

Selected invasive species of the Polish and European avifaunae

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Abstract: *Selected invasive species of the Polish and European avifaunae.* The present paper defines the potentially invasive and invasive non-native species of Polish avifauna that constitute a potential threat to the biodiversity and the ecosystems. The work describes two pieces of legislation currently in force in Poland that deal with the issue of invasive bird species. At the national level the issue is regulated by Art. 120 of the Nature Conservation Act from 2004, which prohibits the relocation of the listed species and their introduction into the natural environment. At the EU level, the relevant legal act currently in force is the Regulation (EU) 1143/2014 on the prevention and management of the introduction and spread of invasive alien species. An overview of non-native and invasive species is included, which takes account of the Canada Goose (*Branta canadensis*), the Egyptian Goose (*Alopochen aegyptiacus*), and the Ruddy Duck (*Oxyura jamaicensis*). In addition to the species included in the national law, mention is also made of potentially invasive non-native species, namely the Mandarin Duck (*Aix galericulata*) and the exotic Rose-ringed Parakeet (*Psittacula krameri*). Using members of *Anseriformes* as examples, the paper discusses concerns regarding brood parasitism and hybridization of birds. Measures undertaken to control invasive species are mainly limited to monitoring, but they also include trapping and eradication via shooting in certain cases.

Key words: birds, non-native species, invasive species

INTRODUCTION

Biodiversity is the variability among the entirety of Earth’s living organisms within its individual terrestrial, freshwater and saltwater ecosystems, as well as its ecological complexes (Convention on Biological Diversity 1992). Any discussion of such biodiversity cannot fail to touch upon the two important notions of non-native (alien) species and invasive species. Non-native species are species (or sub-species taxa), gametes, seeds, spores or eggs that extend beyond their natural range. These may establish small reproducing populations, but they may also fail to adapt to the new conditions and die out (Convention on Biological Diversity 1992). Therefore, it is not always possible to assess whether or not an alien species is likely to pose a threat to biodiversity in a given environment. The definition of invasive species differs from that of non-native species. According to Garcia-Berthou (2007), an invasive species is a non-native species that poses a threat to biodiversity and ecosystems. This threat results partially from the very high adaptability of some non-native species, which allows them

to thrive in their new environments (Alcaraz et al. 2005). Such species are also able to reproduce and proliferate at a fast rate, and are often generalist in nature, i.e. not specialized in regards to their diet (Andrzejewska et al. 2011). Invasive species not only colonize the habitats of native species and outcompete them, but also disrupt food cycles. Invasive species of animals are certain or likely to eventually affect the fauna and flora of a given ecosystem through competition for food or nesting, predation, ecosystem alteration, and transmission of disease. They may also spawn interspecific crossings (Gurevitch and Padilla 2004). According to Caughley and Gunn (1996), invasive species are responsible for 40% of animal and plant species extinctions.

There is also another definition of invasive species used within ornithology. Within the scope of this second definition, invasive species are ones that appear periodically in large numbers in areas where they are naturally absent or scarce. This phenomenon is referred to as irruption (Jędrzejewski 2000). It is usually associated with species-specific population fluctuations, e.g. within migration pathways. At irregular intervals, larger groups of individuals begin to migrate in search of food, usually when the food is in short supply and lacks variety (Newton 2006).

LEGISLATION

There are two principal pieces of legislation concerning invasive species in Poland, and their scope includes invasive species of birds. At the national level the issue is regulated by Art. 120 of the Nature Conservation Act, which pro-

hibits the relocation of the listed species and their introduction into the natural environment. The Annex to the Regulation of the Minister of the Environment of 9 September 2011 defines plants and animals of non-native species that could pose a threat to native species or natural habitats if released into the natural environment. This list includes the following species of birds: the Canada Goose (*Branta canadensis*), the Egyptian Goose (*Alopochen aegyptiaca*), and the Ruddy Duck (*Oxyura jamaicensis*). Fifty-two species of plants and animals are listed in total. At the EU level, the relevant legal act currently in force is the Regulation (EU) 1143/2014 on the prevention and management of the introduction and spread of invasive alien species. 3 August 2016 saw the entry into force of Commission Implementing Regulation (EU) 2016/1141 adopting a list of invasive alien species of Union concern pursuant to Regulation (EU) 1143/2014. The implementing regulation lists 37 species of invasive non-native birds, including the African Sacred Ibis (*Threskiornis aethiopicus*), the Ruddy Duck, and the House Crow (*Corvus splendens*). The Committee on invasive alien species has accepted a proposal to extend the list and include 12 additional species of plants and animals of European Union concern, such as the Egyptian Goose. The amended list is valid as of 2 August 2017. Of note is the inclusion of the Ruddy Duck and the Egyptian Goose in both of these legal acts.

REVIEW OF SPECIES

The Red Crossbill (*Loxia curvirostra*) is one example of a species that irrupts

within the Polish territory. In Poland, the Red Crossbill's main nesting habitat is the mountains, and its prevalence is correlated with the abundance of spruce seeds that the bird feeds upon. In lowland areas these birds appear sporadically, but usually in large numbers. Newton (2008) links this with migrations spurred by food shortages. From the boreal zone, which is the main area of occurrence, the birds move to southwest Europe. This type of irruptive migration was observed within the Kalisz region from 2002 to 2003, with a total of 731 individuals counted across the months (Wilzak 2012). Other species observed to undergo irruptive migrations include the Bohemian Waxwing (*Bombycilla garrulus*) and the Common Redpoll (*Acanthis flammea*) (Jankowiak et al. 2013), both highly specialized. The Common Redpoll feeds on birch (*Betula* sp.) and spruce (*Picea* sp.) seeds, while the Bohemian Waxwing favours rowanberries (*Sorbus* sp.). Whenever seeds or fruit become scarce in the birds' breeding areas (Scandinavia and Northern Europe), numerous individuals proceed to migrate in search of new food supplies. Mass arrivals of the Common Redpoll were recorded in the North Podlachian Lowland region from 2005 to 2006 and from 2007 to 2008 (Lindén et al. 2011) as well as in the western and central-eastern parts of Poland (Bednorz et al. 2000). Bohemian Waxwing irruptions were detected not only in Poland but in other European countries as well, including Germany, Switzerland (Posse and Volet 2005) and the Czech Republic (Schröpfer et al. 2010).

The Ruddy Duck is a duck species native to North America. Of note is the inclusion of both the Ruddy Duck and

the Egyptian Goose (described below) in the two legal acts. The bird was introduced to the UK in 1948 to be bred in captivity (Hughes 1998). Accidental escape of captive birds has resulted in them rapidly acclimatizing to European conditions, which in turn resulted in an increase of the active breeding population (currently numbering approx. 5,000 individuals). In the UK, the bird was first observed to breed in the wild as early as in 1960 (Hughes 1998). Regular broods were subsequently noted in Ireland, the Netherlands, France, Spain, Iceland, and Sweden (Hughes et al. 2004, Drake 2009). The presence of the invasive Ruddy Duck has become a threat to the White-headed Duck (*Oxyura leucocephala*) native to the Mediterranean, mainly due to the potential hybridization between the two species and due to competition for breeding sites and food. In order to protect the White-headed Duck, a Ruddy Duck control and eradication program was implemented in Spain, Portugal, and other counties (Hughes et al. 2004). As of yet, the Ruddy duck does not pose a material threat to other species of *Anseriformes* in Poland, as there have been only individual sightings of the duck, and even those have been scarce. This is not entirely the case with the Egyptian Goose. The first brood of the goose in Poland was discovered in 2007 around the Odra river, within the Powiats (Counties) Raciborski and Wodzisławski. The geese in question had escaped from a mini zoo. Betleja and Rojek (Komisja Faunistyczna 2009) have already recorded three pairs and their offspring in the ponds of Upper Silesia in 2008. The natural range of the Egyptian Goose is the majority of Africa.

A free-roaming population of the goose has persisted in the UK for 200 years, descended from birds which escaped from private breeders (Holloway 1996). A similar scenario occurred in the Netherlands, where the population of the Ruddy Duck has reached over 10,000 as a result of uncontrolled escapes (Arens and Rebling 2007). More than 2,600 pairs also regularly nest in Germany. This group partially consists of birds that migrated from the Netherlands, and some of them have also escaped from German breeding farms. There is also a significant population in Belgium, numbering at approx. 1,000 individuals (Bauer and Woog 2008). Broods have also been found in many other countries, such as Switzerland, Denmark, France and Sweden. The main threats resulting from an invasion of this species are its potential to hybridize with other *Anseriformes* (Banks et al. 2008a), its strong territoriality and aggressive behavior towards native species (Pieterse and Tamis 2005), and its status as a potential vector of the avian influenza virus (Gyimesi and Lensink 2010).

The Canada Goose is another invasive species of avifauna. Its assorted subspecies inhabit a multitude of different regions of North America (Fabricius and Norgren 1987). The United Kingdom was the first country to introduce the Canada Goose in Europe, doing so as early as 1665. The species was initially introduced to royal gardens and parks as an ornamental bird (Kirby 1999). It is continually bred for this purpose to this day. The birds have been increasingly encountered in the wild throughout the years. The species was introduced to Sweden for a similar reason but the

goose came to be adopted as a game bird. This tradition has also spread to other countries, including Germany, Norway, Finland, and Denmark. However, in spite of the hunting, deliberate introductions and escapes from breeding farms and zoos have led to the rapid increase in the number of Canada Geese in the wild. At present, the largest number of free-living individuals is found in Sweden. According to Nilsson (2006), the population was calculated to be 43,000 specimens in 2005. Populations in the UK and Sweden are among the largest and constitute the major foci from which the species has spread across Europe (the two European populations are considered to be completely separate from each other). It is believed that the populations living in Scandinavia (mainly in Sweden) gave rise to populations in Poland by way of migration. The Polish populations also include escapees from zoos and ornamental bird breeding farms. The species has not been intentionally introduced to Poland. The first Polish observations of the Canada Goose date back to 1935. The geese have been found to annually winter in the waters of the Elbląg Bay. However, the species has been mostly encountered at the Gdańsk Bay and in the vicinity of Włocławek. The brooding female and assisting male were detected in Gdańsk – Oliwa in 2004, however the nest was destroyed by predator (Sikora et al. 2007). The first brood was confirmed in Gdańsk in 2005, and the number of breeding birds increased in 2007 (Głowaciński and Solarz 2011). A 2008 brood observed around Lake Somińskie was unusual in that it is thought to have been a result of crossbreeding with the native Greylag Goose (*Anser anser*). This may be indic-

ative of one of the dangers that the rising population of the Canada Goose poses in Poland. The Canada Goose is considered to be one of the 100 most dangerous non-native species in Europe. It, alongside the Greylag Goose and the Snow Goose (*Anser caerulescens*), has been observed to engage in interspecific brood parasitism (Kampe-Persson and Lerner 2007), which involves laying eggs in the nests of other goose species. The hatchlings recognize the foster parent as a member of their own species. It is very likely that such birds will interbreed upon reaching maturity, creating hybrids. Greylag Goose × Barnacle Goose hybrids are commonly found in Germany (Gebhardt 1996) and Sweden (Söderholm 2005).

Apart from the aforementioned species, which are included in the national law, also worth mentioning are the potentially invasive non-native species. This designation refers to species that are currently unable to function and multiply without human intervention, but whose populations may spike drastically given suitable conditions (such as the progressive warming of Poland's climate). An example is Mandarin Duck (*Aix galericulata*), an escapee from private breeding farms and zoos. A fairly numerous group of these birds has established itself in the Łazienki Park in Warsaw. Tomiałoć and Stawarczyk (2003) report that the first broods were recorded in the Park in 2001, and the birds make new breeding attempts annually, with varying results. As of yet, the birds cannot be considered to have fully adapted to the environmental conditions, as account must be made for humans feeding the birds and other factors. The Mandarin Duck is a species of bird belonging to the Anatidae family,

originally endemic to the Amur basin, Japan, Manchuria, and eastern China. It has been bred in Europe since the 18th century as an ornamental species, while free-living escapees are considered to be an invasive species. At present, little is known about the impact of introducing Mandarins on native species and their habitats. Escaped Mandarins have been observed to destroy nests and eggs of other bird species, and further research would be beneficial to determine the impact of Mandarin Ducks artificially introduced into the environment on the native species and their habitats (Blair et al 2000, Banks et al. 2008b, van Kleunen and Lemaire 2014). The Mandarin is considered to be a protected species under the International Union for Conservation of Nature Red List of Threatened Species, but only under the LC designation ("least concern").

There are many barriers to interspecific hybridization in the wild, which encompass both pre- and post-zygotic barriers. These include geographical, ecological, and behavioral barriers, as well as anatomical barriers that prevent the egg cell of the female of one species from binding with the sperm of a male from another species (Prager and Wilson 1975). The Mandarin Duck is considered to be the only duck species unable to crossbreed with other species belonging to the Anatidae family. Hypotheses to explain this fact are predominantly centered around the different chromosome numbers between different species of the family. However, research to date indicates that hybridization between individuals with different chromosome counts can occur. The Indian Muntjac (*Muntiacus muntjak*), whose diploid

chromosome number is 7 (the lowest value currently recorded in mammals), hybridizes readily with the Chinese Muntjac (*Muntiacus reevesi*) despite the latter's diploid chromosome count of $2n = 46$. Therefore, in light of current knowledge about the molecular mechanisms of Mandarin Duck hybridization, it can be safely assumed that this species does crossbreed with other members of the Anatidae family, though very rarely. In addition, the Mandarin's capacity to hybridize has been confirmed by the results of crosses carried out by some scientific teams, including Ackermann 1898, Gray 1958, Hopkinson 1926, Leverkusühn 1890, Prestwich 1960, Salvadori 1895, all of which crossed a female Mallard with a male Mandarin Duck (McCarthy 2006). Members of this species are able to crossbreed with four other species of ducks in captivity, while in the UK the Mandarin seems to be dominant over the closely related Carolina Duck (*Aix sponsa*). However, hybridization of these two species has seldom been recorded (Blair et al. 2000). Previous studies employing phylogenetic analysis have shown that the Mandarin and the Muscovy Duck (*Cairina moschata*) belong to a single phylogenetic clade. As such, they may exhibit considerable genetic similarity and possess the capacity to hybridize. Membership to the same clade has been demonstrated on the basis of multiple sequence analyses, including: an analysis of a region of mtDNA spanning a region of cytochrome b (Sraml et al. 1996), of the D-loop region (Donne-Goussé et al. 2002), the *COI* gene also present in the mitochondrial genetic material (Jin et al. 2012), the *ND2* gene (Mitochondrially Encoded

NADH: Ubiquinone Oxidoreductase Core Subunit 2) (Liu et al. 2014), and the complete sequence of the mitochondrial DNA (Liu et al. 2014, Zhang et al. 2017). These studies have also indicated that the Mandarin Duck and the Mallard (*Anas platyrhynchos*) fall into separate phylogenetic clades and are separated by several phylogenetic nodes, the exact number of which depends on the sequences analyzed and the method of phylogenetic tree construction (Sraml et al. 1996, Donne-Goussé et al. 2002, Jin et al. 2012, Liu et al. 2014, Zhang et al. 2017). The different phylogenetic position of the two species may contribute to them being unable to hybridize (Donne-Goussé et al. 2002).

Also indicative of the considerable evolutionary distance between the two species are the results of the research conducted by Prager and Wilson (1975) that compared the immunological distance (i.e. the measure of the degree of reactions between antigens and antibodies, used to determine the evolutionary distance between the two studied groups of animals) between different bird species. These studies have shown that the albumin immunological distance between the Mallard and the Mandarin Duck is 8 units, while the transferrin immunological distance is 16. When comparing the Mallard and the Muscovy Duck, the values were 9 and 21 for albumin and transferrin, respectively.

There are also recorded attempts to create a Mandarin Duck × Mallard hybrid in Poland, however, no information is available on whether this venture was successful (Banks et al. 2008b).

Another exotic species increasingly being encountered in the wild is the Rose-

-ringed Parakeet (*Psittacula krameri*). While this species is rare in Poland, the number of Rose-ringed Parakeet sightings has been increasing year-to-year. The bird is most commonly encountered along the western border of Poland, but individual specimens have also been found at the Świętokrzyskie Mountains (Wachecki and Lewczuk 2013). Additionally, in January 2016 five individuals were identified around the Gałczyński district in Nysa – something of a curiosity to the Polish avifaunistic commission. So far, the relatively cold climate of Poland has been a significant factor in limiting population growth. Consequently, while the birds are capable of surviving the winter, they fail to breed due to the longer length of the cold season. That is not the case in other European countries. Butler (2003) reports that the Rose-ringed Parakeet has been found in 24 countries, though the size of the population differs from case to case. In some countries only individual (and in many cases non-breeding) specimens (e.g. in Romania and Bulgaria), while in other countries populations of over 10,000 have been found. The largest European populations have been found in the UK – more than 30,000 individuals, Germany – more than 10,960 individuals, Belgium – approx. 10,800 individuals, and in the Netherlands – approx. 10,100 individuals. In addition, the bird occurs in fairly large numbers in Greece, Spain, Italy, France, bringing the total population count in Europe to 90,000 (Pârâu et al. 2016). It is also interesting to note that some authors offer 1885 as the date of the first instance of Rose-ringed Parakeets breeding in the wild in Britain (Braun and Wink 2013). This issue is conten-

tious and subject to a certain measure of uncertainty, as others have reported that the first recorded brood originated in 1996 (Butler 2003). The introduction of the Parakeet was spurred in some part by the interest from zoo owners, but the most significant driver was private owners eager to keep the exotic animal as a pet. The Green Parakeet proved to be very intelligent, easily domesticated, able to perform various tricks and imitate single words. Black market activity and inattention on the part of the owners led to the uncontrolled escape of the birds to the environment and subsequent rapid adaptation. Invasive species are a subject of research across multiple European countries. One such study aimed to determine the relationship between the Parakeet and the breeding population of the Eurasian Nuthatch (*Sitta europaea*) in Belgium (Strubbe and Matthysen 2007). The study showed that the non-native species negatively impacts the Nuthatch population by limiting the number of available nesting sites – both the Rose-ringed Parakeet and the Eurasian Nuthatch favor large diameter tree cavities, which are usually made by woodpeckers. The conflict emerges during nest selection. The Parakeet proceeds to search for a breeding location in early February and claims most of the available cavities early. The Nuthatch begins the search between March and April.

Another study, conducted by Czajka et al. (2011), showed no negative impact of the Parakeet on the breeding population of the Common Starling (*Strunus vulgaris*) within Germany. The findings indicated that the species have different nesting preferences. Parrots choose cavities located on higher parts of trees and

favor older trees with large trunk diameters. The Starling, in contrast, prefers small cavities with narrow entrances, located at the lower parts of young trees. Similarly, the Belgian team's observations of the Rose-ringed Parakeet's bilateral relationships with the European Green Woodpecker (*Picus viridis*) and the Great Spotted Woodpecker (*Dendrocopos major*) (Strubbe and Matthysen 2007) failed to indicate any negative impact of the Parakeet's presence on the breeding success of the two woodpecker species. Despite the Parakeets claiming the available nesting sites earlier on (mainly cavities made by the two species of woodpeckers), the woodpeckers bred at the species-typical time. Whenever there was a shortage of cavities, the woodpeckers excavated new ones. However, referring to Reuven et al. (2016) Rose-ringed Parakeet had a negative impact on indigenous Eurasian Hoopoe (*Upupa epops*) due to its aggressive behavior during takeover of cavities. Another study focused on the Greater Noctule Bat (*Nyctalus lasiopterus*), whose small population occupied the tree cavities in a park in Seville (Spain) during its breeding season (Hernández-Brito et al. 2014). The study established that the Rose-ringed Parakeet completely dominated the bat population, displacing it from the cavities and thus necessitating a marked relocation of the bat's nesting sites.

SUMMARY

We live in a rapidly changing world, wherein human activity and the broadly defined environmental changes are causing numerous populations of plants and animals to decline. At times, human

inattention causes species that may pose a threat to the local avifauna to escape into the environment. For this reason, it is crucial that we possess a tool that will allow us to understand and control these phenomena. Keeping track of the wildlife is critical to the effectiveness of any and all conservation measures. Additionally, a solid understanding of ecological processes is an indispensable in terms of predicting the effects of political actions.

When invasive species are concerned, educating the society on the impact of invasive on the local avifauna is well-warranted. Such educational measures should contribute to better security in aviaries and fowl yards where captive bird species are kept. Monitoring is one of the main methods through which the ecological relationships between native species and invasive/potentially invasive species can be more effectively understood. Monitoring may be understood as one of the essential prerequisites for the implementation of biological resource management strategies. The entire decision-making process for nature conservation is based on information obtained from monitoring activities (species, behavior, habitat types, etc.). The concept of monitoring is currently undergoing a shift. Beforehand, past occurrences in a given system (e.g. population growth or decline) were the focal point – currently, the focus is placed on predicting future developments and analyzing the obtained data with the target state in mind. As such, the ability to make informed decisions in regard to resource management and target resource control is directly related to proper monitoring. Intervention control measures are used in countries where invasive species cause

significant declines in populations of native species – such measures include trapping or shooting programs.

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- Streszczenie:** *Wybrane inwazyjne gatunki ptaków awifauny Polski i Europy.* W pracy zdefiniowano gatunki obce potencjalnie inwazyjne oraz inwazyjne ptaków awifauny Polski w odniesieniu do Europy stanowiące potencjalne zagrożenie dla bioróżnorodności i ekosystemów. Przybliżono dwa akty prawne obowiązujące w Polsce dotyczące gatunków inwazyjnych ptaków. Na szczeblu krajowym jest to art. 120 ustawy o ochronie przyrody z 2004 r. mówiący o zakazie przemieszczania i wprowadzania wymienionych gatunków do środowiska przyrodniczego. Na szczeblu unijnym obowiązuje rozporządzenie Parlamentu Europejskiego i Rady UE 1143/2014 w sprawie zapobiegania wprowadzania i rozprzestrzeniania się inwazyjnych gatunków obcych i zarządzania nimi. Dokonano przeglądu gatunków obcych i inwazyjnych, tym samym scharakteryzowano berniklę kanadyjską (*Branta canadensis*), gęsiówkę egipską (*Alopochen aegyptiacus*) i sterniczkę jamajską (*Oxycura jamaicensis*). Ponadto oprócz gatunków, które są ujęte w prawie krajowym, wspomniano o obcych gatunkach potencjalnie inwazyjnych. Za przykład wymieniono kaczkę mandarynkę (*Aix galericulata*) i egzotyczny gatunek ptaka – papugę aleksandrettę obroźną (*Psittacula krameri*). Na przykładzie blaskodziobych omówiono zagrożenia wynikające z pasożytnictwa lęgowego oraz hybrydyzacji różnych gatunków ptaków. Działania podejmowane w przypadku kontroli gatunków inwazyjnych to przede wszystkim monitoring, a w pewnych przypadkach odłów oraz odstrzał.
- Słowa kluczowe:** ptaki, gatunki obce, gatunki inwazyjne

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