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Long-term changes in the population of the Aquatic Warbler *Acrocephalus paludicola* in Poleski National Park (Eastern Poland) in the context of extensive agricultural use

Wieloletnie zmiany liczebności wodniczki *Acrocephalus paludicola* w Poleskim Parku Narodowym (wschodnia Polska) w kontekście ekstensywnego użytkowania rolniczego

Summary. The aim of the work is to analyse changes in the size of the population of the Aquatic Warbler *Acrocephalus paludicola* in the context of extensive agricultural use of Bagno Bubnów (Bubnów Marsh) and Bagno Staw (Staw Marsh) in Poleski National Park. Between the years 2007 and 2009 the population of the Aquatic Warbler was small and amounted to only 172–182 singing males (♂♂). Since 2011 there has been a growth in the size of the population, which has reached 351–389 ♂♂. The surface area of extensive use of the Aquatic Warbler's habitat was variable and comprised between 11.3 ha in 2002 and 537.7 ha in 2014. The Aquatic Warbler population in Poleski National Park is one of the most important worldwide, and one of the key ones in Poland and the EU; therefore, it is essential to maintain its extensive use at the level of at least 300–500 ha. On the other hand, the population of over 200 ♂♂, i.e. about 2% of the global population, should be considered as 'minimally safe'.

Key words: *Acrocephalus paludicola*, Aquatic Warbler, number of singing males, Poleski National Park

INTRODUCTION

In the 20th century the size of the global population of the Aquatic Warbler *Acrocephalus paludicola* decreased by over 90%. As a result this bird has become not only the rarest migratory bird in Europe, but also a globally endangered species (VU category – Vulnerable) with a relatively high risk of extinction [Aquatic Warbler Conservation Team 1999, Flade and Lachmann 2008, BirdLife International 2013, IUCN 2013]. In the 1990's the size of the global population was estimated at 13500–21000 ♂♂ [Aquatic Warbler Conservation Team 1999]. By the year 2008, the number had decreased to the level of 12600–17000 ♂♂, and the present state of the global population reveals a further

decrease to 10500–14200 ♂♂ [Flade and Lachmann 2008]. This species breeds in merely 40 sites worldwide situated in 6 countries. Over 90% of the existing global population inhabits only 3 countries: Belarus, Ukraine and Poland. Belarus is inhabited by 5840 ♂♂ (about 40% of the global population); Ukraine – 3500–4000 ♂♂ (about 30% of the global population), and Poland – 2700–3460 ♂♂ (about 25% of the global population) [Flade and Lachmann 2008]. Moreover, in Europe small populations that are becoming extinct are encountered also in Germany [Flade and Lachmann 2008]. The Aquatic Warbler has stopped nesting in Latvia and Hungary within the last few years (Z. Végvári – unpublished materials). This bird is a migratory species, and during the migration to winter habitats it was recorded in Holland, Belgium, France, Spain, Portugal and Morocco, as well as Great Britain and Bulgaria. It winters in West Africa – Senegal, Mauretania and Mali [Flade and Lachmann 2008, Atienza *et al.* 2001, Jiguet *et al.* 2011, Poluda *et al.* 2012].

The Aquatic Warbler has been the object of numerous research papers [e.g. Dyrcz and Zdunek 1993, Dyrcz *et al.* 2004, Kozulin *et al.* 2004, Vergeichik and Kozulin 2006, Tanneberger *et al.* 2008, 2009, 2010, 2013, Oppel *et al.* 2011, Flade *et al.* 2011, Dyrcz *et al.* 2011, Buchanan *et al.* 2011, Kubacka *et al.* 2014, Grzywaczewski *et al.* 2014a, 2014b, Oppel *et al.* 2014]; yet, there are few works devoted to current trends in the size of the population of this species worldwide [Aquatic Warbler Conservation Team 1999, Kozulin and Flade 1999, Flade and Lachmann 2008], including Poland [Piotrowska *et al.* 1990, Dyrcz and Czeraszkiewicz 1993, Piotrowska 2000, Tomiałojć and Stawarczyk 2003, Sikora *et al.* 2007, Wójciak *et al.* 2005, Zadrąg 2012].

Poleski National Park is one of the 12 most important breeding sites for the Aquatic Warbler in the world [Flade and Lachmann 2008]. Simultaneously, it is one of the key areas for the breeding population in Poland and the EU [Wilk *et al.* 2010]. Such is the significance for the Aquatic Warbler of the open low peatlands of Poleski National Park that an analysis is required of the change in the size of the population of this endangered bird species, which is becoming extinct. The study aimed to analyse the changes in the size of the Aquatic Warbler population in the context of extensive agricultural use at Bubnów Marsh and Staw Marsh.

STUDY AREA AND METHODS

The study was carried out at Bubnów Marsh and Staw Marsh, which are the Natura 2000 area (area code: PLB060001) and a part of Poleski National Park (fig. 2). The park is located in eastern Poland, and in terms of administrative division it belongs to the Lubelskie region. In terms of physiography the location of the park is as follows: Province: East Baltic-Belarusian Lowlands; Sub-province: Polesie; Macro-region: West Polesie; Meso-region: Łęczna-Włodawa Lakeland). The area's climate is influenced most of all by masses of polar-and-sea and polar-and-continental air. Precipitation, which has a direct influence on the Aquatic Warbler's breeding site, runs at about 275 mm. Summer rainfalls prevail, which in July reach the maximum level of 76–83 mm. The average number of days with rainfall or snowfall in this area amounts to about 150. Moreover, the average annual temperature amounts to 7.3°C with January being the coldest month (–4.1°C on average), and July the hottest one (17.9°C on average) [Kondracki 1998, Kaszewski 2002, www.poleskipn.pl].

The level of groundwater was variable both in particular months and consecutive years (changes in water level were defined on the basis of changes in groundwater level on a piezometer mounted on the eastern part of Bubnów Marsh, near the village of Karczunek – 51°21'22,1N, 23°19'02,4"E). The highest groundwater level is reached (according to the data for the years 2009–2014) in April (6.4 cm on average) and May (9.8 cm on average). In the following months the groundwater level lowered and reached the following averages: June – 13.2 cm, July – 17.8 cm and August – 20.5 cm (table 1) (Poleski Park Narodowy – unpublished materials).

Table 1. Changes in groundwater level on Bubnów Marsh between 2009 and 2014 (on the basis of data from hydrological monitoring conducted by Poleski National Park)
Tabela 1. Zmiany poziomu wód gruntowych na Bagnie Bubnów w latach 2009–2014 (opracowano na podstawie danych z monitoringu hydrologicznego prowadzonego przez Poleski Park Narodowy)

Month Miesiąc	2009	2010	2011	2012	2013	2014	2009–2014 average/ średnia
IV	13	8	3	5	–9	6	6.4
V	13	9	11	11	3	4	9.8
VI	11	11	37	11	–2	–1	13.2
VII	–7	10	16	55	10	7	17.8
VIII	2	12	–2	66	40	5	20.5

The density of singing males (♂♂) is positively correlated with the number of females and the density of nests. That is why the counting of singing males is an appropriate index and a simple tool in monitoring the population, including the effectiveness of efforts connected with active protection of the Aquatic Warbler's habitats [Kubacka *et al.* 2014]. Field research was conducted according to methodology suggested by Dyrcz and Krogulec [2009] in the years 2007, 2009, 2011, 2012, 2013 and 2014. Each year, one count was carried out of the whole of the Aquatic Warbler's breeding habitats only on Bubnów Marsh and Staw Marsh (fig.1). Field inspections were made between 20th May and 10th June, during the first hatching of the Aquatic Warbler. They could exceptionally be complemented by additional inspections made until the turn of June and July. The counting was carried out between 7.30 and 9.30 p.m., i.e. about an hour or an hour and a half before, and half an hour after sunset, when the singing activity of males is the highest. A group of 5–7 people moved within a distance of 50–70 metres on mapped out routes and counted the singing Aquatic Warbler males. Each observer was equipped with a GPS receiver which served to determine the geographic coordinates of particular singing males. For comparison, data published in the 1980's and 1990's for this area were taken into consideration [Piotrowska *et al.* 1990, Dyrcz and Czeraszkiewicz 1993, Piotrowska 2000].

RESULTS

1. Changes in population in Poleski National Park

At the beginning of the 21st century, the Aquatic Warbler of Poleski National Park inhabited only two fen mires: Bubnów Marsh and Staw Marsh (fig. 1) The Aquatic Warbler population between the years 2007 and 2009 was low and amounted to 172–182 ♂♂. Since 2011 there has been a growth in the number of the population up to the level of 351–389 ♂♂ (table 2). The smallest number on Bubnów Marsh was noted in 2009 – 131 ♂♂ and 2007 – 137 ♂♂. Since 2011 there has been a growth in the number of singing males on this fen mire, and in 2014, 355 ♂♂ were noted (which is the highest number noted within the last 25 years). On Staw Marsh, between 2004 and 2005, 55–105 ♂♂ were noted. From that time, the number of males had been decreasing until 2011, when only 19 ♂♂ were noted. Since 2012 the population has increased up to 34–44 ♂♂ (table 2).

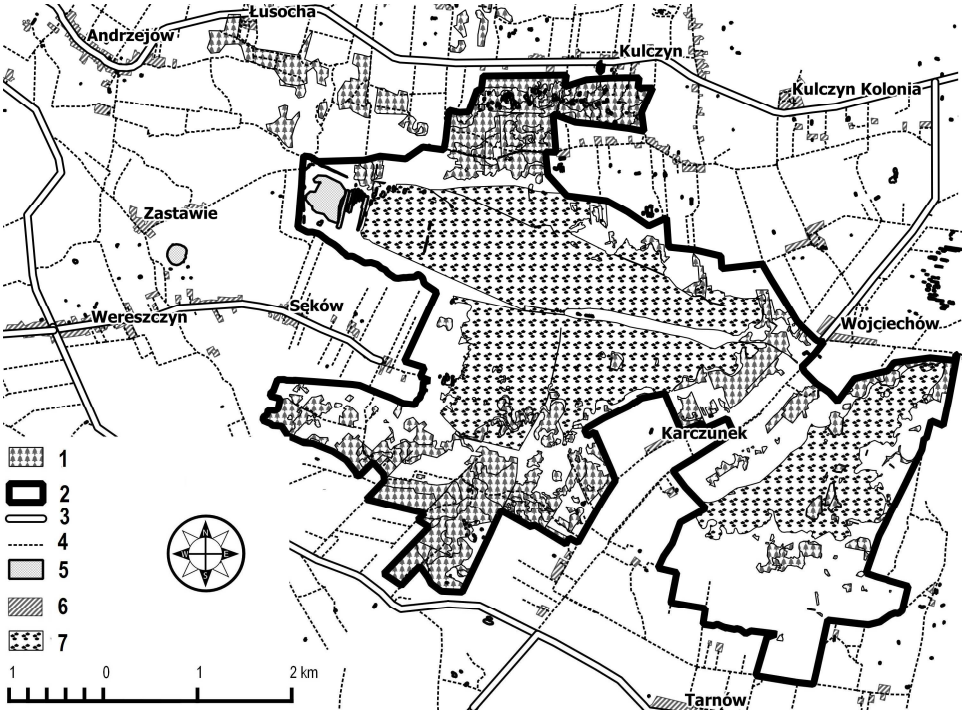

Fig. 1. Distribution of Aquatic Warbler's breeding habitats on Bubnów Marsh and Staw Marsh in Poleski National Park at the beginning of the 21st century; BB – Bubnów Marsh, BS – Staw Marsh, 1 – Forrest; 2 – Poleski National Park frontiers, 3 – main roads, 4 – local roads, 5 – lake/pool, 6 – village, 7 – Aquatic Warbler breeding site

Rys. 1. Rozmieszczenie siedlisk lęgowych wodniczki na Bagnie Bubnów i Bagnie Staw w Poleskim Parku Narodowym na początku XXI w.; BB – Bagno Bubnów, BS – Bagno Staw, 1 – lasy, 2 – granica Poleskiego Parku Narodowego, 3 – główne drogi, 4 – lokalne drogi, 5 – jezioro/rozlewisko wody, 6 – wsie, 7 – siedlisko lęgowe wodniczki

Table. 2. The dynamics of the population of the Aquatic Warbler singing males (♂♂) on Bubnów Marsh and Staw Marsh in Poleski National Park between 2004 and 2014
Tabela 2. Dynamika liczebności śpiewających samców (♂♂) wodniczki na Bagnie Bubnów i Bagnie Staw w Poleskim Parku Narodowym w latach 2004–2014

Year Rok	BubnówMarsh Bagno Bubnów	Staw Marsh Bagno Staw	Poleski National Park total Poleski Park Narodowy razem
2004		105	
2005		55	
2006		59	
2007	137	45	182
2008		35	
2009	131	41	172
2010		26	
2011	212	19	231
2012	254	43	297
2013	307	44	351
2014	355	34	389

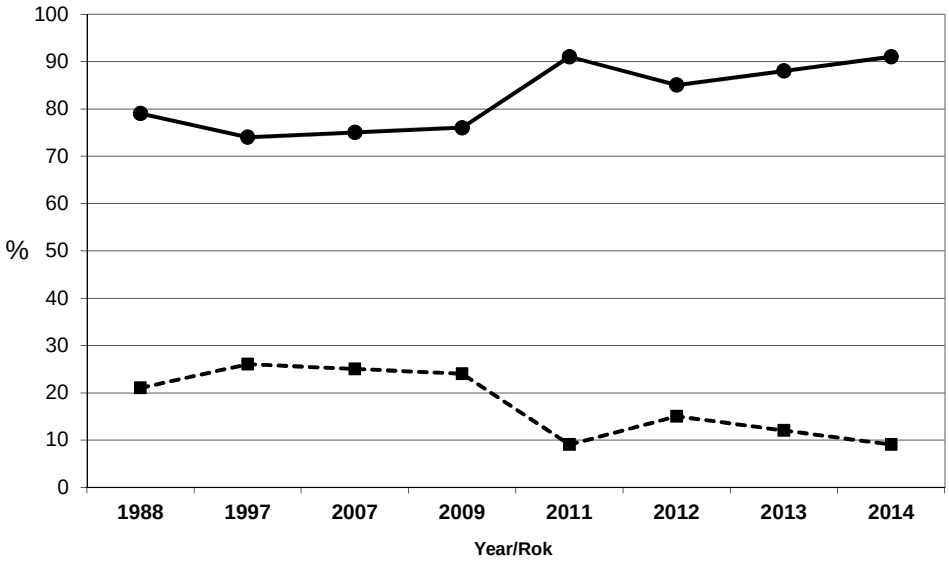

Fig. 2. The Significance of Bubnów Marsh and Staw Marsh for the Aquatic Warbler in Poleski National Park (data from the year 1988 – Piotrowska *et al.* 1990, data from the year 1997 – Piotrowska 2000); —●— Bubnów Marsh, -■- Staw Marsh
Rys. 2. Znaczenie Bagna Bubnów i Bagna Staw dla wodniczki w Poleskim Parku Narodowym (dane z 1988 r. – Piotrowska *et al.* 1990, dane z 1997 r. – Piotrowska 2000); —●— Bagno Bubnów, -■- Bagno Staw

Until 2009, Staw Marsh was inhabited by over 20% of Poleski National Park's population. Within the latest 4 years, the number has decreased and at present, less than 15% of the Park's population inhabits this marsh (fig. 2). The population number of the Poleski National Park Aquatic Warbler has increased since 2011 to the level of over 200 ♂♂, i.e. about 2% of the global population; such a number should be considered to be 'minimally safe'.

2. The effect of extensive agricultural use

The area of extensive use of the Aquatic Warbler's habitat was variable and extended between 11.3 ha in 2002 and 537.7 ha in 2014. Between the years 2002 and 2012, each year an average of 50 ha of the Aquatic Warbler's breeding habitat was exploited (fig. 3). The greatest part of the land (>500 ha) was exploited through mowing the sedge *Carex* sp., the saw sedge *Cladium mariscus* and the common reed *Phragmites australis*. These activities were done with the use of snowcats in August and September. The mown biomass was removed out the breeding habitat. This usage was applied in the years 2013 and 2014. The longest period of using the habitat (between the years 1998 and 2001) was for the purpose of mowing the reed, cutting down shrubs, tree saplings and suckers. Once, in 1990, a fire broke out, which caused 100 ha of the peatland to be burnt.

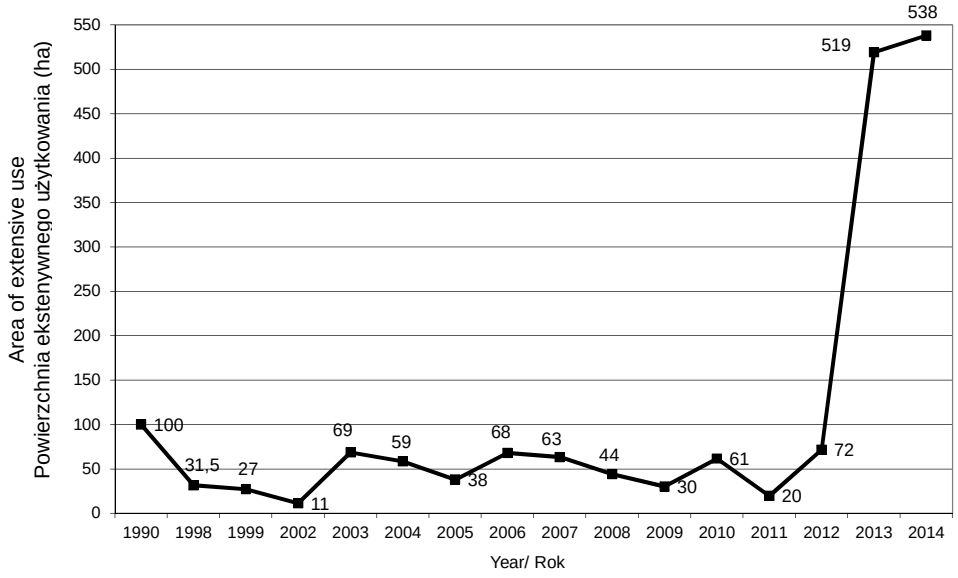

Fig. 3. Extensive use of Bubnów Marsh and Staw Marsh in Poleski National Park
(W. Raduj – Poleski National Park – unpublished data)
Rys. 3. Ekstensywne użytkowanie Bagna Bubnów i Bagna Staw w Poleskim Parku Narodowym
(W. Raduj – Poleski Park Narodowy – dane niepubikowane)

DISCUSSION

According to various authors, in the 21st century the population of the Aquatic Warbler in Poland was estimated differently: 2900–2950 ♂♂ [Tomiałojć and Stawarczyk 2003], 2800–3000 ♂♂ [Sidło *et al.* 2004], 3400–3550 ♂♂ [Sikora *et al.* 2007], 2700–3460 [Flade and Lachmann 2008]. Despite these slight differences, the Aquatic Warbler population in Poland seems to be stable, as in the year 2012, as a result of a precise nationwide survey, 3256 ♂♂ were estimated [Zadrąg 2012].

Over 90% of the national population inhabits eastern Poland, especially two regions: the Biebrza Valley (2671 ♂♂ – over 80% of national population, about 20% of global population) and the Polish part of the Polesie region (494 ♂♂ – 15% of national population, 4% of global population) [Zadrąg 2012]. In the Polesie region, the highest number of the Aquatic Warbler is encountered in Poleski National Park on Bubnów Marsh and Staw Marsh (297 ♂♂ – 9% of national population, 2% of global population) [Zadrąg 2012]. Aquatic Warbler had not been discovered in this area until the late 1980's, before Poleski National Park was established [Piotrowska *et al.* 1990, Piotrowska 2000]. It was a period of the first, and simultaneously the highest size of the population – in 1998, 340 ♂♂ was noted on Bubnów Marsh, and 90 ♂♂ on Staw Marsh. The total number for this period amounted to 430 ♂♂ (fig. 5) [Piotrowska *et al.* 1990, Dyrcz and Czeraszkewicz 1993, Piotrowska 2000]. In 1997, when Poleski National Park already existed, the number lowered down to 240 ♂♂ – on Bubnów Marsh there were 179 ♂♂, and on the Staw Marsh 61 ♂♂. From this time, for almost 15 years the population was decreasing and the lowest level of the population in the history of the research on the Aquatic Warbler in this area was reached in 2009, when only 172 ♂♂ were noted. Since 2011 an increase in the population has been noted (fig. 4). The decrease may have been caused by many reasons, such as: channeling groundwater and surface water in the period of breeding; too high a water level above the ground (>10 cm), succession of reeds, shrubs and trees; fire in the period of breeding; abandoning extensive mowing and pasturing; intensifying extensive mowing and pasturing; changes in habitats in the places of migration and wintering [e.g. Dyrcz and Zdunek 1993, Dyrcz and Czeraszkewicz 1993, Dyrcz *et al.* 2004, Kozulin *et al.* 2004, Vergeichik and Kozulin 2006, Tanneberger *et al.* 2008, 2009, 2010, 2013, Jiguet *et al.* 2011, Oppel *et al.* 2011, Flade *et al.* 2011, Dyrcz *et al.* 2011, Buchanan *et al.* 2011, Poluda *et al.* 2012, Grzywaczewski *et al.* 2014a, Kubacka *et al.* 2014].

One of the most important methods of an active protection of the Aquatic Warbler's breeding habitats is the mowing. This way of managing the breeding habitat is a principal and effective tool of controlling the succession of reeds, shrubs and trees [Flade and Lachmann 2008, Tanneberger *et al.* 2009, Lachmann *et al.* 2010, Kubacka *et al.* 2014]. Moreover, the number of singing males is positively correlated with the density of nests; therefore, males are a good index of the effectiveness of mowing as a method of an active protection of the Aquatic Warbler's habitats [Kubacka *et al.* 2014]. Through mowing, the quality of the Aquatic Warbler's breeding habitat improves [Kloskowski and Krogulec 1999, Tanneberger *et al.* 2009, Kubacka *et al.* 2014]. However, in the first year after mowing the value decreases due to changes in the vegetation structure, similarly to a situation when a fire takes place [Kloskowski and Krogulec 1999, Grzywaczewski *et al.* 2014a]. Yet, in the second year the flora regenerates and the habitat value increases

[Kloskowski and Krogulec 1999, Kubacka *et al.* 2014]. Therefore, it is recommended that the areas of the Aquatic Warbler's breeding habitats should not be mown more frequently than every second year, after 15th September [Kubacka *et al.* 2014]. Moreover, mowing ensures the availability of a high-quality habitat, which is indexed by the density of nests, the number of which increases in the second year after mowing. The growth in the density of nests is connected with the vegetation regeneration and the appearance of a layer of litter, where females build nests. An increase in the number of nests increases the productivity of chicks, which in turn reinforces the species population [Kubacka *et al.* 2014]. In Poleski National Park activities have been taken for many years to actively protect the Aquatic Warbler's breeding habitats through mowing plants and/or removing shrubs, trees and their suckers. Since 2013, the mown area of the Aquatic Warbler's reproduction has increased due to leasing the grounds to private people and companies with the aim of their extensive agricultural use. This responded to the needs of active protection of the Aquatic Warbler's breeding habitat, and funds for these activities were obtained from the Agro-environmental programme. This, in turn, resulted in the growth in the species population. The population of the Aquatic Warbler in Poleski National Park is one of the most important worldwide, nationwide and in the EU; therefore, it is essential to maintain the extensive use at the level of at least 300–500 ha.

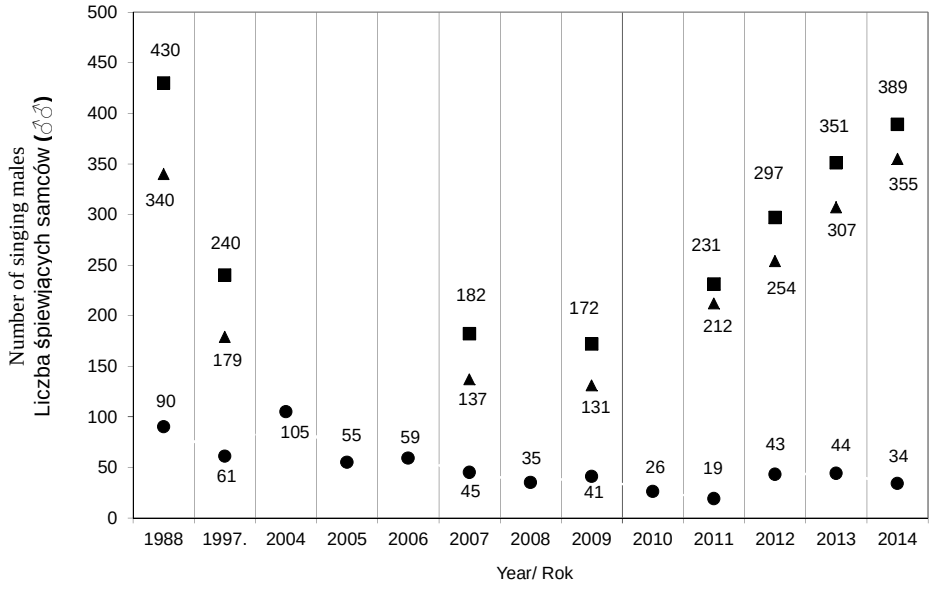

Fig. 4. Population dynamic of Aquatic Warbler population in Poleski National Park between 1988 and 2014 (data from 1988 – Piotrowska *et al.* 1990, data from 1997 – Piotrowska 2000); ● Bubnów Marsh, ▲ Staw Marsh, ■ total of Poleski National Park

Rys. 4. Zmiany liczebności wodniczki w Poleskim Parku Narodowym w latach 1988–2014 (dane z 1988 r. – Piotrowska *et al.* 1990, dane z 1997 r. – Piotrowska 2000); ● Bagno Bubnów, ▲ Bagno Staw, ■ razem Poleski Park Narodowy

A positive influence of mowing, not only in fen mires but also road shoulders was proved in the case of the Skylark *Alauda arvensis*. This bird species obtained food and built nests on road shoulders rather than the surrounding fields, and summer mowing had a decisive influence on the number or distribution of the birds [Laursen 1981]. However, some data indicate that mowing has also negative effects, especially in the case of centripetal method. This method contributed to an increase in a mortality rate of the Corncrake *Crex crex* chicks. A change in time and the method of mowing into centrifugal led to an increase in chicks' survivability. Similarly to the peat bogs in Poleski National Park, a programme of the Corncrake protection was realised in Great Britain and Ireland; it was connected with payments for farmers as compensation for the delayed meadow mowing [Green *et al.* 1997]. However, one should take into consideration that active protection should be conducted extensively as the intensification of agriculture leads to a decrease in the size of the population of many bird species [Newton 2004]. A growth in agricultural intensification on permanent grasslands depends inter alia on an increase in chemical fertilizers used and animal stock, which results in lowering the usefulness of these lands as breeding habitats of birds [Vickery *et al.* 2001].

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Streszczenie. Celem pracy była analiza zmian liczebności populacji wodniczki w kontekście ekstensywnego użytkowania rolniczego na Bagnie Bubnów i Bagnie Staw w Poleskim Parku Narodowym. Liczebność wodniczki w latach 2007–2009 była niska i wyniosła 172–182 śpiewających samców (♂♂). Od 2011 r. nastąpił wzrost do poziomu 351–389 ♂♂. Powierzchnia ekstensywnego użytkowania siedliska wodniczki była zmienna i zawierała się w przedziale od 11,3 ha w 2002 r. do 537,7 ha w 2014 r. Ponieważ populacja wodniczki w Poleskim Parku Narodowym jest jedną z najważniejszych na świecie, a Poleski Park jednym z kluczowych obszarów dla populacji lęgowej w Polsce i Unii Europejskiej, stąd też istotne jest utrzymanie rozpoczętego ekstensywnego użytkowania na poziomie co najmniej 300–500 ha. Natomiast liczebność śpiewających samców >200 – tj. około 2% populacji światowej – należy uznać za „minimalnie bezpieczną".

Słowa kluczowe: *Acrocephalus paludicola*, wodniczka, liczebność śpiewających samców, Poleski Park Narodowy