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RESEARCH ARTICLE

Lake minnow, *Eupallasella percnurus* (Pall.), in Lubelskie Voivodeship in Poland – occurrence, threats, and protection

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Abstract. This paper presents updated information on the past and present occurrence of the endangered cyprinid lake minnow, *Eupallasella percnurus* (Pall.), in Lubelskie Voivodeship in Poland. It includes an approximate assessment of threats to its existence and perspectives for its protection. The area of today's voivodeship was the largest national sanctuary for this species as early as in the 1950s; however, of 52 known historical sites, only seven are currently extant. Wide-ranging field inventories conducted in the voivodeship in 2002-2010 revealed the existence of 40 previously unknown sites. The present state of *E. percnurus* occurrence was assessed for 44 sites, nearly half of which are located in the Dorohuskie Depression mesoregion around the village of Siedliszcze. Only one site was confirmed in Poleski National Park. The sites in this region appear to be less endangered in comparison to those located in other Polish voivodeships with nearly 50% classified as threatened to a low degree. At present, 18 sites, or 40.9%, are under various forms of protection, mainly under the auspices of the European Ecological Natura 2000 Network.

Keywords: lake minnow, distribution, threats, conservation, Lubelskie Voivodeship (Poland)

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Introduction

The lake minnow, *Eupallasella percnurus* (Pall.), is one of the rarest, most endangered freshwater fish species occurring in Poland (e.g., Wieser 1992, Witkowski 1992, Kusznierz 1995, 2001). This tiny representative of the family Cyprinidae inhabits small, shallow water bodies that are highly vulnerable to destruction, currently most often of anthropogenic origin as former peat or clay excavations (Wolnicki and Radtke 2009). In the twentieth century, the region of today's Lubelskie Voivodeship comprised the largest sanctuary for this species in Poland (Wolnicki and Kolejko 2008, Wolnicki and Sikorska 2009). Following extensive swamp drainage and land reclamation projects conducted there in the 1960s and 1970s, the vast majority of *E. percnurus* sites became extinct just before the beginning of the 2000s (Danilkiewicz 1973, 1985, 1997, 2001). A decade ago, the number of existing sites in the voivodeship, outside of the Poleski National Park, was estimated at just three (Kusznierz et al. 2005). These authors, however, anticipated the discovery of as many as several more sites within the park boundaries.

In 2002, the most systematic and far-reaching inventory ever conducted in Lubelskie Voivodeship was begun. It focused on parts of the region where *E. percnurus* was known to have occurred previously and other areas in which this species had never been found. An unexpected number of sites that had previously been unknown were confirmed in many of

the areas inventoried (Kolejko et al. 2005, Kolejko and Wolnicki 2006, Wolnicki et al. 2006, Sikorska et al. 2007, Wolnicki and Kolejko 2008).

The present work is an updated review of both published and unpublished data on the past and present occurrence of *E. percnurus* in this voivodeship, and it includes an assessment of threats to existence of the habitats, populations, and sites of occurrence of this species. Data regarding the present status of the species and measures required for its protection in the voivodeship are also discussed.

Study area

The present studies focused on all the regions of Lubelskie Voivodeship in which there were sites at which *E. percnurus* had been confirmed to occur abundantly in the twentieth century. These included the Łęczyńsko-Włodawska Plain mesoregion (Kondracki 2009) and the valleys of the Tyśmienica, Piwonia, and Włodawka rivers (e.g., Urbański 1946, Kulamowicz 1962, Danilkiewicz 1965, 1968, 1973, Gąsowska and Rembiszewski 1967) (Fig. 1). Other areas of the voivodeship were chosen to be inventoried based on topographic maps (1:25,000 scale) that indicated where particularly large complexes of former peat and clay excavations had been located. Much valuable information concerning the occurrence of *E. percnurus* was obtained from local communities, especially anglers. Reports that were considered reliable were verified in the field, and from July 2002 to May 2010 more than 200 water bodies were investigated.

Material and methods

In 2002-2004, *E. percnurus* occurrence in water bodies was investigated using either rods and lines or lift nets, but later the fish were caught with specialized baited folding traps with two openings (25 x 25 x 40 cm; mesh 5 mm; opening diameter 60 mm) (Wolnicki et al. 2006, 2008). Fishing was conducted mostly from May to August. Trap exposition time was 0.5-1 h, and usually 2-4 traps were deployed in individual water bodies. If no fish were caught during a single sampling event, another attempt was made usually within the same year. The number of *E. percnurus* individuals caught as a single sample in individual water bodies where population of this species occurred ranged from several to more than a hundred. All fish caught were immediately released alive into the same water body in which they had been caught.

The geographical situation of all water bodies inhabited by *E. percnurus* was determined with a handheld GPS hand (Garmin GPSmap 60C; 4-8 m accuracy). At each confirmed *E. percnurus* site, the factors crucial for the continued existence of the fish populations or habitats or both were determined. The degree of threat to the continued existence of all sites was evaluated according to the classification system developed by Wolnicki and Radtke (2009, 2010).

Results

The field inventory performed in Lubelskie Voivodeship in 2002-2010 indicated that *E. percnurus* inhabited more than 60 individual water bodies at 42 distinctly separate sites. Most of the sites (27 or 61.4%) were cohesive complexes of at least several water bodies; however, not all were necessarily inhabited by this fish. All of the water bodies inhabited by *E. percnurus* were man-made, and nearly all had formed following peat extraction several decades previously. The total number of sites currently extant in the voivodeship is estimated to be 44 (Table 1). The highest concentration of sites (20) was noted within a radius of several kilometers from the village of Siedliszcze in the Dorohuskie Depression mesoregion (Fig. 2). Five sites were also confirmed in the Tyśmienica River valley, and another five were located on the Łęczyńsko-Włodawska Plain.

Six major threats to the continued existence of *E. percnurus* habitats and populations were identified (Table 1). Continual shallowing of water body

Table 1

List and general characteristics of extant *E. percnurus* sites in Lubelskie Voivodeship in May 2011 (alphabetical order)

No.	Site/year of discovery	Geographical coordinates	Number of water bodies	Protection status[1]	Threats identified[2]	Level of threat[3]
1	Aleksandrówka/ 2007	51°12'32"N; 23°07'47"E	1	NOP	SHA, OVE	H
2	Andrzejów/2009	51°23'21"N; 23°12'54"E	1	NOP	INT	M
3	Bagno Serebryskie/2007	51°10'50"N; 23°31'51"E	c	N20[4]	SHA, OVE	L
4	Bełcząc/2008	51°40'28"N; 22°35'15"E	c	N20[5]	SHA, OVE	H
5	Bilsko/2006	51°12'37"N; 23°03'14"E	1	NOP	SHA, OVE, FIL, EXT	L
6	Ciesacin/2007	51°21'57"N; 23°06'32"E	2	N20[6]	INT	H
7	Dębowce/2006	5113'34"N; 23°09'44"E	1	N20[7]	SHA, OVE	L
8	Dębowiec/2007	51°22'37"N; 23°07'46"E	1	NOP	SHA, OVE	H
9	Dobromyśl 1/2006	51°13'27"N; 23°11'12"E	c	N20[7]	SHA, OVE	L
10	Dobromyśl 2/2006	51°13'40"N; 23°10'27"E	1	N20[7]	OVE	L
11	Dobropol/2007	51°32'12"N; 23°29'35"E	c	NOP	SHA, OVE	M
12	Dubeczno/2007	51°26'23"N; 23°26'49"E	3	N20[7]	SHA, OVE	L
13	Gliny Pn./2006	51°12'27"N; 23°07'25"E	c	NOP	SHA	L
14	Gliny Pd./2007	51°11'44"N; 23°08'12"E	c	NOP	SHA, OVE	H
15	Głębokie/2007	51°17'37"N; 23°05'59"E	c	NOP	SHA, OVE	M
16	Gotówka 1/2007	51°10'49"N; 23°33'15"E	3	NOP	SHA, OVE	M
17	Gotówka 2/2007	51°10'59"N; 23°33'25"E	1	NOP	SHA, OVE	L
18	Grabniak/2007	51°22'51"N; 23°06'51"E	c	N20[6]	SHA, OVE	H
19	Janowica/2005	51°12'57"N; 23°11'10"E	1	NOP	SHA, OVE, INT	H
20	Jelino/1997	51°25'29"N; 23°02'14"E	9	N20[9]	SHA, OVE, INT	L
21	Kolonia Zabitek/2006	51°12'53"N; 23°12'02"E	1	NOP	SHA, OVE	H
22	Konstantynówka/ 2008	51°21'59"N; 23°25'35"E	1	NOP	SHA, EXT	M
23	Kosyń 1/1992	51°23'46"N; 23°33'38"E	c	N20[8]	OVE	L
24	Kosyń 2/2008	51°23'12"N; 23°34'51"E	1	NOP	OVE, INT	H
25	Kulik/2005	51°14'56"N; 23°11'03"E	3	NOP	OVE	M
26	Lichty/2008	51°42'17"N; 23°37'09"E	2	N20[5]	SHA, OVE, WAT	H
27	Lipniak/2008	51°40'07"N; 22°32'22"E	3	NOP	OVE	L
28	Ludwinów/2007	51°16'38"N; 23°13'59"E	1	NOP	OVE	L
29	Mogielnica/2006	51°12'47"N; 23°13'55"E	c	NOP	OVE, EXT	L
30	Moszne/2008	51°27'26"N; 23°06'44"E	1	PNP	WAT	M
31	Poczekajka/2007	51°09'35"N; 23°12'29"E	c	NOP	OVE	L
32	Podpakule/1991	51°21'12"N; 23°28'26"E	4	N20[10]	OVE, INT	L
33	Rzymki/2007	51°53'05"N; 22°28'45"E	1	NOP	SHA, OVE	H
34	Siedliszcze 1/2005	51°11'56"N; 23°09'04"E	3	NOP	SHA, OVE	L
35	Siedliszcze 2/2005	51°11'53"N; 23°09'18"E	1	NOP	SHA, OVE	L
36	Siedliszcze 3/2006	51°12'08"N; 23°09'14"E	1	NOP	SHA, OVE	M
37	Siedliszcze 4/2006	51°12'11"N; 23°08'57"E	1	NOP	SHA, OVE	H
38	Skoki/2008	51°42'04"N; 23°08'57"E	c	N20[5]	SHA, FIL	H
39	Stasin Dolny Pn./2007	51°11'25"N; 23°08'38"E	c	NOP	SHA, OVE	H
40	Stasin Dolny Pd./2006	51°10'05"N; 23°09'14"E	c	N20[11]	SHA	L
41	Suchowola/2004	51°41'15"N; 22°42'55"E	4	N20[5]	SHA, OVE	L
42	Sumin/2002	51°22'33"N; 23°10'21"E	4	N20[6]	SHA, OVE	L
43	Wólka Siemieńska/2009	51°38'21"N; 22°43'39"E	2	NOP	SHA, OVE, INT	H
44	Żminne/2009	51°38'45"N; 22°46'56"E	c	N20[5]	SHA, OVE, WAT	M

c – large complex of water bodies, exact number not determined

[1]N20 – protected within the Natura 2000 Network; NOP – non-protected; PNP – protected in Poleski National Park;

[2]SHA – permanent shallowing of water body basin; OVE – overgrowth by aquatic vegetation; WAT – unfavorable water properties; FIL – intentional filling in; EXT – industrial extraction of peat or other materials in the neighborhood; INT – fish introductions or presence of invasive fish species or both; [3]L – low, M – medium, H – high;

[4]PLH060023 "Torfowiska Chełmskie"; [5]PLB060004 "Dolina Tyśmienicy"; [6]PLH060009 "Jeziora Uściwierskie";

[7]PLH060033 "Dobromyśl"; [8]PLH060043 "Lasy Sobiborskie"; [9]PLH060095 "Jelino";[10]PLH060048 "Podpakule"; [11]PLH060065 "Pawłów".

basins and submerged and emerged macrophyte overgrowth, which usually occurred simultaneously, were classified as posing the greatest threat to fish habitats. Six sites were threatened by introductions of potentially dangerous fish species. Fifteen sites (34.1%) were found to be endangered to high degree, while 20 sites (45.5%) were assessed to be threatened to low degree.

At present, 17 *E. percnurus* sites are protected under the auspices of the European Ecological Natura 2000 Network, and one is protected in Poleski National Park (Table 1).

Discussion

Historical state of occurrence

Wolnicki and Sikorska (2009) reviewed all available scientific sources, and 52 *E. percnurus* sites in today's Lubelskie Voivodeship were reported in the twentieth century. It is noteworthy that in four other voivodeships in Poland where populations of this species were confirmed historically, just 47 sites were confirmed during the same time period. The historical sites in Lubelskie Voivodeship were fairly scattered, but there are two larger concentrations (Fig. 1). The first comprises 23 sites located along the Tyśmienica River, and the second comprises 20 sites within the Lubartów-Parczew-Włodawa-Łęczna quadrilateral.

It is surprising that the earliest reports of *E. percnurus* occurrence in the area of Lubelskie Voivodeship were made late in comparison to those from other regions in Poland. Kaj (1953) published the first report of a site that existed in 1936 in Wola Tulnicka, not far from Parczew. Urbański (1946) reported there were six other sites near Sosnowica and Lubartów (e.g. Chlewiska, Kocia Góra, Zawieprzyce). Subsequent reports were published considerably later in the 1960s. Kulamowicz (1962) was the first to publish information about sites discovered in 1957 in Jedlanka, Ryczka, Krasne, and Krzczeń, which were also quite close to Lubartów. Then Danilkiewicz (1965, 1968) reported the occurrence

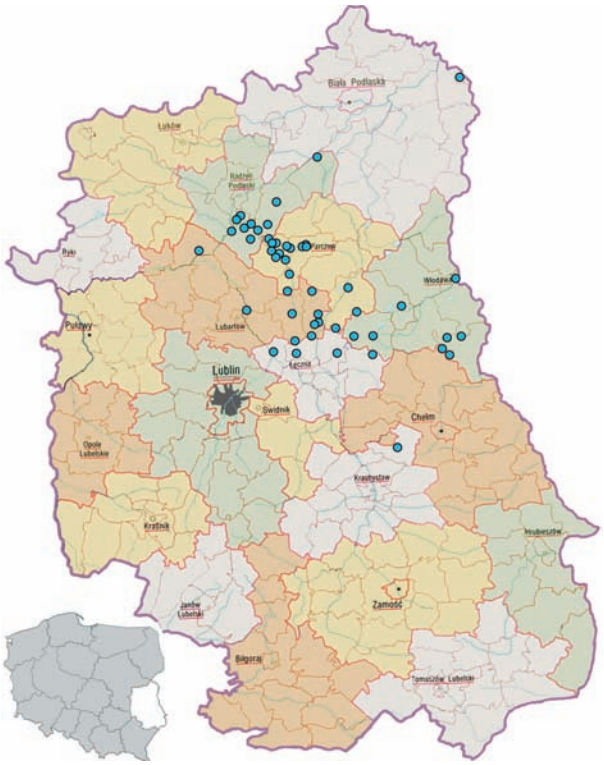

Figure 1. Distribution of *Eupallasella percnurus* sites in the today's Lubelskie Voivodeship in Poland by the end of the twentieth century.

of *E. percnurus* at 13 sites in the vicinity of Parczew, whereas Gąsowska and Rembiszewski (1967) reported one site in Parczew itself and another one in Rejowiec. Some further historical sources (Danilkiewicz 1973, 1984-85, 1985, 1997, 2001, Kusznierz unpubl. data) mention sites occurring in other parts of the voivodeship. Piotrowski (1994) and Radwan et al. (2002) published the only known reports of *E. percnurus* sites in Poleski National Park.

Despite the rather modest figures quoted above, the fact that slightly less than a half of a century ago, the area of today's Lubelskie Voivodeship was the largest *E. percnurus* sanctuary in the country is unquestionable (Wolnicki et al. 2006). This was certainly because of the widespread local custom of excavating peat for use in household heating and cooking. Peat excavations were concentrated in places with rich peat deposits that occurred in many of the region's swampy areas, such as river valleys (Kondracki 2009). The tradition of peat exploitation resulted in thousands of smaller or larger sites being

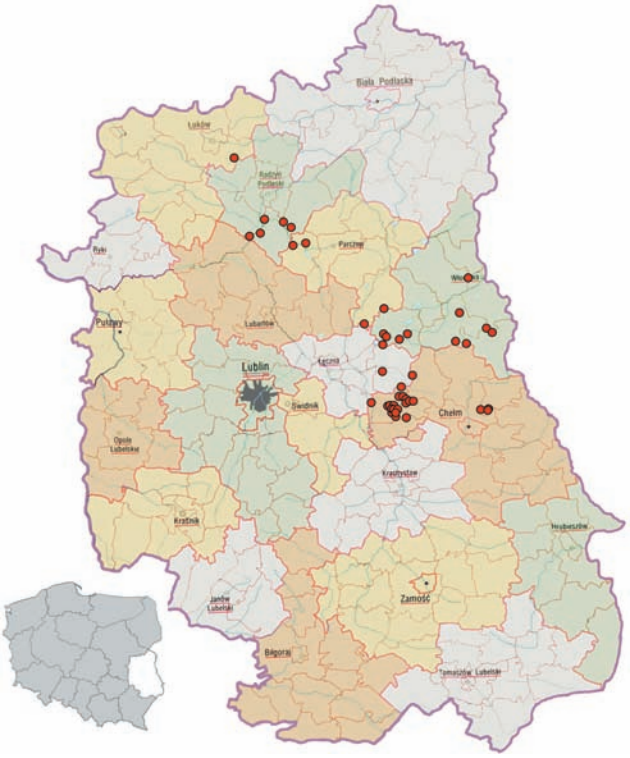

Figure 2. Present distribution of *Eupallasella percnurus* sites in the Lubelskie Voivodeship in Poland.

excavated, and hundreds of these were inhabited by *E. percnurus* populations (Danilkiewicz 1965, 1985).

It should be stressed that nearly all of the historical *E. percnurus* sites in the voivodeship referred to in scientific sources became extinct quite a long time before the end of the twentieth century (Kusznierz 1995, 1996 and unpubl. data, Danilkiewicz 2001, Wolnicki and Kolejko 2008, Wolnicki and Sikorska 2009). The latter authors estimate that a maximum of seven of these sites are extant today, and include those located in Podpakule (discovered in 1991), Kosyń 1 (1992), and Jelino (1997).

Present state of occurrence

A considerable share of the newest *E. percnurus* finds were made in areas where no previous attempts were made to find sites where this species occurs, for example in the vicinity of the village of Siedliszcze (Figs. 1 and 2). This relatively small area which extends from Rejowiec (between Chełm and Krasnystaw) northward to the Łęczna parallel has numerous old peat excavation sites as well as *E. percnurus* populations (Wolnicki et al. 2006, Wolnicki and Kolejko 2008). In light of this, discoveries of more *E. percnurus* sites in the voivodeship seem possible. The Łęczyńsko-Włodawska Plain, which has been investigated thoroughly and gives no indication there could be *E. percnurus* populations, should be excluded from areas that are considered promising (Wolnicki and Kolejko 2008).

With the 17 new discoveries of *E. percnurus* sites in the 2002-2005 period (Kolejko et al. 2005, Kusznierz et al. 2005), by 2006 there were 20 confirmed sites in Lubelskie Voivodeship outside of Poleski National Park (Kolejko and Wolnicki 2006, Wolnicki et al. 2006). A number of new finds during the 2007-2010 period (Kolejko et al. 2007, Wolnicki et al. 2007, Wolnicki and Kolejko 2008 and unpubl. data) increased the number to 44. However, *E. percnurus* became extinct at one site located in "Magazyn" Nature Reserve near Sobibór. This was likely because of predation by the invasive fish species Amur sleeper, *Perccottus glenii* (Dyb.), which is exceptionally abundant in this area, and if so this would be the first recorded incidence of *E. percnurus* extinction caused by invasive species predation (Wolnicki and Kolejko 2008).

Of the 44 *E. percnurus* sites currently extant in the voivodeship, probably as few as one is in Poleski National Park near Lake Moszne. Although its location was not identified precisely (Kolejko et al. 2007), it is likely that it is the same site reported previously by Radwan et al. (2002). The disappearance of *E. percnurus* sites in the park is worthy of discussion. It was widely believed for years that this protected area provided living conditions that were considerably more advantageous for the survival of this fish species than those in areas surrounding the park (e.g., Wolnicki 2004, Kusznierz et al. 2005, Wolnicki et al. 2006, Kolejko et al. 2007), despite the fact that the disappearance of small water bodies in the park had been noted in the twentieth century (Piotrowski 1994). According to some investigators (e.g., Różycki pers. comm.), *E. percnurus* populations might have occurred in at least 20 individual water bodies located in the park

before the end of the past century. The most recent field studies conducted in the park indicated that most of these water bodies had completely dried up (Kolejko et al. 2007, Wolnicki and Kolejko 2008). These authors contend that the site they identified in 2007 is likely the only extant one in Poleski National Park.

Threats

The extant sites in Lubelskie Voivodeship are exposed to the same major threats as those identified in other voivodeships (Wolnicki and Radtke 2009, 2010). The most common among these are permanent shallowing of water body basins and vegetation overgrowth, which usually occur simultaneously and have been confirmed to afflict the vast majority of sites (Table 1). Other threats include fish introductions and/or the presence of invasive fish species, which were recorded in the Lubelskie Voivodeship more often than in other areas (Wolnicki and Radtke 2010). It should be emphasized that the dangerous invasive fish species, brown bullhead *Ameiurus nebulosus* (Les.), has been stocked in this area for the several past decades (Wolnicki and Kolejko 2008), which is regarded as something of a local custom.

E. percnurus sites in Lubelskie Voivodeship are generally under lesser threat than those in other regions of Poland. Since these sites are often large complexes rather than single water bodies and are usually located in remote locations, they are less exposed and less susceptible to the impact of human activity. Consequently, almost 50% of the sites in this region are considered to be threatened to low degree (Table 1). In other voivodeships the share of such sites is generally lower (Wolnicki and Radtke 2009, 2010, Radtke et al. 2011, Wolnicki et al. 2011a, 2011b).

Protection

Currently, 18 *E. percnurus* sites are under various forms of protection in Lubelskie Voivodeship (Table 1), and the share of these, at 40.9% of all sites known to exist there, is higher than in Pomorskie Voivodeship with 102 sites (Radtke et al. 2011) and Mazowieckie Voivodeship with 16 (Wolnicki et al. 2011b). However, it is noteworthy that one third of protected sites are classified as threatened to high degree.

In spite of all the facts presented above, the circumstances of *E. percnurus* occurrence in this region, namely the relatively high number of sites occurring in the voivodeship, the high share of sites under protection, and the share of sites that are least threatened, actually provide conditions that favor the long-term survival of this species in this part of Poland. This assessment, however, does not apply to Poleski National Park with its (most probably) single site where active protection measures, such as those used in Mazowieckie Voivodeship, must be implemented immediately (Wolnicki et al. 2006, 2008, 2011b). Although the peat pits at Moszne Lake, which are thought to be inhabited by *E. percnurus*, do not suffer from water deficits (Kolejko et al. 2007, Wolnicki and Kolejko 2008), the living conditions there are extreme for this fish species because of the periodically high acidity of the water (Kolejko et al. unpubl. data). Thus, it would be highly desirable to construct several small, deep water bodies (by deepening former peat pits and/or digging the new ones) in which young cultivated fish (the preferable solution) or individuals captured in the wild could be safely translocated. In either instance, the fish used for translocations should originate from a large, robust, local population from a site close to Poleski National Park, such as that from Sumin.

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Streszczenie

Strzebla błotna *Eupallasella percnurus* (Pall.) w województwie lubelskim w Polsce – występowanie, zagrożenia, ochrona

Celem pracy było uaktualnienie informacji na temat dawnego i obecnego występowania w województwie lubelskim zagrożonego wyginięciem gatunku ryby karpiowatej, strzebli błotnej *Eupallasella percnurus* (Pall.), z uwzględnieniem zagrożeń dla jej siedlisk i/lub populacji oraz stanu i perspektyw ochrony. Do czasu rozpoczęcia szeroko zakrojonych prac melioracyjnych w latach 60. i 70. ubiegłego wieku, Lubelszczyzna obfitowała w małe zbiorniki wodne. Powstawały one najczęściej w wyniku wykopywania przez ludność torfu, wykorzystywanego w gospodarstwach domowych jako opał. W tamtych latach Lubelszczyzna była niewątpliwie największą krajową ostoją strzebli błotnej, a jej populacje prawdopodobnie występowały w setkach torfianek. W efekcie osuszania bagien i mokradeł większość torfianek całkowicie wyschła. Przyjmuje się, że spośród 52 historycznych stanowisk strzebli błotnej wzmiankowanych w literaturze, do początków bieżącego stulecia dotrwało najwyżej siedem. W wyniku prac inwentaryzacyjnych, przeprowadzonych w województwie w latach 2002-2010, odkryto około 40 stanowisk nieznanych nauce. Obecny wojewódzki stan posiadania ocenia się na 44 stanowiska, z których 27 (61,4% wszystkich) to kompleksy co najmniej kilku zbiorników wodnych. Większość stanowisk cechuje się trwałym przekształceniem siedlisk, tj. wypłyceniem misy zbiorników wodnych i/lub silnym ich zarośnięciem roślinnością wodną. Lokalnym poważnym zagrożeniem dla populacji strzebli błotnej są również introdukcje inwazyjnych gatunków ryb. Specyfika stanowisk lubelskich (m.in. położenie z dala od siedzib ludzkich) sprawia jednak, że 20 z nich (tj. 45,5% wszystkich) uważa się za zagrożone w stopniu niskim. Obecnie 18 stanowisk podlega różnym formom ochrony, przede wszystkim w ramach sieci Natura 2000.