

Rediscovery of *Dytiscus latissimus* Linnaeus, 1758 (Coleoptera: Dytiscidae) on the southern edge of its distribution area in Central and Eastern Poland

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Abstract: *Dytiscus latissimus* was recorded in a deep drainage ditch at the edge of the Bagno Bubnów fen in the Poleski National Park. Eight dead individuals (4♀♀ and 4♂♂) were found on 11.04.2019 in a poaching net for fish in which an otter *Lutra lutra* (Linnaeus, 1759) was caught and died. The remains of another three individuals (2♀♀ and 1♂) were found on the shore at the same site on 17.04.2020. This data is discussed on the background of data on the geographical distribution and habitat preferences of this species. The new record confirms the existence of a small island of its occurrence area in Central and Eastern Poland, the only one in the country outside the young glacial lake districts in the north-western and northern part of Poland. The new record also suggests that the habitat spectrum of the species may be at least locally wider than it is recognized – which is worth considering when looking for its potential sites.

Keywords: habitat preferences, fen, geographical distribution, conservation, protection

Introduction

Dytiscus latissimus Linnaeus, 1758 is a water beetle globally exposed to extinction (Vulnerable category). Its geographical range extends from Scandinavia and north-western Russia to Italy and the northern part of the Balkans. However, it is in a population and geographical regression: boreal zone of Europe remains its refugium, while in large areas of the western and central part of the range this species has become extinct or is on the edge of extinction (Foster 1996, Hájek & Šťastný 2005). The regress of *D. latissimus* also takes place in Poland, where it is considered vulnerable (VU) and subject to strict legal protection (Pawłowski *et al.* 2001, Przewoźny 2012). The situation is dynamic, even controlling of some of the sites discovered in the 90s of the 20th century has provided negative results (Przewoźny pers. inform.). There is a significant problem applicable to the policy of conservation of this species: what is the actual distribution area of

D. latissimus? Is it clumped, where are its boundaries? Therefore, any new data on this species is desirable, especially from areas on the edge of the its current range. In this paper, we present such data from Central and Eastern Poland and analyze it on the background of information on the occurrence of *D. latissimus* in Poland and neighboring countries.

Material and methods

The study area is located in the exclave of the Poleski National Park including the twin fens called the Bagno Bubnów and Bagno Staw (Fig. 1A). This area is located on the southern edge of the Western Polesie, rich in surface waters and wetlands, and within – on the Łęczyńsko-Włodawska Plain, which is the only lake district in Poland situated outside the zone of young glacial lake districts in the north and north-west of the country. The Bagno Bubnów is a very valuable area, which belongs to the largest open fens in Poland.

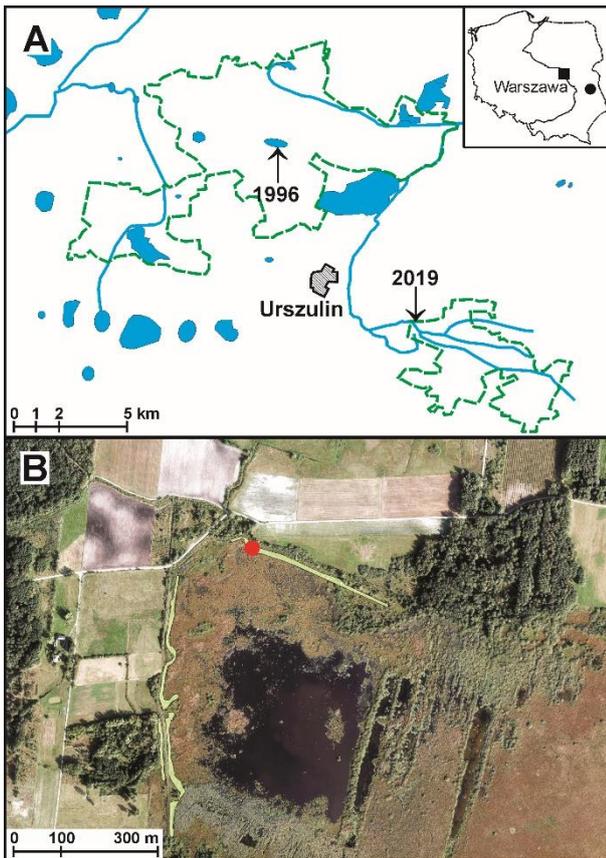


Fig. 1. Sites of *Dytiscus latissimus* in the Poleski National Park: A) map of the park (drawn by P. Buczyński); B) an aerial photo of the new site (taken from the GoogleEarth); 1996 – the site in Lake Długie (Buczyński & Piotrowski 2002), 2019 – the new site in the Bagno Bubnów fen; the drainage ditches are marked in green, the red point is the place where *Dytiscus latissimus* was found.

In addition, it represents a rare type of calcareous fens. It is characterized by: very well preserved fauna typical of this habitat, high biodiversity and the occurrence of numerous rare and endangered species and their assemblages. Therefore, on the Bagno Bubnów, Natura 2000 special area of conservation of birds – Bagno Bubnów PLB060001 and the special area of conservation of habitats SAC “Ostoja Poleska” PLH060013 have been designated (Petruczuk 2015, 2016, Solon *et al.* 2018).

The analyzed material was collected at the northwestern edge of the Bagno Bubnów, where the fen bowl is separated from the arable fields by a high dyke (Fig. 1B) made of material obtained by digging ditches up to 10 m wide and 2 m deep at the border of the

fen (Fig. 2A). The dyke slightly accumulates water in this part of the fen: there is a permanent water body with a depth of up to 2 m and an area of about 10 ha. Nearby, there are also old hand-made peat excavations of different size (Fig. 1B). The fen is overgrown with diverse sedge communities, in the ditch there is rich emerged vegetation (*Caltha palustris* L., *Carex acuta* L., *C. appropinquata* Schumach., *C. elata* All., *C. riparia* Curt., *C. rostrata* Stokes, *Typha angustifolia* L., *T. latifolia* L.), and nymphaeids are represented by large patches of *Potamogeton natans* L. in the deeper parts of the ditch. According to Buczyńska *et al.* (2015) water pH in this part of the fen is 7.64 and the electrolytic conductivity $424 \mu\text{S}\cdot\text{cm}^{-1}$.

On 11.04.2019, a dead otter *Lutra lutra* (Linnaeus, 1758) was found in a ditch at the northern part of the dyke (Figs. 1B, 2A).

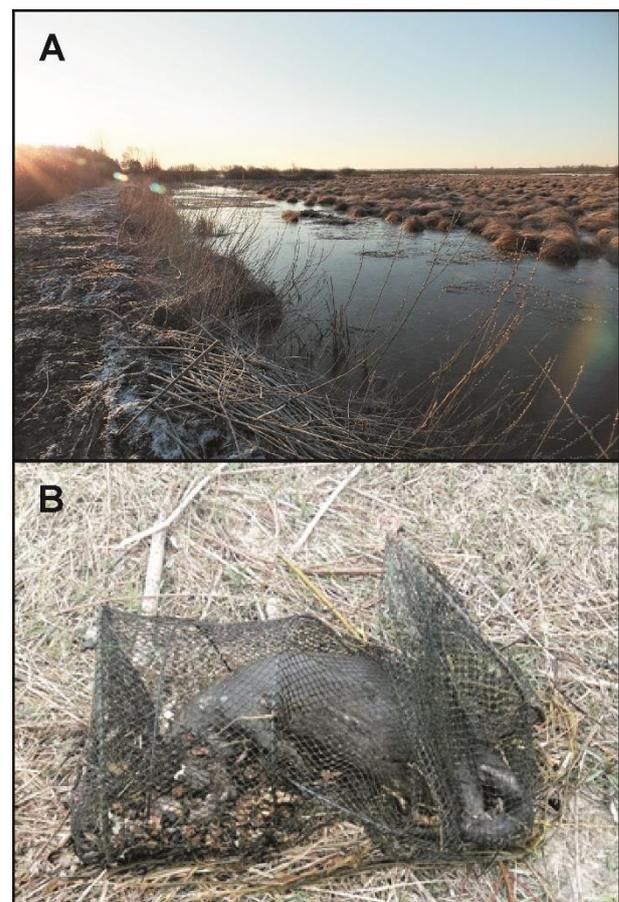


Fig. 2. A ditch in which *Dytiscus latissimus* was found: A) general view, photo by P. Markowski; B) the net with *Lutra lutra*, photo by W. Raduj.

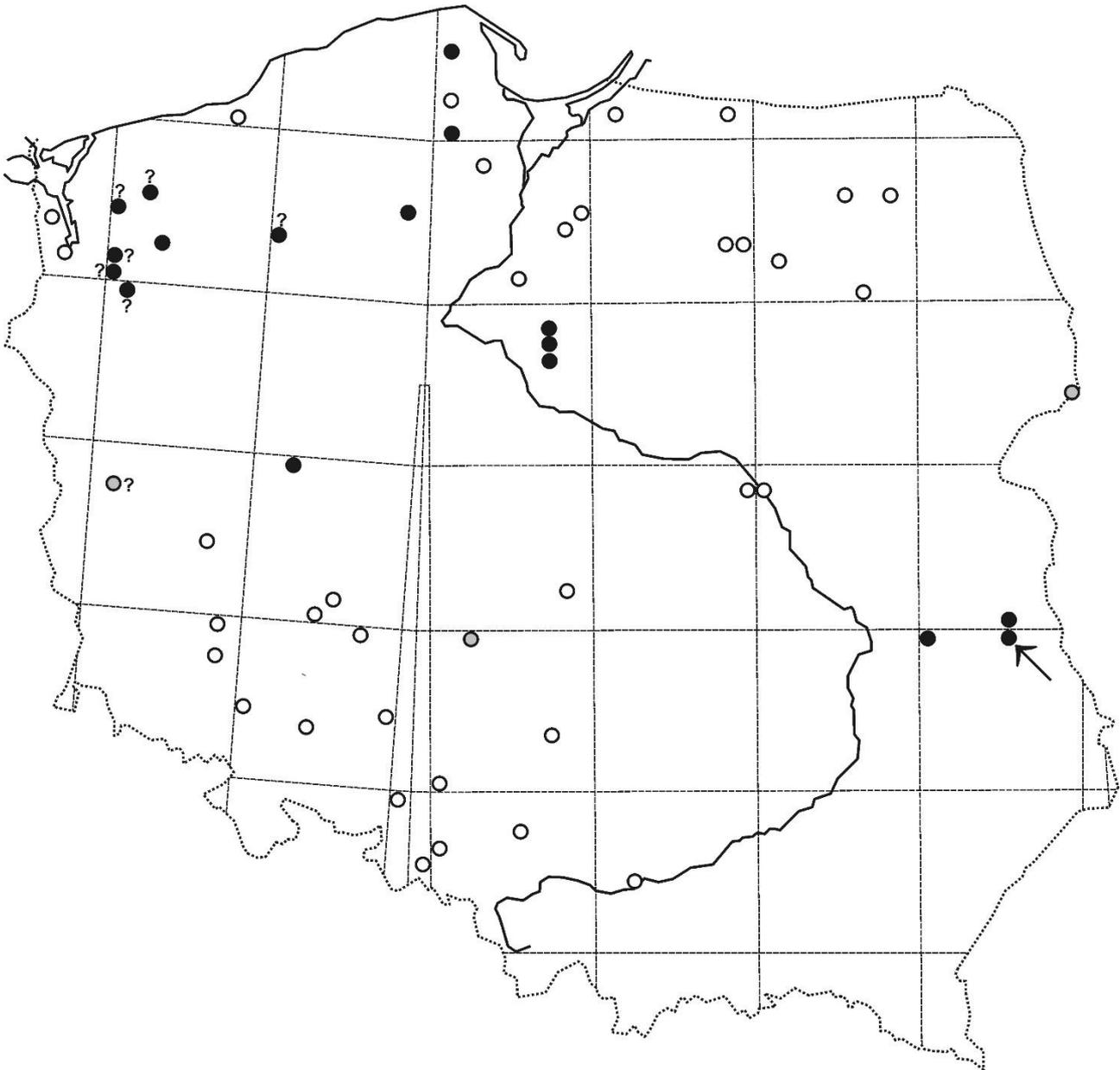


Fig. 3. The occurrence of *Dytiscus latissimus* in Poland (drawn by P. Buczyński). Dashed lines indicate the boundaries of UTM squares 100x100 km, dots – UTM squares 10x10 km with data (empty ones – data from before 1945, grey ones – from the years 1945-1990, black ones – from the period after 1990). Questionable data were indicated by question marks.

(51°22'33"N, 23°15'13"E, UTM: FB59), drowned in an illegally placed fish net with bone and meat as bait (Fig. 2B). The net lay at the bottom and was not visible therefore it was overlooked by park service controlling the area almost every day. Only putrefactive gases pushed the dead animal to the surface. There were also gray toads *Bufo bufo* (Linnaeus, 1758) in the net and a large number of adult beetles in a state of advanced decay. The remains of an otter and all the contents of the net were buried on the dyke

near the place of finding. A few days later, photographs of the net were analyzed and the elytron of a female of *D. latissimus* was noticed on one of them. Therefore, the park services returned to the place of the finding, which in the meantime was dug out and dragged by dogs. This place was examined and the remains of beetles were collected. The rest of the material was obtained in the same place in March 2020 by searching the remains of the contents of the net, in the meantime even more dragged by animals.

The collected beetle remains were washed, cleaned and placed in the collection of the Museum and Educational Center of the Poleski National Park in Stare Załucze.

Results

The remains most likely belonged to eight individuals of *D. latissimus*: four females and four males.

Other, co-occurring species were: *Dytiscus dimidiatus* Bergsträsser, 1778 (12 indiv.) and *Cybister lateralimarginalis lateralimarginalis* (De Geer, 1774) (2 indiv.) (Dytiscidae) as well as *Hydrophilus aterrimus* von Eschscholtz, 1822 (1 indiv.) and *H. piceus* (Linnaeus, 1758) (1 indiv.) (Hydrophilidae).

On the same site on 17.04.2020, the remains of two females and one male (elytrae and remains of thorax) were found on the bank. The remains smelled of fresh rot. They were probably individuals that did not survive the winter.

Discussion

The site of *D. latissimus* in the Bagno Bubnów is important for the knowledge of the contemporary geographical distribution of this species. Fig. 3 summarizes its 61 sites known from Poland (review of older data in Burakowski *et al.* 1976; later published data: Galewski & Tranda 1978, Bercio & Folwarczny 1979, Cerbin 1997, Klukowska & Tończyk 2002, Buczyński & Piotrowski 2002, Przewoźny & Lubecki 2004, Buczyński *et al.* 2007, Greń 2009, Zaremska & Zaremska 2009, Spieczyński *et al.* 2010, Przewoźny & Lubecki 2011, Michoński 2013, Ruta *et al.* 2016, Kadej 2018, Strzelecki & Templin 2018, data in this paper). This compilation shows that, although theoretically the area of occurrence of the species covers all Poland except for mountain and submontane areas (Przewoźny 2012), it has never occurred throughout this area. It can be said with high probability that the range of *D. latissimus* was

once almost continuous in the area from the foothills of the Sudetes and highlands of southern Poland to the Baltic coast, even if the density of sites in this area varied. However, the species did not occur in south-eastern Poland and was found at only few and dispersed sites in its central-eastern part.

In turn, a comparison of historical and modern data indicates the complete withdrawal of *D. latissimus* from southern and south-western Poland, where it was once found frequently and in a large area. Surprisingly, there is no data from the period after the Second World War from almost the entire lake districts east of the Vistula River. This is not the result of a lack of newer studies. A thriving team of hydrobiologists has been working at the University of Warmia and Mazury for over 40 years focusing on, among others, the occurrence and ecology of water beetles (Czachorowski 1999). Contemporary or near contemporary sites are concentrated in the north and northwest of the country, some of which are uncertain – this applies especially to the paper of Spieczyński *et al.* (2010), in which there are many gross mistakes regarding information about insects and the data on *D. latissimus* and *D. lapponicus lapponicus* Gyllenhal, 1808 cannot be separated. Everything seems to indicate that *D. latissimus* has retreated to a range island covering the Pomeranian Lake District *sensu lato*, with one distant outpost in the Wielkopolska Lake District (Cerbin 1997) – however, after all these years the occurrence of the species in the lake lying on the edge of the town of Mosina and subjected to strong anthropic pressure (Przewoźny pers. inform.) should be verified.

Two sites of this species were also discovered in Central and Eastern Poland: in the Poleski National Park (Buczyński & Piotrowski 2002) and the Kozłówka Forests (Buczyński *et al.* 2007). Although it was found only in 1996 in Lake Długie in the Poleski National Park (Buczyński & Piotrowski 2002) (Fig. 1A) and during subsequent studies it

could not be rediscovered (Guz 2006, Przewoźny pers. inform.), but new data confirms the continuous presence of the species in this park. It is likely that there are more populations waiting to be discovered here because the number of habitats suitable for *D. latissimus* is significant.

Also in a broader perspective, the area of occurrence of *D. latissimus* is today very discontinuous, consisting of islands of different sizes and isolated individual sites, especially in areas south and west of Poland. As for neighboring countries, it has already become extinct in the Czech Republic and Slovakia, and taking into account the areas located in the even more southern part of the former range: also in Hungary, Romania, Switzerland and Croatia (Foster 1996, Hájek & Šťastný 2005). In Germany, it occurs only in the northeast of the country, in Mecklenburg-Vorpommern and neighboring Brandenburg (Fraase & Schmidt 2012, Hendrich *et al.* 2012, Fraase 2013). Further west, it is extinct or known for individual sites (e.g. van Dijk 2006, Scheers 2015). Also, to the east of Poland, few modern sites have been discovered in the Ukraine. They are mainly located north and northeast of Kiev (Puchkov 2009, Sheshurak *et al.* 2018, Sukhomlin *et al.* 2019), but a few are also in the west of this country (Khorbut 2007, Suchkov & Zolotova 2014, Yurchik *et al.* 2014). A larger amount of contemporary data is only from Belarus (e.g. Aleksandrovitch *et al.* 1996, Moroz & Ryndevich 2000, Ryndevich 2005, Moroz 2013, Ryndevich *et al.* 2014), and in the Baltic countries this species is already found throughout their area, although at different densities of sites (Vahruševs & Kalniņš 2013). On this background, modern sites in north-western Poland clearly refer to the data from Mecklenburg-Vorpommern – both areas are probably one island of the area with a relatively large population and a significant number of sites. On the other hand, data from Central and Eastern Poland

may indicate the existence of a small, strongly isolated island of the area of the discussed species, possibly including a fragment of the western Ukraine: *D. latissimus* was given from the Shatsk National Park (Yurchik *et al.* 2014) – rich in lakes and situated near the Poleski National Park. Considering this situation – the hypothetical island of the distribution range in central and eastern Poland belongs to the area where *D. latissimus* has a chance to survive.

Another interesting aspect of the data discussed in this paper is the habitat in which *D. latissimus* was found. It is a species preferring large and shallow water bodies. Initially, it was probably associated mainly with lakes, after the appearance of anthropogenic habitats in the landscape he successfully colonized fish ponds. It was also found in larger rivers (in Poland it was caught in the Vistula near Warsaw – Hildt 1907), streams and ditches flowing between lakes (Klukowska & Tończyk 2002), and in the east of Europe, also in oxbow lakes (Hendrich 2011). Such a selection of habitats would allow to include *D. latissimus* in the group of lake-riverine species (Biesiadka & Pakulnicka 2004). In the past, some secondary habitats were also of great importance. Large ponds dominated among the sites of *D. latissimus* in the south and south-western Poland. Hendrich (2011) indicates that today's methods of carp pond management are very unfavorable for this species and today it is found exceptionally in it. He means not eutrophication caused by intensification of fish production, but first of all of liming and removing of submerged and emerged vegetation. It cannot be ruled out that this economically conditioned change in the once optimal substitute habitat has contributed to the disappearance of *D. latissimus* outside the lake districts in Poland, although at least an equally important factor that explains this situation is climate warming: low water

temperatures are needed for species development (Przewoźny 2012). Climate warming also enters positive feedback with eutrophication of waters, which is also a threat to the discussed species (Rossa 2004).

On the background of the information discussed above, the habitat of the species in the Bagno Bubnów, namely a fen, is not typical. Based on the original data, only Szulczewski (1922) mentioned the association between this beetle and fens or peat bogs, writing about its occurrence in Wielkopolska: “widespread but rare, usually in peat excavations”. Large peat excavations at the appropriate stage of succession may constitute a substitute habitat for some lake insects (Buczyński 2015) but although such water bodies are present in the Bagno Bubnów, this species was caught far away from them in circumstances indicating an autochthonous occurrence. It is evidenced by a fairly large number of individuals collected and a 1:1 sex ratio in the poach suggesting that they could have been copulating pairs. Given the data on the biology of the species (Galewski & Tranda 1978, Przewoźny 2012), the species was recorded during the breeding period. The autochthonous occurrence of the species confirms another, one year later, record of the species at the same site. However, the water in the ditch at the edge of the fen, where it occurred, was deeper than on the fen itself. A large and similarly deep pool was nearby. Perhaps these effects of anthropogenic modification of the habitat have created suitable conditions for the development of *D. latissimus*.

Due to the unusual nature of the site at the Bagno Bubnów, *D. latissimus* would not be sought there on purpose. From this point of view, the poacher's activity can be considered a happy case, although unfortunately it also caused the death of 10 individuals of redlisted beetles (except for *D. latissimus*, also *Hydrophilus aterrimus* and *H. piceus* – cf. Pawłowski *et al.* 2002). The net with the bait

and a decaying otter acted as a crayfish trap used in catching Dytiscidae (Miller & Bergsten 2016).

Conclusions

The conclusions drawn from the new record of *D. latissimus* are as follows. First of all, when looking for sites of this species it is worth expanding the spectrum of studied habitats – certainly at least by well-preserved fens with places where high water levels persist for a long time. Then it may prove that the habitat base of this beetle is slightly wider than it is thought. Secondly, *D. latissimus* still stays in the belt of central Poland – in its eastern part, where there is probably a permanent island of the area worthy of more thorough research and protective activities. In the current state of knowledge, “the centre of gravity” of this island seems to be the Poleski National Park, which is covered by high-level forms of protection (such as: national park, Natura 2000 refuges, International Biosphere Reserve) (Chmielewski 2000) – it would seem that it is enough to protect the park against environmental degradation. However, the Bagno Bubnów and the entire Poleski National Park may soon be threatened by the construction of a new coal-producing area just outside the park's protection zone (Grzywaczewski & Kitowski 2018). The data presented in this paper are another argument against this investment.

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