

Essay

The Past, Present and Future of the Common Crane (*Grus grus*) in Poland

Marcin Polak ^{1,2,*} and Romuald Mikusek ²

¹ Department of Zoology and Nature Protection, Institute of Biological Sciences, Maria Curie-Skłodowska University, Akademicka 19, 20-033 Lublin, Poland

² The Foundation for Nature, Al. Spółdzielczości Pracy 36, 20-147 Lublin, Poland

* Correspondence: marcin.polak@mail.umcs.pl

Simple Summary: Worldwide, there are 15 species of cranes within the family Gruidae. These large, charismatic, and sociable birds are associated, above all, with wetland ecosystems. These are disappearing and/or suffering habitat degradation, so most crane species have a high threat status. Two species of cranes occur in Poland: (i) the exceedingly rare, nonbreeding Demoiselle Crane (*Grus virgo*), with a mere three records, and (ii) the Common Crane (*Grus grus*), a breeding species widely distributed throughout the country. Poland is the nesting area of the third-largest breeding population of Common Cranes in Europe (not counting the Russian population), and the country also lies astride their main migration flyway. There are few species on the Polish checklist of birds that have restored their former numbers so quickly and returned to areas where, for various reasons, local populations went extinct. But since this spectacular increase in abundance in Poland, suitable Common Crane habitats have become saturated, and numbers have stabilized.

Abstract: In Poland, it is highly probable that in past centuries, Common Cranes (*Grus grus*) were widespread all over the country. In the 19th century, a particularly dramatic decline in this population took place when Common Cranes abandoned many regions. At present, this species inhabits the whole of lowland Poland, only avoiding the uplands and mountainous regions in the south of the country. The rate of population growth between 2001 and 2018 was c. 5% per annum. The breeding population increased tenfold in the 30 years from 1990 to 2020. The results of the Polish Bird Monitoring Programme in 2018–2020 show that Common Crane numbers had stabilized. The latest count (2013–2018) of breeding pairs in Poland is 23,000–30,000, while that for the years 2010–2012 was 20,000–22,000, i.e., 15% of the European population or 19% of the breeding population in the EU. The greatest threats to the Polish Common Crane population come from habitat and climate changes, two factors that are inextricably interlinked. Experts are alerting that climate warming, in combination with increased pressure from human activities, can, in the long term, reverse this trend and lead to declines in Common Crane populations in this part of Europe.

Keywords: wetland birds; habitat suitability; global warming; migration; predation



Citation: Polak, M.; Mikusek, R. The Past, Present and Future of the Common Crane (*Grus grus*) in Poland. *Birds* **2024**, *5*, 671–684. <https://doi.org/10.3390/birds5040046>

Academic Editor: Jukka Jokimäki

Received: 23 August 2024

Revised: 9 October 2024

Accepted: 11 October 2024

Published: 17 October 2024



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1. Introduction

Worldwide, there are 15 species of cranes within the family Gruidae [1]. These large, charismatic, and sociable birds are associated, above all, with wetland ecosystems. These are disappearing and/or suffering habitat degradation, so most crane species have a high threat status. The most vulnerable is the Siberian Crane (*Leucogeranus leucogeranus*), which the IUCN has categorized as Critically Endangered (CR). Active crane conservation programs are being implemented in many countries all over the world. Because of their unusual appearance (they are the tallest flying birds in the world), their striking courtship rituals, fascinating biology, and spectacular migrations, they are well known to local communities and are, as it were, the ambassadors par excellence of wetland conservation. Two species

of cranes occur in Poland: (i) the exceedingly rare, nonbreeding Demoiselle Crane (*Grus virgo*), with a mere three records, and (ii) the Common Crane (*Grus grus*), a breeding species widely distributed throughout the country [2].

The Common Crane is one of the most easily identified, well-studied, and most widely distributed of all the 15 species [1,3]. Compared with many other crane species, it is at present not endangered and has the lowest conservation status on the IUCN scale—Least Concern (LC). The Common Crane (henceforth, Crane) is globally more widely distributed than any other crane species, inhabiting extensive areas of Eurasia and North Africa. It nests mainly in the boreal zone and overwinters in Western Europe, Africa, and southern Asia. The wintering grounds of the European population are in the Iberian Peninsula, France, Tunisia, Algeria, Turkey, the Middle East, Iran, Afghanistan, and Pakistan, as well as in Ethiopia and Sudan, and probably in India [1]. The Crane is a polytypic species with two subspecies: *Grus g. grus* (the nominative subspecies), which inhabits Europe (including Poland) eastwards as far as the Urals, and *Grus g. lilfordi*, which occurs in Turkey, the Caucasus, Armenia, western and central Siberia, and eastwards as far as the River Ob [1]. However, some authors have proposed two new subspecies [4]. The Crane has a worldwide population of 500,000–520,000 individuals, of which as many as 430,000–450,000 are in Europe and 70,000 in Asia [5,6]. The Crane's range used to cover large parts of Eurasia [1]. But wetland degradation caused it to shrink dramatically in the 19th and 20th centuries. In recent decades, however, its numbers have recovered in many regions, and it has returned to the areas from which it had earlier withdrawn [2] (Figure 1).



Figure 1. The breeding site of the Crane on midforest peat bogs near Jamniki village in Poleski National Park (eastern Poland) (Photo by Marcin Polak).

There has been a lot of work published on this species in Poland in recent years. However, the articles have often been published in local and Polish-language scientific journals. The main aim of this essay is to summarize and present the present knowledge on the actual situation of the Crane in Poland. The specific objectives of this paper are to (1) provide some general historical information and evaluate changes in the Crane population in Poland; (2) show the current state, trend, and the main threats to the population of this species in

this country; and (3) describe the need for further research and predict the future of the Crane in this part of Europe.

2. The Status of the Crane in Poland

2.1. Interpretation of Count Results—Methodological Problems

Even though the Crane is a large bird, easily visible from afar, and emits characteristic loud and far-reaching calls, it is not easy to make accurate assessments of its breeding population. Many pairs inhabit almost impenetrable environments. On the one hand, some pairs are exceptionally secretive when incubating and caring for their nestlings, so for this reason alone, they are difficult to discover. On the other, some birds stay in the breeding area for a long time during the breeding season, calling but neither building a nest nor laying eggs [7]. The most serious problem arising when attempting to interpret assessments of the Crane's breeding population seems to be associated with the presence of a nonbreeding population, the numbers of which are very hard to determine. This problem is especially acute in areas with high densities of Cranes. These birds become sexually mature at the age of 4–6 years [1]. Satellite transmitter data indicate that, in the first years of their lives, immature Cranes return to the areas where they hatched [8]. During this period, they may be mobile and visit many potentially suitable breeding habitats, including their birthplace. But while they usually remain within a narrowly restricted area, they may sometimes make loop-like flights of up to 500 km in 24 h, especially at the beginning of the breeding season. Moreover, some sexually immature birds and adults (as many as 25% of all pairs) occupy suitable breeding habitats for a few weeks in a given season but do not actually start to breed [7]. When making superficial counts, less experienced observers may treat both groups of Cranes as belonging to the breeding population. Past abundance figures may have underestimated the numbers of Cranes, whereas more recent counts, now that densities of Cranes are much higher, could have been overestimated.

2.2. Historical Distributions and Breeding Population Trends among Cranes in Poland

It is highly probable that in past centuries, Cranes were widespread all over the country; evidence for this comes from their fossils from the 14th to 18th centuries [2]. Cranes used to be hunted for their flesh and feathers, and tamed Cranes may have been used to guard houses [9]. In the 19th century, a particularly dramatic decline in this population took place when Cranes abandoned many regions, central Poland among them. What remained were relatively and locally large populations in regions with the largest area of optimal habitats in the north and northwest of the country, above all in Pomerania and Masuria. Nevertheless, this overall negative trend strengthened in the early 20th century, and it is highly probable that the number of Cranes in Poland reached an all-time low in the 1920s and 1930s. Thereafter, however, the Crane population began to recover, and in 1947, the species gained legal protection [10]. At the turn of the 1970s, the national population was tentatively estimated at 800–900 pairs [2]. At the beginning of the 1990s, the abundance of Cranes may have been 2300–2600 pairs, rising to 10,000–12,000 by the year 2000 [11]. The recovery of the Polish Crane population was due to its more effective protection (as long ago as 1921, it was prohibited in Silesia to kill Cranes during the breeding period [9]), a decline in their fear of humans—once at a high level—and the colonization of new, hitherto unoccupied habitats in open farmland areas. Cranes expanded into new terrain from northern Poland and probably from neighboring countries, too. At that time, Crane populations in many European countries were rising, which may well have had a positive effect on the tempo of recolonization in many parts of Poland, which these birds had earlier abandoned. In optimal habitats, numbers rose rapidly. Here are some examples from different parts of Poland: the Biebrza Marshes—26 pairs in 1970, 170–200 in 1980–1990, and 269–274 in 1997; the Barycz Valley—15 pairs in 1950–1980, 25 in 1995, 60 in 2004–2007, and 77–79 in 2013–2014 [2,12]; and the Bielawskie Błota nature reserve—3–5 pairs in the early 1980s, 10 in the early 1990s, 12–14 in 2006, 25 in 2013, 49 in 2018, and 30 in 2019 [13].

2.3. The Present-Day Status of the Crane in Poland

2.3.1. Distribution

At present, Cranes inhabit the whole of lowland Poland, only avoiding the uplands and mountainous regions in the south of the country (Figure 2) [14]. The highest known breeding locality in the Carpathians lies at an altitude of 600 m asl [15] and in the Iżera Mts (Sudetes range) at 840 m asl [7]. Its most numerous local populations occur in Western Pomerania, the Masurian Lake District, and the Suwałki region (NE Poland).

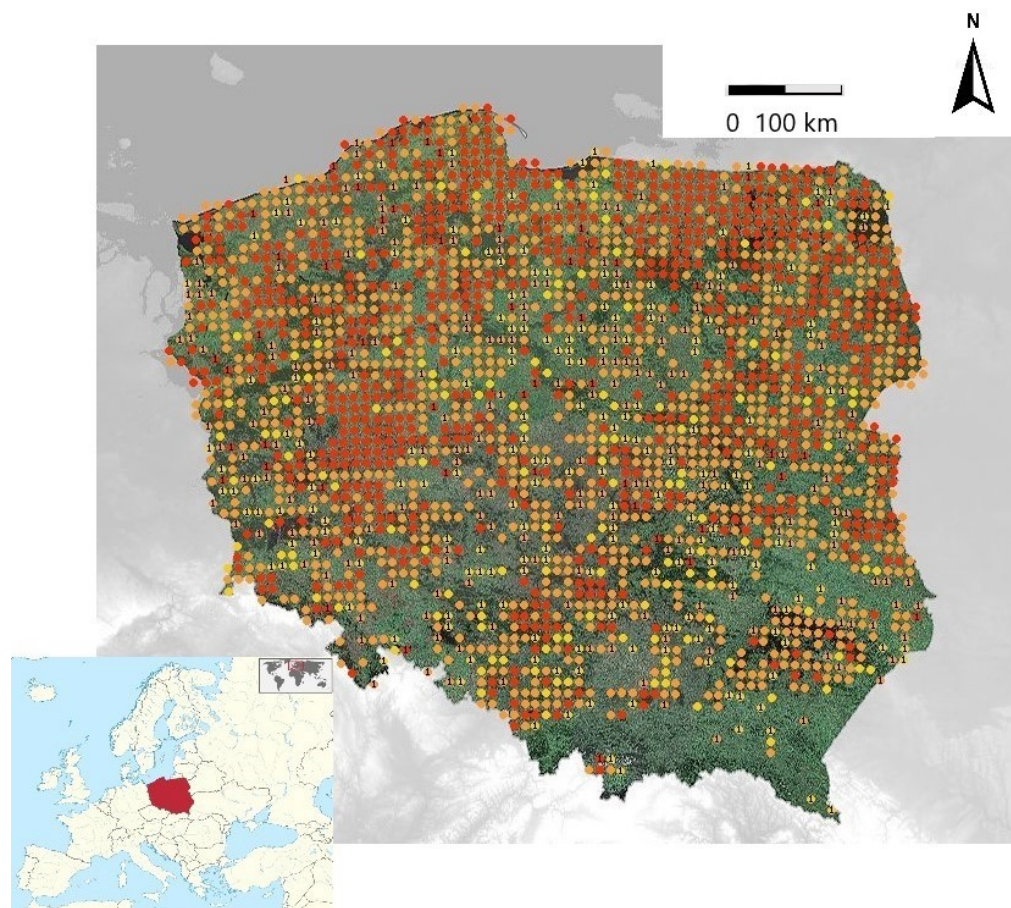


Figure 2. The breeding distribution of the Common Crane (years 2015–2024) in a grid of 10×10 km ($N = 2251$) squares in Poland. Yellow circles—possible breeding (e.g., one individual, a pair observed outside nesting habitat; $N = 323$ squares); orange circles—probable breeding (e.g., a pair observed in suitable nesting habitat; copulation and display; $N = 1137$); red circles—confirmed breeding (e.g., nest with nestlings or eggs found; flightless fledglings; $N = 791$); 1—one record; dark green color—forests, light green color—open areas [14,16].

2.3.2. Breeding Population Size

Poland is the nesting area of the third-largest breeding population of Cranes in Europe (not counting the Russian population), and the country also lies astride their main migration flyway, so we are duty-bound to ensure the adequate protection of these birds [10]. This species has overcome its fear of humans, and following its colonization of the agricultural landscape, its numbers have risen steeply so that, at present, all its potential habitats are saturated. The rate of population growth between 2001 and 2018 was c. 5% per annum. The breeding population will have increased tenfold in the 30 years from 1990 to 2020 [11,13,17]. The results of the Polish Bird Monitoring Programme in 2018–2020 show that Crane numbers had stabilized. These data were collected by numerous groups of bird observers across the whole country on 10×10 km plots. The latest count (2013–2018)

of breeding pairs in Poland is 23,000–30,000 [17], while that for the years 2010–2012 was 20,000–22,000, i.e., 15% of the European population or 19% of the breeding population in the EU [18–27].

2.3.3. Breeding Density

Precise counts of Cranes in large areas have shown very wide differences in their densities in different parts of Poland, from 0.1 to 41.4 pairs/100 km² (Table 1) [18–20,24–27]. But we have to treat these data with caution. Very likely, during rapid, superficial counts of Cranes not combined with nest searches, observers may tend to classify single birds, or foraging pairs sighted in a suitable habitat, as territorial breeding pairs, thereby overestimating the breeding population. The mean density of Cranes in Poland is 12/100 km² [18], but locally, densities can be very high, e.g., 53 pairs/100 km² in Western Pomerania [19] and 43 pairs on an area of 721 ha in the Bielawskie Błoto nature reserve in northern Poland [13]. On the latter, a peat bog, Cranes were nesting colonially: 26 occupied nests were found on an area of 72 ha where, moreover, the minimum distance between nests was just 19–20 m. In Poland, there is a distinct gradient of Crane densities, from the highest values in the north, through intermediate ones in the center of the country, to the lowest ones in the south.

Table 1. The number and density of Common Crane’s local populations in the different regions of Poland.

Region	Surface Area (km ²)	Period	Number of Breeding Pairs	Density (Pairs/100 km ²)	Source
Iński Landscape Park	440	1992–1995	121	27.5	[19]
Wołów	825	1997–1998	41–46	5.0–5.6	[20]
Polesie National Park	101	2005–2006	28–30	27.7–29.7	[18]
Wysoczyzna Elbląska upland	400	2004–2007	90–150	22.5–35.0	[9,24]
Małopolskie Province	15,182	2006–2013	12–24	0.1–0.2	[15]
Sobibór Forest	118	2016	43–49	36.4–41.4	[27]

2.3.4. Autumn Migration Counts

In order to determine the numbers and distribution of Cranes during the autumn migration in 2009–2013, counts were undertaken at 88–103 nocturnal roosts, all in the lowlands [5]. The combined maximum number of Cranes recorded at all these roosts was 93,000–120,000 individuals. Between 2009 and 2013, numbers increased at a rate of 7% per annum. The largest numbers of monitored staging sites during that period were in the lake districts—59% (N = 57), along the Baltic coast—18% (N = 17), and in the central lowlands—24% (N = 23). The proportions of young birds in the autumns of 2009–2013 varied little, from 8 to 12% (av. 10%). Of the 123 staging sites monitored in 2009–2013, where at least 100 birds were recorded, 74 (66%) are protected in at least one form. If the habitat conditions at the nocturnal roosts do not change significantly, Cranes may use them for many decades. A total of 20% of the Crane’s global population and c. 25% of its European population migrate across Poland; moreover, c. 30% of the birds migrating across central Europe do so across Poland [5].

2.3.5. Wintering

In Poland, the number of wintering Cranes has strongly increased over the last two decades. This situation can be explained by climate warming and the availability of high-energy food, mainly maize, in the winter season [21]. By the end of the 20th century, the birds had been recorded only a dozen times in January, mainly in the western part of the country [2]. At this time, the most important wintering site for the Crane was the Wrocław sewage farm, where wintering Cranes have been regularly observed since 2004. During regular counts in 2012/2013, a maximum concentration of as many as 1042 birds was recorded in the central part of irrigation fields [22]. In January 2020, counts of waterbirds wintering in the whole of Poland were conducted, encompassing rivers, water reservoirs,

and other water bodies. A total of 6839 Cranes were observed across the country (prevalence index—7%) [23]. In recent years, the most important refuge for wintering Cranes has been the “Ujście Warty” National Park, with a record concentration of about 4000 birds in January 2023 [21]. The total abundance of the species in the country was estimated at around 10,000 birds. Due to climate change and the associated increasingly milder winters, further increases in Crane numbers should be expected in future winter seasons.

2.4. Habitat Selectivity

Though an eclectic species, the Crane actually has quite specific habitat requirements. Optimum patches of habitat are very limited in area, isolated, and scattered all over its breeding grounds. In Poland, it prefers postglacial landscapes with large numbers of lakes, moraines, pools of water, and peat bogs (Figure 1) [7,24]. It builds its nests within a broad spectrum of diverse wetland habitats [25–30]. The nest platform is usually constructed from plants growing in the immediate vicinity (Figure 3) [7,8]. On the Elbląg Upland, Cranes nested in forests (89%, including 73% in alder swamps) and less often in open terrain (11%) [9]. Birds nesting on open ground usually do so on drained peat bogs (often crisscrossed by drainage ditches), overgrown meadows, sedge fields, reed beds, and peat workings. In the Polesie National Park in 2005–2006, most pairs (47%) nested in alder swamps and marshy birch woodland, 26% in waterlogged meadows, 21% on peat bogs, and 6% in other habitats [18]. In Lublin Province, in 2022, 67% of pairs nested in forests and 33% in open landscapes [8]. All the nests in this region had been built in depressions in the terrain with a water surface that did not dry out at any time during the breeding season. The birds choose tranquil sites for their nests, usually remote from any human habitations. On the Elbląg Upland, Crane nests were situated 50–1800 m (av. 885 m) from a tarred road and 150–1400 m (av. 680 m) from buildings [9]. In the Lublin region, the corresponding figures were of a similar magnitude: the distance between a nest and a tarred road was 93–1180 m (av. 553 m; SD = 321.3 m), while that between a nest and an inhabited building was 219–1470 m (av. 746 m; SD = 385.7 m) [8]. However, in northern and western Poland, the part of the country with the greatest abundance of Cranes [14,26], where there is stiff competition for nesting sites, these birds sometimes choose highly unusual spots to nest in—close to lightly trafficked roads, railway lines, or inhabited buildings, to name but a few examples.

2.5. The Migration Routes and Wintering Grounds of Cranes in Poland

Because Cranes migrate mainly by day, in large flocks, and are highly vocal in flight, these birds have long since fascinated not only ornithologists and birdwatchers but also people living near their flyways and staging sites [3,31]. Cranes usually set off on their long flights at some time in the morning hours, rising high into the air on thermals, i.e., rising currents of warm air [8,28]. They may also fly by night, especially in the later stages of their journeys, but obviously, there are then no thermals to take advantage of. During their very first migration flights, young birds learn from adults and more experienced birds in the flock not only the actual routes of flyways and where the staging sites are situated but also how to soar and glide, as well as how to take the best advantage of thermals. Average flight speeds are in the region of 50–60 km/h, but with favorable tailwinds, speeds of up to 100 km/h are achievable [8]. A single flight of a migrating flock without landing can last as long as 33 h. Over low-lying terrain, Cranes usually fly at altitudes of 200–400 m asl, but when overflying mountainous regions, they may rise to as high as 3200 m asl. In Europe, most peat bogs have been drained, so Cranes use the extensive wetlands that are well preserved as national parks and nature reserves, such as the Camargue and the Hortobágy National Park, as staging sites. The Crane’s flyways across Europe are fairly well known. Ornithologists distinguish four principal ones [3,31]: (i) Western European, (ii) Baltic–Hungarian, (iii) Eastern European, and (iv) Volga–Caucasian. Cranes originating in Poland use the first two. Birds from northern and western Poland fly across the North German Plain and the Lorraine Plateau to their wintering grounds in the lowlands of France

and the Iberian Peninsula. Birds from eastern Poland fly over the Eastern Carpathians in small flocks to reach the Great Hungarian Plain. Regular observations carried out at 28 points in the Polish Carpathians showed that the autumn migration lasted 80 days (from 24 August until 11 November) and that, on average, flocks consisted of 29–222 individuals. The spring migration lasted 43 days (from 8 March until 19 April), with average flock sizes of 62–292 birds [32]. In spring, 69.2% of flocks, and in autumn, 87.6% of flocks, crossed mountain areas using active flight. Compared with previous decades, the spring and autumn migrations across the Polish Carpathians now take place earlier [32].



Figure 3. The different types of Crane nesting sites in the Lublin region (eastern Poland) (Photos by Marcin Polak).

The most important staging sites for Cranes from eastern Poland are the fields and wetlands within and around the Hortobagy National Park [8]. Some birds spend the winter on the Great Hungarian Plain, but others, after the stopover, continue their migration in a westerly direction, flying across the Dinaric Alps and the Gulf of Venice to reach the Po

Plain (Figure 4). There, in the north of the Italian Peninsula, the situation repeats itself, with some birds staying for the winter, while others fly on over the Alps (sometimes reaching altitudes of 3200 m asl) to reach the Rhone Delta and the Iberian Peninsula or even northern Africa. Another variant of this flyway traverses the northern Alps. The migration strategy is strongly differentiated within and between populations. Cranes have a very flexible migration strategy; this includes factors like the choice of route, staging sites, and wintering grounds, as well as modifying the dynamics and phenology of migration [8,32]. Young birds from a particular population avail themselves of different migration strategies and routes and thus overwinter in various parts of Europe. Polish ornithologists suggested that some of our Cranes migrating along the Baltic–Hungarian flyway returned to their breeding grounds via the western European flyway, in other words, they undertook a typical loop migration [5].



Figure 4. The spring and autumn migration routes of seven young Common Cranes tagged with GPS/GSM transmitters in the Lublin part of Polesie (eastern Poland) in 2021–2023. The different colors indicate migration routes of ringed individuals with Polish names.

3. Threats to the Crane Population in Poland

3.1. Habitat and Climatic Factors

The greatest threats to the Crane population in Europe come from habitat and climate changes, two factors that are inextricably interlinked [11,18,25,29]. Global warming is leading to increasingly frequent extreme weather events, and climatologists are predicting that these are going to become even more commonplace in the near future [33]. Cranes are among the first birds in Poland to commence nesting, building their nests in March [7]. So, crucially, the local weather and hydrological conditions at this time have to be stable [3,25]. At the beginning of the breeding season in March and April in Poland, extreme weather conditions, like blizzards and sudden changes in the weather with low temperatures, are becoming ever more common. Our observations of nests using camera traps have shown, however, that embryos are relatively resistant to chilling and below-zero temperatures [8]. The Crane is also an umbrella and a prominent flagship species of wetland conservation in Poland and Europe [3]. It can be an indicator of valuable and endangered habitats and species [25]. By protecting its breeding sites, we protect the nesting areas of other specialized wetland species, such as the Eagle Owl (*Bubo bubo*), the Lesser Spotted Eagle (*Clanga pomarina*), the Black Stork (*Ciconia nigra*), the Spotted Crake (*Porzana porzana*), the Green Sandpiper (*Tringa ochropus*), etc. [our unpublished data from camera traps]. Extremely significant in the context of Crane conservation, this circumstance highlights the importance of constant habitat and hydrological conditions in the immediate vicinity of a nest during both the nestling and fledgling periods [25]. Once the chicks have hatched, some parents visit the nest for as long as 85 days [8]. Hence, a stable water surface must persist around the nest throughout this long time [13]. On the one hand, long-term deficiencies in precipitation resulting, for example, from less than abundant snowfall and the absence of long-lasting snow cover, are causing water levels in wetland habitats to fall. This poses a serious danger to waterbird breeding sites, as shallow water near nests is not a sufficient barrier to deter predators [34]. On the other hand, blizzards and heavy rainfall during the incubation and early nestling periods can cause water levels to rise rapidly near nests, as a result of which these are flooded or the chicks are drowned [our unpublished data from camera traps and nest controls].

3.2. Intensification of Agriculture

Unfortunately, there is no universal and effective mechanism in Poland for supporting farmers who have water bodies and small areas of wetland on their land [10]. If they receive direct payments, many farmers eliminate and plow up such spots (especially in dry years), treating them as fallow land on which they cannot grow any crops [7]. Moreover, local farmers' associations exert strong pressure on public administration bodies, and in recent years, many midfield ponds have been drained, and smaller rivers and watercourses have been regulated and deepened, thereby draining their catchment areas and lowering water levels on adjacent wetland areas [7,35]. During some stages of their annual life cycle, Cranes may damage certain crops [21,36,37], but there is still no system in place to compensate farmers for such losses [10]. Even though Cranes are a protected species, the Treasury does not recompense farmers for any damage they cause, in contrast to damage caused by some other species like the European Beaver (*Castor fiber*), where such compensation is paid. This kind of approach has been recommended in the Polish national management plan for Cranes [10]. In addition to natural factors, e.g., predation, nestling mortality is also influenced by agricultural operations such as meadow mowing and, for late-breeding pairs or rebreeding pairs, even the beginning of the harvest (winter barley) [25]. One of the young Cranes with our GPS/GSM transmitter most likely died from a farmer mechanically mowing a meadow. The change to an earlier average time for the start of the harvest may be one of the most important causes of mortality of unfledged Cranes in future seasons.

3.3. Intensification of Forest Management

In Poland, forests are owned either privately or by the state. A large part of the Polish Crane population nests within waterlogged or marshy forests [9,24,25]. Recent years have witnessed the intensification of forest management in Poland [38]. In both types of forest, felling takes place during the Cranes' breeding season, sometimes in their territories and the immediate vicinity of their nests, which disturbs them and disrupts their natural activities [8]. Some territories are located in felled areas, tree nurseries, and eroded woodland rides.

3.4. Predatory Pressure Modified by Human Activities

Most brood losses among Cranes are probably caused by predators [8,25,39]. Adult birds are extremely cautious and have very few natural enemies. One of the few species that is capable of catching an adult Crane is the White-tailed Eagle (*Haliaeetus albicilla*) [40]. In recent years, the population of the latter species in Poland has risen substantially, as a result of which pressure on aquatic birds is also increasing [41]. In contrast, the eggs and chicks of Cranes are eaten or hunted by the Red Fox (*Vulpes vulpes*), Pine Marten (*Martes martes*), Wild Boar (*Sus scrofa*), Common Raven (*Corvus corax*), and Marsh Harrier (*Circus aeruginosus*) ([8,39], our unpublished data from camera traps). Recent habitat changes and human activities may have depleted the food resources of these predators in some habitats, as a result of which they will have experienced problems in feeding their young. This will have forced them to seek alternative sources of food and to intensify their pressure on the birds living in the vicinity, including Cranes. We do not know what the mortality rate is for fledged Cranes in their first years of life. The results from the project "The migrations of Common Cranes from the Lublin region" show us that the level could be high because five out of eleven (46%) GPS/GSM transmitters stopped sending data (one bird was found dead).

3.5. Hunting

Although the Crane is not a game bird in Poland [10], its staging sites where they congregate during migration are endangered by hunters after ducks and geese, not to mention red deer stags [5]. Sites that are attractive to aquatic game birds are usually also suitable for Cranes. But hunting within or near nocturnal roosts may scatter the roosting birds and even cause them to abandon such sites [our unpublished data].

3.6. Disturbances and Barrier Effects

New forms of disturbance to roosting Cranes, causing them to be scared off, are associated with outdoor sports like powered hang-gliding, quad-biking, and moto-cross racing, as well as with the development of wind power [5]. Inappropriately located wind farms, e.g., near nocturnal roosts, on the Cranes' main feeding grounds, or on local flight routes between a feeding ground and a roost, may increase mortality and lead to the loss of feeding grounds and the barrier effect [10]. Farmers may accidentally or deliberately scare off Cranes because of the damage these birds can cause in crop fields. However, this applies mainly to feeding grounds and not to the nocturnal roosts themselves. Other activities that may disturb Cranes include poaching for fish and the presence of tourists or photographers.

4. The Future of the Crane Population in Poland

The state of the Crane's breeding populations in Poland is relatively good [7,11,13,39]. There are few species on the Polish checklist of birds that have restored their former numbers so quickly and returned to areas where, for various reasons, local populations went extinct [10,17]. Experts are alerting, however, that climate warming, in combination with increased pressure from human activities, can, in the long term, reverse this trend and lead to declines in Crane populations in this part of Europe [11,25,29]. Though as yet sparse and fragmentary, there are worrying data indicating that in recent years, particularly in

dry ones, the breeding success of Cranes in some regions is low [8,13], albeit this tendency is to some extent compensated for by the species' longevity. It has been estimated that one Crane generation can persist for as long as 12 years [17]. Moreover, the need for the support and passive conservation of the European Beaver, whose activities improve the habitat conditions in Crane territories, is stressed [11,25,27].

5. Conservation of the Crane and the Need for Further Research

In Poland, the Crane is a strictly protected species, cited in the Bonn and Bern Conventions; it is also on the CITES checklist [10]. In EU member countries, the Crane is a particularly important species and is listed in Annex I of the Bird Directive. In Poland, the Crane is currently subject to passive conservation, and no extensive projects are ongoing for its active conservation [10,39]. Many of its key breeding areas, staging sites, and nocturnal roosts are protected in the form of national parks, nature reserves, and Natura 2000 areas, to name but three examples [39]. Suitably large concentrations of Cranes on migration serve to indicate Natura 2000 Special Protection Areas—these cover 16% of Polish territory and attract c. 75% of Cranes observed during their autumn migration [5]. Obviously, then, such areas are crucial for Crane conservation, both in Poland and on a global scale. We have fairly extensive knowledge of the distribution, abundance, and trends of the Polish Crane population, which has been monitored annually for more than 20 years [11]. These birds are counted during the breeding and nonbreeding seasons in sampling areas as part of the program for monitoring birds in Poland [17]. We have up-to-date information on local breeding populations [9,12,13,15,18,19,25,27]. Moreover, every year during the autumn migration, observers count migrating Cranes at their most important staging sites and nocturnal roosts [5,28]. From these counts, we have some idea of the trends in the numbers of breeding and migrating birds. In recent years, in Poland, research projects have been implemented involving the marking of juvenile and adult Cranes using standard metal rings, colored rings, and GSM/GPS transmitters (Figure 5) [8].

Nevertheless, the focus must now be on assessing the Crane's breeding success in different parts of Poland [13]. We have no knowledge of its productivity or its breeding success in optimal and suboptimal habitats (see [26,39]). Data from recently colonized habitats like small midfield water bodies in extensive areas of farmland would be particularly interesting. These patches of suitable nesting habitat are so small and their surroundings so monotonous that we can expect a higher level of predator pressure, as well as problems with the safe leading and feeding of the chicks while they are still flightless. This knowledge is essential in the context of new threats resulting from the penetration of alien, invasive species of predators, the increasing incidence of drought, and the degradation of wetland environments in Poland [10,25]. For the near future, it is recommended to implement a project whereby observers will, on an annual basis, assess the Crane's breeding success in large, representative sampling areas. Two methods should be considered: with and without searching for nests. To evaluate the causes of clutch/brood losses, nests would have to be found, near which camera traps could be set up. But this approach is time-consuming and labor-intensive, and it also requires great experience and a very broad knowledge of the Crane's biology [7]. Hence, it is feasible only if it can be performed by experienced ornithologists who are very well versed in the Crane's natural history. Every time an adult bird leaves the nest while the camera trap is being installed, the chances of a predator plundering the nest increase [7]. Using the second method, the Crane's breeding success can be assessed without the need for a nest search, but again, only on the basis of the number of families discovered on the ground when the chicks are being led. This is where less experienced bird watchers can make a valuable contribution. Another monitoring parameter will be productivity, i.e., the index of the number of flightless chicks per breeding pair. By this means, it will be possible to monitor the long-term trend in breeding success.



Figure 5. A juvenile Crane with a metal ring and a GSM/GPS transmitter in eastern Poland. This bird was ringed as a part of research activity in the project “The migrations of Common Cranes from the Lublin region” (Photo by Marcin Polak).

Author Contributions: Conceptualization, M.P.; resources, M.P.; writing—original draft preparation, M.P.; writing—review and editing, M.P. and R.M.; visualization, M.P. All authors have read and agreed to the published version of the manuscript.

Funding: The Foundation for Nature would like to thank all the people and institutions that have supported the project “The migrations of Common Cranes from the Lublin region”. This activity was funded by Marshal’s Office of the Lublin Voivodeship in Lublin, Bogdanka S.A., Polesie National Park, Voivodeship Fund for Environmental Protection and Water Management in Lublin, Regional Directorate for Environmental Protection in Lublin and Lublin Landscape Parks Unit.

Institutional Review Board Statement: The project “The migrations of Common Cranes from the Lublin region” was approved by Polesie National Park and Regional Directorate for Environmental Protection in Lublin.

Acknowledgments: We warmly thank our friends for help in the fieldwork: Grzegorz Grzywaczewski, Marek Kołodziejczyk, Adam Lesiuk, Kamil Stepuch, Michał Stepuch, Sławomir Wróbel. We thank Peter Senn for his linguistic assistance. We would like to thank the Reviewers for improvements to the paper. We thank all Polish Crane observers and enthusiasts for their work in the field, and Tomasz Chodkiewicz for permission to use the map from the portal www.omitho.pl, accessed on 9 October 2024.

Conflicts of Interest: The authors declare no conflicts of interest.

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