August (Figure 2). The elevated death rate in the period from April to May is related to increased mortality of the young during the nestling period and the temperature changes. Research of Jovani & Tella (2004) shows that 91% of deaths occurred on nestlings below 20 days of age, 73% concentrating on nestlings up to 10 days-old, when the thermoregulation of the birds is not well developed and this coincides with the period of spring rainfall. Another reason for these high values appear to be the inexperienced attempts of the young birds to fly from their nests, which makes them more susceptible to accidents (Harness & Wilson, 2001).

The highest percentage of injured individuals was observed in the month of July (34.1%), which is associated with the lack of experience of the young birds during their post-nesting period. During the beginning of the migration and hunting season, the admittance of shot birds increases due to the high percentage of incidents in the month of August, 31.5% of the entire annual intake. In a study conducted in 2004 in southern Bulgaria, a fatal outcome was found in most cases with storks taken in due to collision with power lines; this study found an increase in mortality after collision with power lines, mainly during migration and roosting in large flocks (Demerdzhiev et al., 2009). Storks gather in large flocks in preparation for flight, and their gathering and resting places are often close to power lines, and the crowding of many individuals in limited areas forces the birds to land on power lines and increases the risk of accidents (Demerdzhiev, 2014; Gradev et al., 2012). The explanation of the high values found by us in the victims of electricity in August at the beginning of the migration process is also due to the so-called bottleneck territories along the migration route. It is known that during flight, when birds reach natural barriers (e.g. mountain, sea, etc.), their migration is concentrated on a limited strip of land (e.g. Burgas Bay, Bosphorus, etc.) (Gerdzhikov et al., 2014.). In the same way, the migration pattern in northeastern Bulgaria can be explained, where in the relatively flat topography white storks fly on a wider front and in smaller flocks compared to the barrier in Burgas Bay, southeastern Bulgaria (Gerdzhikov et al., 2014). The presence of a lot of agricultural land and open grassland habitats is also relevant to the high casualty rates, with the lack of tall trees leading to the use of electric poles as perches by the birds, as well as the fact that raptors use these habitats as hunting grounds (Gerdzhikov & Demerdzhiev, 2009).

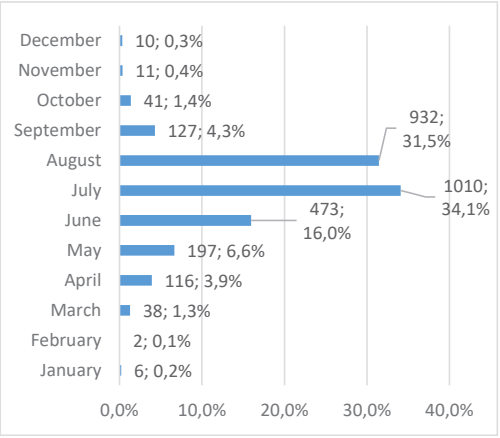

Figure 2. Monthly admissions to the Wildlife Rehabilitation and Breeding Centre "Green Balkans" for White Storks

The analysis of injured storks admitted to WRBC, distributed by age, shows that 64.4% of all accepted birds of the species were juveniles. The main reason for the incidents in this age group (41.0%) (Table 1) is falling from the nest during their first flight attempts. A study in Poland shows that early post-fledgling mortality rate varied from 2 to 11% (mean 4.3%) of all fledglings per year, with 73% dead birds found less than 100 m from their nests (Tobolka, 2014). On the other hand, the increasing use of plastic (polypropylene) string results in a large number of adult white storks carrying pieces of it into the nest. When moving, stork chicks can become entangled in the free ends of such strings, which, as the bird grows, often leads to limb necrosis (Kwieciński et al., 2006). It is the most common cause of injury in the category of "Other anthropogenic factors" in young birds admitted for treatment at WRBC.

In adult birds, where the main anthropogenic factor is again electricity, a prerequisite for accidents is the fact that the large wingspan

creates the potential for contact between two wires and the creation of a voltage arc, as a result of which they become a victim of electricity (Stoychev & Karafeisov, 2003). The birds' use of electric poles as a resting place increases the risk of poaching due to them being easily spotted by hunters. In certain terrains, electric poles are the only possible resting place for the birds, but their location near roads makes them an easy target for shooting. However, such observed cases are few and the number of gunshot patients is 1.3%.

When discovering fallen nests or nests built on old buildings, in adverse weather conditions or for safety reasons, it is necessary to take the eggs. Such eggs are incubated at WRBC and represent 0.6% of all incoming patient cases of the species.

Table 1. Distribution of white storks admitted for treatment at the WRBC by etiology and age

AGE	egg n/% of total	juveniles n/% of total	immaturus n/% of total	adult n/% of total
Infection disease	0/0.0%	2/0.1%	0/0.0%	2/0.3%
Rivalry	0/0.0%	6/0.2%	2/0.1%	6/0.2%
Other anthropogenic factors	8/0.3%	50/1.7%	16/0.5%	12/0.4%
Electrocution and collision with power line	0/0.0%	29/1.0%	17/0.6%	36/1.2%
Confiscated	0/0.0%	6/0.2%	6/0.2%	2/0.1%
Fallen from a nest	0/0.0%	1214/41.0%	73/2.5%	13/0.4%
Unknown	0/0.0%	485/16.4%	318/10.7%	466/15.7%
Gunshot	0/0.0%	8/0.3%	3/0.1%	26/0.9%
Collision with vehicles	0/0.0%	9/0.3%	9/0.3%	10/0.3%
Extreme weather	10/0.3%	100/3.4%	2/0.1%	17/0.6%
Total	18/0.6%	1909/64.4%	446/15.1%	590/19.9%

In our study, the analysis of rehabilitation outcomes showed an overall discharge rate of 43.1% of hospitalised Storks (Table 2). This rate corresponds to data from the total number of rehabilitated patients of other centres in Great Britain (40%) (Grogan & Kelly, 2013) and lower than the total success of fully recovered patients in centres in Spain - 50% (Molina-Lopez et al., 2017). The "Fallen from nest" category represents the most favourable prognosis for survival and recovery back in the wild (24.9%). The survival of juveniles of all species is the same and that this age group is released more than 50% in a rehabilitation centre (Ress & Craig, 2004). Juveniles usually have less injuries and the goal is to feed and grow them without habituation with humans until they are ready for release and independent survival in the wild.

Table 2. Final outcome for White storks admitted to WRBC

Outcome	Captivity	Euthanasia	Lethal	Released
Infection disease	0/0.0%	1/0.0%	2/0.1%	1/0.0%
Rivalry	0/0.0%	1/0.0%	10/0.3%	3/0.1%
Other anthropogenic factors	3/0.1%	18/0.6%	37/1.2%	28/0.9%
Electrocution and collision with power line	3/0.1%	27/0.9%	41/1.4%	11/0.4%
Confiscated	0/0.0%	1/0.0%	1/0.0%	12/0.4%
Fallen from a nest	26/0.9%	156/5.3%	379/12.8%	739/24.9%
Unknown	75/2.5%	294/9.9%	486/16.4%	414/14.0%
Gunshot	2/0.1%	2/0.1%	27/0.9%	6/0.2%
Collision with vehicles	0/0.0%	6/0.2%	18/0.6%	4/0.1%
Extreme weather	2/0.1%	8/0.3%	60/2.0%	59/2.0%
Total	111/3.7 %	514/17.3 %	1061/35.8 %	1277/43.1 %

For 35.8% of the white storks admitted to the WRBC, despite rehabilitation efforts, the injuries were severe and ended fatally. High mortality is observed mostly in storks injured by electrocution and collision with power lines. Because death in these types of injuries is often

instantaneous, a large proportion of these patients were found dead. Those who made it out alive were usually in poor condition with severe disabilities. Birds may survive the initial injury and recover or die later from complications. Due to the lack of any chance of survival, euthanasia was required in 17.3% of the injured individuals. In 3.7% of the incidents with white storks, independent survival in nature was impossible, as a result of which they became part of reintroduction programs in zoos, visitation and reintroduction centres.

CONCLUSIONS

Despite the legal regulations in place, anthropogenic activities continue to be a threat to the white stork with a number of offences and wildlife crimes. Wildlife rehabilitation centres are structures that can support both the survival of populations and the monitoring of changes in them.

Corroborating a number of other studies, the analysis of WRBC admissions data shows that young birds are most vulnerable during the breeding season due to temperature changes during this season, as well as unsuccessful first flight attempts of the young ones.

The power grid poses potential risks to populations of protected bird species. The specific location of Bulgaria in relation to international migration routes makes it an important factor for the survival of migratory species.

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