



Numbers and distribution of breeding population of the Great Egret *Ardea alba* in Poland

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Abstract: Research on the distribution and abundance of the breeding population of the Great Egret *Ardea alba* was carried out using an unmanned aerial vehicle (drone) in eastern Poland (east of the Vistula river) in 2018. Data from western Poland (west of the Vistula river) came from reports of the Polish Avifaunistic Commission and local observers. As only single pairs nested in western Poland, a detailed description and analysis of breeding sites have been made only for eastern Poland. In total, 496 breeding pairs were recorded in 8 colonies hosting from 13 to 248 pairs (mean = 62; SD=77; Me=40) in eastern Poland. Surveyed heronries were located on shrubs in wetlands (50%), in reedbeds (37.8%), in a young pine stand and on bushes on a lake island. In total 5 mixed colonies, where Great Egrets nested together with the Grey Heron *A. cinerea* or with the Grey Heron and the Great Cormorant *Phalacrocorax carbo* (one case), were recorded. The average distance between the Great Egret colonies and human settlements was 989 m (range: 63–3700; SD=441; Me=1245). The average distance of mixed colonies of the Great Egret and the Grey Heron to human settlements (909 m) was lower compared to single species colonies of the Great Egret (1227 m). A colony on Lake Gaładuś (248 pairs; about 50% the national population) and surrounding feeding grounds deserve protection as the SPA Natura 2000. In 2018 the breeding population of the Great Egret in eastern Poland probably included almost the entire Polish population of this species, as only 2 pairs were recorded in the western part of the country. Therefore it can be assumed that the national population of the Great Egret amounted to 498 pairs in 2018. It is postulated that Polish monitoring of the Great Egret breeding population planned to be launched in 2020 within the framework of Polish Birds Monitoring should be conducted with the use of drones, which are an efficient tool for the detection and inventory of breeding sites of this species.

Key words: Great Egret, *Ardea alba*, breeding colony, heronries, drone, UAV, survey

Liczebność i rozmieszczenie lęgowej populacji czapli białej *Ardea alba* w Polsce. Abstrakt:

Badania nad liczebnością i rozmieszczeniem lęgowej populacji czapli białej *Ardea alba* przeprowadzono z wykorzystaniem bezałogowego statku powietrznego (drona) we wschodniej Polsce (na wschód od Wisły) w roku 2018. Dane z zachodniej Polski (na zachód od Wisły) pochodziły z raportów Komisji Faunistycznej PTZool. i lokalnych obserwatorów. Ze względu na gniazdowanie tylko pojedynczych par w zachodniej Polsce, szczegółowy opis i analizę miejsc lęgowych wykonano tylko dla wschodniej Polski. We wschodniej części kraju stwierdzono gniazdowanie 496 par czapli białej w 8 koloniach. Poszczególne kolonie skupiały od 13 do 248 par (średnia=62, SD=77, Me=40). Na terenach silnie podmokłych czaplince zlokalizowane były na krzewach (50%) lub w trzcinowiskach (37,8%), a pojedyncze kolonie odnotowano w młodym drzewostanie sosnowym i na krzewach na jeziornej wyspie. W 5 koloniach odnotowano gniazdowanie czapli białej z czaplą siwą *A. cinerea*, a w jednej z czaplą siwą i kormoranem *Phalacrocorax carbo*. Średnia odległość ko-

lonii od zabudowań ludzkich wyniosła 989 m (zakres: 63–3700; SD=441; Me=1245). Przeciętna odległość czaplińców złożonych z par lęgowych czapli białej i czapli siwej od zabudowań (909 km) była niższa w porównaniu do jednogatunkowych kolonii czapli białej (1227 m). Stanowisko lęgowe położone na wyspie na jez. Gaładuś (248 par; ok. 50% krajowej populacji) i otaczające żerowiska zasługują na objęcie ochroną jako obszar specjalnej ochrony ptaków w ramach Sieci Natura 2000. Liczebność populacji lęgowej czapli białej we wschodniej Polsce odzwierciedla prawdopodobnie jej całą krajową populację w roku 2018, gdyż w zachodniej części kraju odnotowano w tym czasie tylko 2 pary. W związku z tym można przyjąć, że krajowa liczebność tego gatunku w roku 2018 wyniosła 498 par. Postuluje się, że planowany od roku 2020 ogólnopolski monitoring populacji lęgowej czapli białej w ramach Monitoringu Ptaków Polski powinien być oparty na wykorzystaniu dronów jako skutecznego i bezpiecznego dla ptaków narzędzia do wykrywania i inwentaryzacji stanowisk lęgowych tego gatunku.

Słowa kluczowe: czapla biała *Ardea alba*, kolonia lęgowa, czapliniec, dron, BSP, inwentaryzacja, wschodnia Polska

The Great Egret *Ardea alba* can be viewed as a symbol of animals saved from extinction. Massive hunting, mainly to obtain ornamental feathers, almost resulted in the species extinction (McCrimmon et al. 2011). The idea of the Great Egret protection led to the foundation of the first non-governmental organisations focused on the avian research and conservation, e.g. American Ornithological Union (USA, 1883), National Audubon Society (USA, 1886), Royal Society for the Protection of Birds (UK, 1898) (Dunning 1994).

Originally the Great Egret inhabited central and southern Europe, in particular the Danube Delta (Snow & Perrins 1998). Effective conservation measures resulted in the population growth and range expansion (Ławicki 2014). At present the European breeding population is estimated at 20 700–34 900 pairs, and exhibits a growing trend (BirdLife International 2017). Also in Poland the species range has been expanding during recent years, and its population has been rapidly growing, especially in the eastern part of the country hosting the majority of the national population (Stawarczyk et al. 2017). The regular nesting of Great Egrets has been recorded since 2002, with confirmed breeding in 12 localities, and probable in two other ones (Stawarczyk et al. 2017). In 2011–2012 the national population was estimated at 110–180 breeding pairs (Chodkiewicz et al. 2015), and in 2016 it comprised at least 268–275 pairs (Stawarczyk et al. 2017). However, the analysis of old satellite images indicates that the number of birds in some historical colonies was underestimated (Zbyryt 2018a).

Current methodical recommendations for the monitoring of breeding localities of the Great Egret include the penetration of potential nesting sites and searching for occupied nests. Places that birds repeatedly visit with food can also be classified as breeding localities. Surveys are recommended to be performed in June, which minimises the disturbance of incubating birds and the risk of nest predation (Janiszewski & Świętochowski 2015). A rapid development of new technologies during last years resulted in a wide and cheap access to unmanned aerial vehicles (UAVs), commonly called drones (Zbyryt 2018b). The application of drones modified and developed survey methods of Great Egret populations: surveys have become more effective and results more accurate. Furthermore, the time needed to complete the survey has considerably declined, limiting the disturbance of incubating birds (Zbyryt & Menderski 2017a). The use of UAVs has lengthened the time period when counts can be conducted: currently from late April to the end of June (Zbyryt & Menderski 2017a). Another important complementary method is the use of public orthophotomaps (e.g. available at Google Maps, Geoport). Such maps helped to identify five new breeding colonies of the species within the Biebrza National Park, that

hosted 183 pairs in 2014 (Zbyryt 2018a). Earlier data provided the information of only 57 pairs breeding in this area (Komisja Faunistyczna 2015). This example shows how limited was the earlier knowledge on the distribution of the species in Poland. Furthermore, annual reports of the Polish Avifaunistic Commission did not include important breeding localities near Lublin (e.g. report of the Avifaunistic Commission from 2014).

The aim of this paper is to present all breeding localities of the Great Egret, recorded and visited during one breeding season with the use of a drone. I also provide the estimates of the breeding population size in eastern Poland in 2018.

Study area and methods

Breeding Great Egrets were surveyed in eastern Poland (east of the Vistula river) in 2018. The research had two stages: (1) collection of information about locations of heronries, (2) visiting of all known localities and other potential breeding sites, arbitrarily selected by the author (e.g. Siemianówka Reservoir, Lake Zygmunt August, Nielisz Reservoir). At the first stage I prepared a list of all breeding localities in eastern Poland, based on published data (Stawarczyk et al. 2017) (Fig. 1). Afterwards, the information about the planned sur-

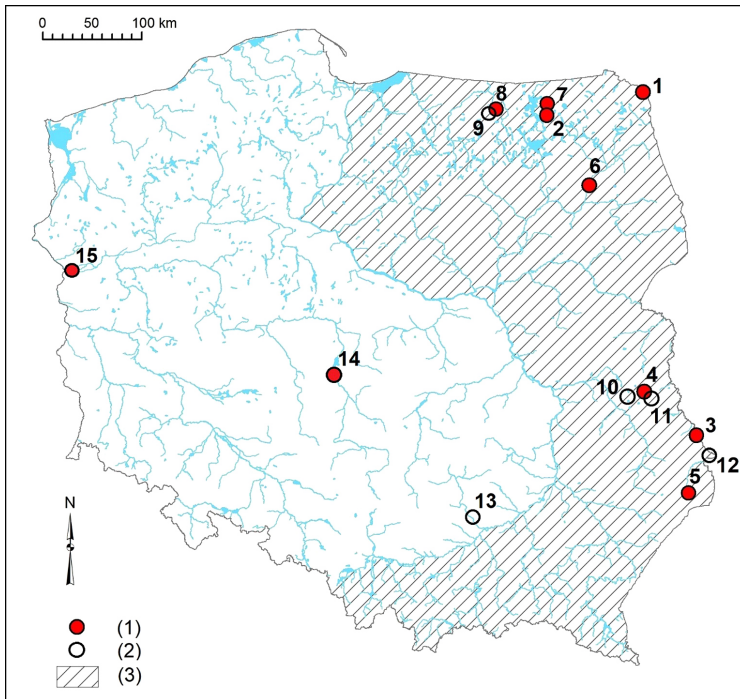
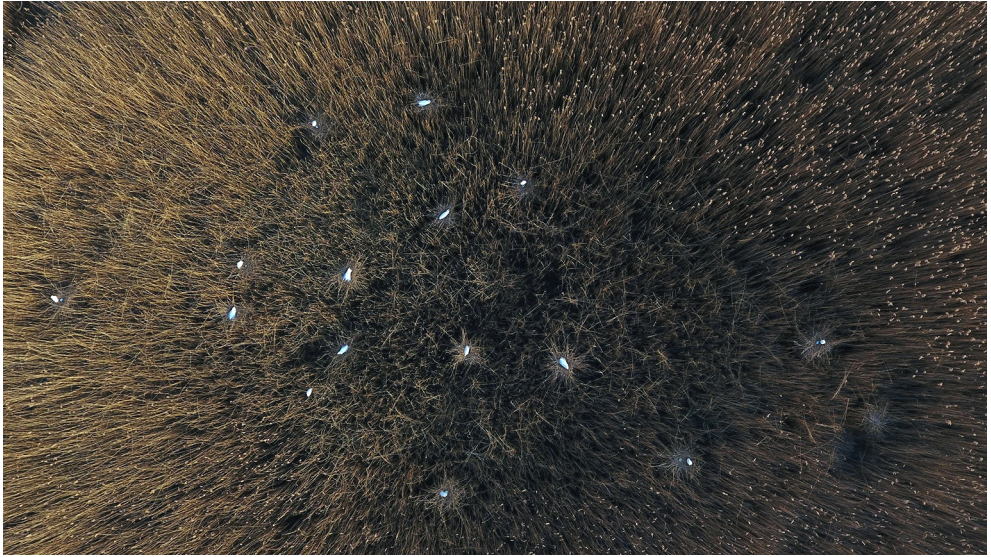


Fig. 1. Distribution of heronries of the Great Egret in eastern Poland in 2018. The numbers correspond with the numbers of the colonies in Table 1. Names of abandoned colonies: 9 – Sątopy-Samulewo polder, 10 – Lake Mytycze, 11 – Bubnów Marsh, 12 – Kacapka Reservoir. (1) – active (occupied) colonies, (2) – unoccupied colonies, (3) – study area

Rys. 1. Rozmieszczenie kolonii czapli białej we wschodniej Polsce w roku 2018. Numery kolonii odpowiadają tym w tabeli 1. Nazwy kolonii opuszczonych: 9 – polder Sątopy-Samulewo, 10 – Jez. Mytycze, 11 – Bagno Bubnów, 12 – zbiornik Kacapka. (1) – czynne kolonie lęgowe, (2) – kolonie opuszczone, (3) – teren badań



Phot. 1. Colony of the Great Egret in reedbeds at Lake Goldapiwo in 2018 (phot. A. Zbyryt) – Kolonia czapli białej w trzcinach na jez. Goldapiwo w roku 2018

vey was advertised on Facebook (profiles of regional ornithological groups: Ornitologdy Warmii i Mazur, Ornitologdy Północnego Podlasia, Podkarpacka Grupa OTOP, and the author's private profile). Additionally, I contacted the most active ornithologists from different areas of eastern Poland with a request to share the information about confirmed and potential breeding localities of Great Egrets.

The second stage involved visits of known and potential breeding sites between 30 April and 17 May. A UAV (quadcopter DJI Phantom 4) was used to fly over reedbeds and areas overgrown with trees and bushes and to make a series of aerophotographs. Nests were photographed from the optimal distance (10–150 m) and with proper flight technique to collect the good-quality data about nest status (the presence of eggs, nestlings, an incubating adults), but at the same time not to frighten the incubating birds (Zbyryt 2018b). Only in case of one colony, located on Lake Gaładuś, where nests were situated on trees and bushes, counts of occupied nests were conducted from the ground. This had two reasons: (1) the necessity to survey more than 700 nests of Great Egrets but also Grey Herons and Cormorants (the survey of last species was commissioned by the Polish General Directorate for Nature Protection); (2) to avoid time-consuming analysis of numerous drone images of a large colony. Furthermore, this was the only colony not located in hard- to-reach and damp area, where the use of conventional method was possible. Nest trees and bushes were marked using biodegradable tags in order to avoid double counting or, much more likely, the exclusion of some nests, resulting in the underestimation of the colony size (Zbyryt & Menderski 2017a). In mixed colonies of Great Egrets and Grey Herons, both species were counted. While estimating colony size, only certain breeding attempts were included, i.e. records where incubating adults, eggs or nestlings were observed.

All nests of Great Egrets surveyed in 2018 were accepted by the Polish Avifaunistic Commission (Komisja Faunistyczna 2019). Drone flights in the area of the Biebrza National Park and Polesie National Park were done under the permits issued by the park



Phot. 2. *Mixed colony of the Great Egret and Grey Heron on trees at Lake Kruklin in 2018* (phot. A. Zbyryt) – Kolonia mieszana czapli białej i czapli siwej na drzewach nad jez. Kruklin w roku 2018

authorities. Flights within the border zone were conducted under the permits issued by proper units of the Border Guard. The drone operator had a licence for using UAVs of the weight exceeding 0.6 kg (VLOS, licence number: PL.39050.UAV).

To assess the size of Polish breeding population of the Great Egret, observations from other historical nesting sites in western Poland (the Nida Valley, Jeziorsko Reservoir and the Warta Mouth National Park), were also used.

Distances between heronries and human settlements were calculated using Google orthophotomaps.

Results

A total of 26 localities in eastern Poland were visited, where Great Egrets had been reported to breed (or probably breed) in the past. In two localities (Dubienka and Gudniki) nesting of the species was confirmed, but no breeding pairs were found in four historical sites (Bagno Bubnów in the Polesie National Park, reservoirs near Zosin-Kacapka and nearby nameless, Lake Mytycze in the Lublin Region and polder Sątopy-Samulewo in Warmia and Masuria) (Fig. 1).

In 2018 a total of 496 pairs of the Great Egret concentrated in 8 colonies were found in eastern Poland (Fig. 1). The colonies included from 13 to 248 active nests (mean=62; SD=77; Me=40; Table 1). Three colonies were located near Lublin (121 pairs; 24% of population) and three other in Warmia-Masuria Province (101 pairs; 20%), and two in Podlasie Province (274 pairs; 55%). Two colonies were situated within the areas of national parks: the Biebrza National Park (Łoje-Awissa) and Polesie National Park (Pieszowola).

Most heronries were located among willow bushes *Salix* sp. in vary damp areas (N=4; 50%), in reedbeds (N=3; 38%), and one colony on a lake island in two habitats: a young pine stand and bushes.

Table 1. Location and abundance of the Great White Egret in eastern Poland in 2018

Tabela 1. Lokalizacja i liczebność czapli białej we wschodniej Polsce w roku 2018. Numery odpowiadają numerom na mapie (rys. 1). (2) – lokalizacja, (3) – liczba par lęgowych, (4) – koordynaty, (5) – razem

No. (1)	Location (2)	N pairs (3)	Coordinates (4)
1	Lake Gaładuś	248	51°03'18.8"N; 23°53'02.3"E
2	Lake Kruklin	70	54°11'20.8"N; 23°24'56.3"E
3	Dubienka	42	54°07'45.5"N; 21°55'58.8"E
4	Pieszowola	42	54°01'39.0"N; 21°55'03.1"E
5	Łaszczów	37	50°32'15.4"N; 23°43'14.4"E
6	Łoje-Awissa	26	51°28'40.3"N; 23°10'16.7"E
7	Lake Gołdopiwo	18	53°22'26.7"N; 22°30'53.5"E
8	Gudniki	13	54°05'41.4"N; 21°08'33.8"E
Total (5)		496	

A total of 6 heronries hosted from 2 to 3 species. In 5 colonies Great Egrets nested with Grey Herons *A. cinerea* (Dubienka – 74 pairs, Łaszczów – 11 pairs, Łoje-Awissa – 76 pairs, Lake Kruklin – 46 pairs, Gudniki – 3 pairs), and in one colony (Lake Gaładuś) with Grey Herons (54 pairs) and Great Cormorants *Phalacrocorax carbo* (324 pairs).

The average distance of the Great Egret colonies from human settlements was 989 m (range: 63–3700; SD=441; Me=1245; N=8). The mean distance of mixed colonies of the Great Egret and the Grey Heron to human settlements was 909 m (N=6), while for colonies hosting only Great Egrets – 1227 m (N=2).

In western Poland Great Egrets nested in two localities: the Warta Mouth National Park and Jeziorsko Reservoir (one pair each).

Discussion

This paper presents results of the first complex survey of the breeding population of the Great Egret in eastern Poland. The estimated numbers probably correspond very well with the actual national population size in 2018. In western Poland in 2018 only two breeding localities of the species with single pairs were found: at the Jeziorsko Reservoir and in the Warta Mouth National Park (Komisja Faunistyczna 2019, T. Janiszewski – in litt., M. Wołowik – in litt.). I did not record nesting of the species in another historical site west of the Vistula river, in the Nida valley (S. Chmielewski – in litt.). This first drone survey provided the accurate numbers of breeding pairs in each colony. Earlier counts the most likely produced underestimated numbers due to difficulties in penetration of reedbeds. Such a situation occurred in the polder Sątopy-Samulewo (Sikora & Czastkiewicz 2014) and Lake Gołdopiwo (pers. obs.). This problem may concern all extensive wetlands in Poland, where nesting of Great Egrets have been recorded. A good example is the oldest Polish colony of Great Egrets in the Biebrza National Park (Pugacewicz & Kowalski 1997), where 57 pairs were counted in 2014 (Komisja Faunistyczna 2015). The analysis of satellite images from Google Maps, conducted in 2016, revealed the presence of additional 183 pairs nesting in 2014 within a few kilometres from the focal colony, in the surrounding reedbeds (Komisja Faunistyczna 2017, Zbyryt 2018a). The use

of satellite images for the estimation of the number of breeding pairs in heronries in earlier years, may help us to recreate the colonisation of the country by the species. Reports of the Polish Avifaunistic Commission indicate that the knowledge about heronries and the number of breeding pairs was incomplete in many years. This concerns especially an important breeding area near Lublin (Komisja Faunistyczna 2013, 2015).

The current state of knowledge enables for some estimates of population growth in eastern Poland: 1997–2000: 0–3 pairs, 2001–2010: 0–39 pairs, 2011–2015: 134–194 pairs, 2016: 268–275 pairs, 2017: 352–356 pairs (Stawarczyk et al. 2017, Komisja Faunistyczna 2018), 2018: 496 pairs (this study). Recreation of colonisation and development of particular colonies is especially important in case of the largest and most northerly located colony on the island on Lake Gaładuś (Podlasie Province) that hosted 116 pairs in 2015, when the colony was discovered (Zbyryt et al. 2015). Such a large number of breeding pairs suggests that it was not the first breeding season of the species in this locality. The analysis of satellite images would help to estimate the year of first nesting and the colony size. To do so, high-resolution images would have to be analysed (VHR – Very High Resolution), e.g. 50 cm (e.g. satellites World-View 1, 2 and 3, Pleiades, GeoEye) or even 31 cm (World-View 4). The problem with such photographs is associated with their high price, proper timing (from the second decade of April to the first decade of June) and non-cloudy conditions (Zbyryt 2018a). Such a situation refers to the colony near Dubienka village at the Bug river (Lublin Province). According to a local ornithologist Great Egrets have nested there since 2014 or 2015 (S.A. Zgorzałek – in litt.).

The described cases, especially the one from the Biebrza marshes, clearly show that the use of a drone, not only resulted in more accurate estimation of the number of breeding pairs, but also lesser interference (in terms of damage of reeds, creation of paths within a reedbed). Such man-made damages of reedbeds may increase the habitat penetration by predators and result in higher nest losses. Another important aspect of drone usage was the reduction of startling of incubating parents and the young (Zbyryt & Menderski 2017b, Zbyryt 2018b). Furthermore, the time needed to complete the survey by a drone is significantly reduced. The earlier monitoring of the heronry located near the village Łoje-Awissa in the Biebrza National Park lasted from 8 to 12 hours, and was associated with 15-km canoeing and penetration of the difficult, frequently flooded area. The survey of the same colony with the use of drone lasted only 45 minutes.

At present half of the national population of the Great Egret nests in one colony on an island on Lake Gaładuś. Since the discovery of this colony in 2015, the number of breeding pairs has been increasing. During only three years, the number of nesting pairs has doubled (own data). The current population size, as well as the fact that the species is included in the Annex I of the Birds Directive, qualify the area to be protected as a Special Protection Area (SPA) within the Natura 2000 network (Rojek & Sadowski 2012). The proper legal status of the site may guarantee the efficient protection of the Great Egret (Amano et al. 2017). Some studies provided evidence that bird conservation is most cost effective in Important Bird Areas (McCarthy et al. 2012), that have been used as the basis for designating Special Protection Areas (SPAs) under the Birds Directive (Rojek & Sadowski 2012). These facts argue in favour of designation of Special Protection Area at the Lake Gaładuś and its vicinity (key foraging grounds). This would allow for better planning of species conservation in the future. Furthermore, the area should be protected, at least as an ecological site, due to its high natural values.

Rare and irregular nesting of the Great Egret in western Poland seems intriguing. Although Great Egrets winter in large numbers in southern and western Poland (Ławicki

2009), almost all heronries were located in eastern Poland (Stawarczyk et al. 2017). Habitats and food resources in both parts of the country seem to be similar, so it is unlikely they could act as limiting factors preventing the expansion of the species in western Poland. It is worth mentioning that the species expansion occurs also in western and north-western Europe (Germany, Sweden, Finland, UK) (Ławicki 2014). Therefore, factors responsible for the species expansion are difficult to indicate, and require further detailed studies. In countries of eastern Europe, neighbouring with Poland, the Great Egret is in expansion, strongly increasing in numbers (reviewed by Ławicki 2014), which corresponds with the occupation of eastern Poland by the species. In contrast, the species expansion into Germany has only begun, and this could explain rare and ephemeral nesting of the species in western Poland.

During the study period I did not record nesting of Great Egrets at the Siemianówka Reservoir, where flocks consisting of more than 100 individuals are regularly observed, including individuals in a breeding plumage (Ławicki 2014, own obs.). Also the analysis of satellite images from years 2014–2016 and months corresponding with the breeding season (April–June) did not confirm nesting of Great Egrets there. Because Egrets are able to perform long foraging flights (even longer than 30 km; Smith 1995), it is possible that they nest in Belarus. However, the analysis of satellite images from Belarus (the areas within 10 km from the border with Poland) did not reveal the presence of heronries (own data).

In Poland Great Egrets nest most often on low bushes (mainly willows) and in reed-beds (this study) compared to Grey Herons (e.g. Żółkoś et al. 2010). In northern and north-eastern Poland Grey Herons usually nest in pine and alder forests (Zbyryt 2016, Zbyryt & Menderski 2017b).

In eastern Poland, the area where both Great Egrets and Grey Herons occur, the distance between breeding colonies of Great Egrets and human settlements was more than twice as long (1227 m) as the distance for Grey Herons in Podlasie Province (556 m) and almost four times greater than in Warmia-Masuria Province (320 m) (Zbyryt 2016, Zbyryt & Menderski 2017b, modified). A shorter distance of mixed colonies compared to colonies consisting of only Great Egrets suggests that the presence of Grey Herons affects the shortening of the distance to human settlements. This results should be treated with caution, however, due to a low number of analysed colonies. Data from the area of Poland indicate that Grey Herons tend to nest closer and closer to human settlements, and even among buildings (Wylegała et al. 2011, Zbyryt 2016, Zbyryt & Menderski 2017b, own obs.). It is not certain, however, which species starts nesting earlier in a mixed colony. In north-eastern Poland Grey Herons appear in breeding colonies already at the beginning of March, while Great Egrets at the beginning of April (own obs.). Therefore, it is more likely that Great Egrets join Grey Herons, inhabiting colonies closer to human settlements. The breeding season of both species in eastern Poland is extended, and may last until end of August (own obs.). In mixed colonies of both species brood age differed considerably, and hence young development cannot be used to verify the hypothesis that Great Egrets join nesting Grey Herons.

In the course of the survey it turned out the many bird observers did not have the knowledge about the breeding plumage of the species. As a result, many places where the birds had been frequently observed, were reported as potential breeding localities, but the survey did not confirm this. Breeding Great Egrets have black bills and legs, as well as ornamental feathers on the back (Jonsson 1998). This study showed that breeding of the species was confirmed only in places where individuals in breeding plumage had been

observed. In most places where birds had been regularly recorded, their nests were not found. Hence the bird appearance (breeding plumage) is the first clue suggesting nesting of the species in the area. This knowledge is important, as ornithologists usually do not have UAVs, and renting of such an equipment is costly. Therefore, the observation of birds in breeding plumage should be the first step preceding the decision of drone inspection.

In case of the Great Egret the regular monitoring of population is recommended, together with implementation of conservation plans and identification of key conservation sites (BirdLife International 2016). Like the Grey Heron, the Great Egret is perceived by fishermen and anglers as an obligatory fish-eater, and hence classified as a conflict bird species (Manikowska-Ślepowrońska et al. 2016). In 2010–2019 General Directorate for Nature Protection issued a permission for killing 443 individuals of Great Egrets in the areas of Podlasie, Łódź, Lublin and Lower Silesia Provinces (issued on 07.05.2019, permit ID: BP.402.411.2019.PB). In three of these provinces breeding colonies of the species exist. Therefore, the knowledge about the current distribution of breeding colonies is important to avoid shooting in places where nesting individuals occur. This would allow to avoid killing of breeding birds, and prevent the possible population decline. Since 2020 monitoring of populations of the Great Egret and Grey Heron is planned within the Monitoring of Birds of Poland (commissioned by the Chief Inspectorate of Environmental Protection, GIOŚ). This research can serve as a reference in future estimates of population size of the Great Egret in Poland. The use of UAVs and satellite images, facilitating nest searching and improving population estimates (Zbyryt & Menderski 2017a, Zbyryt 2018a), should be included in methodical recommendations for monitoring of the species (c.f. Janiszewski & Świętochowski 2015).

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