

## RESEARCH ON ABUNDANCE AND POPULATION DYNAMICS OF *DYTISCUS LATISSIMUS* LINNAEUS, 1758 (COLEOPTERA, DYTISCIDAE) IN THE LABANORAS REGIONAL PARK (LITHUANIA) IN 2008–2009

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### Introduction

Predacious diving beetle *Dytiscus latissimus* Linnaeus, 1758 is considered to be a rare and quickly disappearing species in all Europe. At present the species is included in the Appendix II of Bern Convention (Žin., 1996, Nr. 91: 2126) and in the Annexes II and IV of Habitat Directive (Council Directive..., 1992). This species is listed in the Red Data Book of Lithuania, category 4 (I), and is protected in Lithuania since 2003 (Rašomavičius, 2007). Only five finding places of this species were known in Lithuania up to 1990 (Pileckis & Monsevičius, 1995). A. Palionis found nine specimens in Alytus, Marijampolė, Panevėžys districts and Kaunas city in 1925 – 1939. One individual was found in Kaišiadorys district in 1978. After 1990 naturalists D. Norkūnienė, G. Švitra, S. Obelevičius, B. Šablevičius, and students of Vilnius Pedagogical University found *D. latissimus* in lakes Kavinė and Rūžas (Ignalina district), Liūnelis (Molėtai district), Akmena (Trakai district), in the Dirvonų Ežeras lake (Ukmergė district), in Ežeriekai and Medvėkas (Varėna district), and lake Ilgis (Zarasai district) (Dapkus & Ferenca, 2007). S. Gliudys and M. Lopeta found this species in the Kurtuvėnai Regional Park (Šiauliai district) (Lopeta, 2008). It was found in lake Žuvintas in winter of 2006 (Dapkus, 2006). Generally, only single individuals were found, while populations are sparse (Dapkus & Ferenca, 2007). To this moment there are 4 Natura 2000 territories distinguished for the protection of *Dytiscus latissimus* in Lithuania: the Labanoras Regional Park, the Dirvonų Ežeras lake and marshes, and lakes Ilgašilis and Rūžas (Žin., 2009, Nr. 51: 2039). This species is found in most of European countries, but it is rare everywhere. *D. latissimus* is extinct or possibly extinct in Croatia, Hungary, Romania, Slovakia and Switzerland (IUCN, 2009).

*Dytiscus latissimus* prefers lakes and other water bodies with clean or humous water, such as forest lakes, ponds, gravel quarries and exploited peatbogs filled up with water. This species can live in fairly acid ponds. The surface of the lake should not be fully overgrown with water plants, the depth should not be less than one meter. Adult beetles live in a littoral zone with sparse vegetation. Eggs are layed from the end of March till the end of May (Maehl, 2006). There are three larval instars that evolve from April to July. They feed on caddisfly (Trichoptera) larvae most frequently (Dapkus & Ferenca, 2007).

The main threats are water eutrophication and pesticides. Direct threats are that larvae can be eaten by fish and birds, adults can be caught with fisherman's nets and most possibly get dead (Maehl, 2006).

This article presents new data on *Dytiscus latissimus* finding places, characteristics of habitats, factors, determining the habitat preferences. The data was obtained by the authors during the research in the Labanoras Regional Park in 2008. The article also includes results of the studies on the species abundance and population dynamics in one of the lakes during the year 2009.

## Material and Methods

The standard techniques for monitoring water beetles were applied during the survey. Funnel traps with 40 mm width manhole made from five litre plastic bottles were used. Wooden sticks were attached to the traps horizontally, not allowing the trap to capsize and drown. Traps with bait were submerged under the water near the lake strand, reserving about 10 cm space without water. Traps were fastened to the coast to stay in place. Raw pork or beef liver was used as bait; fresh fish was used in two occasions. Research was carried out using 10 traps that were put in line up to 20 meters one from another. Seeking to reduce the possibility of beetles' deaths during warm season of the year, the traps were set in the evening and picked out of the water in the morning, as preliminary observations showed that the diving beetles are more active at night. The content of the traps was poured out into the white bath; the caught beetles were examined and identified on the spot.

Investigation of the distribution and habitat preferences of *Dytiscus latissimus* in the Labanoras Regional Park was held from 27 of June to 6 of December, 2008. 21 lakes were studied (Table 1, Fig. 1, 2). Statistical analysis (Statistica for Windows, v. 6.0) was used to estimate habitat preferences (selected significance level  $\alpha=0.05$ ).

Lake Minėlis was chosen for the studies of population abundance and dynamics. The research was carried out from 25 of April to 14 of October, 2009. Traps were always set in the same places (Fig. 2), and nine iterations were made.

Table 1. The list of studied lakes in the Labanoras Regional Park in 2008–2009.

No	Name	Coordinates
1	Arkliašūdis lake	55°14'39,7"N, 25°44'03,6"E
2	Arkliašūdis II lake	55°15'46,3"N, 25°53'19,5"E
3	Baltelis lake	55°11'39,1"N, 25°43'03,0"E
4	Blusinė lake	55°06'57,3"N, 25°48'28,0"E
5	Dumblis lake	55°14'59,7"N, 25°50'39,0"E
6	Ešerinis lake	55°13'15,4"N, 25°42'46,9"E
7	Ešerinis (1) lake	55°12'39,1"N, 25°44'38,9"E
8	Ešerinis (Bežuvis) lake	55°13'06,1"N, 25°42'24,5"E
9	Ešerinis I lake	55°10'40,2"N, 25°53'54,9"E
10	Ilgis lake	55°10'13,5"N, 25°46'46,8"E
11	Juodežeris lake	55°06'55,9"N, 25°50'29,5"E
12	Juodynėlis lake	55°11'11,6"N, 25°52'50,1"E
13	Karosinėlis lake	55°09'36,2"N, 25°54'19,0"E
14	Krakinis lake	55°08'34,2"N, 25°50'48,3"E
15	Lydekėlis lake	55°13'34,6"N, 25°42'34,1"E
16	Lydekis lake	55°13'45,7"N, 25°42'32,2"E
17	Minėlis lake	55°14'31,7"N, 25°44'34,5"E

18	Samanykštis lake	55°15'33,4"N, 25°49'44,4"E
19	Šeškinėlis lake	55°16'41,2"N, 25°51'50,2"E
20	Vadokšnas lake	55°18'13,9"N, 25°38'04,4"E
21	Žiežulinis lake	55°11'27,0"N, 25°43'21,5"E

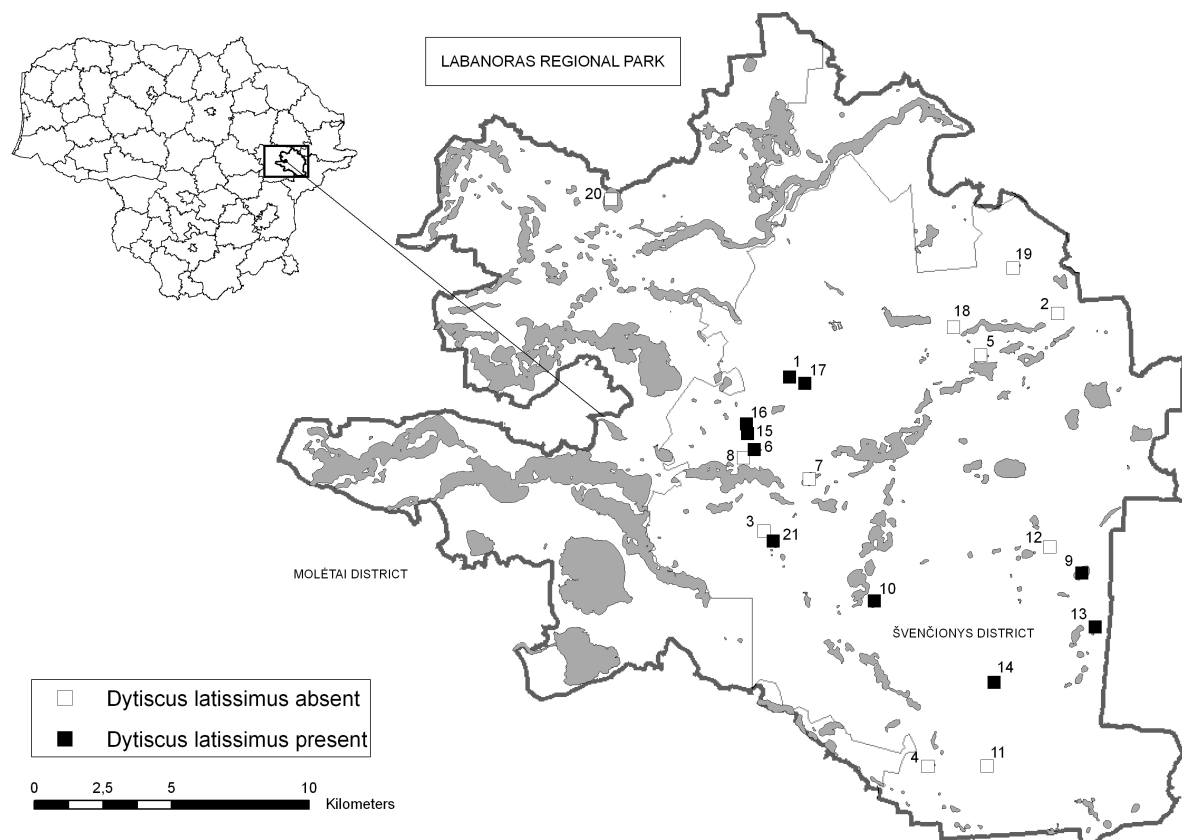


Figure 1. Lakes studied in the Labanoras Regional Park in 2008. Numbers correspond to places in table 1.

## Results

During the investigation of the distribution of *Dytiscus latissimus* held in 2008, insects of this species were found in 10 lakes of 21 studied (Fig. 1, Table 1).

Iterations were made in the lakes Ilgis, Lydekėlis and Minėlis. Specimens of this species were found in Lydekėlis and Minėlis twice. The descriptions of the lakes with *D. latissimus* present (all in Švenčionys district) and numbers of the beetles caught are presented below.

1. Kanio Raistas botanical-zoological preserve, lake Arkliašūdis, 02 08 2008, 1 ♀ (A. Aliukonis).

Studies were carried out along the entire lake shore. This lake is referred to as the dystrophic quagmire overgrowth lake type, regarded as a protected habitat type in the European Union (EU), listed in Annex I of the Habitat directive as "Natural dystrophic lakes and ponds" (3160). The lake is surrounded by bogs and marshes of intermediate type; distance to the forest is 20–30 meters. The coastal area is dominated by *Carex* spp.,

*Sphagnum* spp., and *Rhynchospora* sp. Water is rich in *Myriophyllum verticillatum*, *Nuphar lutea* and *Nymphaea* sp. Its surface is covered with abundant plants. A lot of *Carassius auratus* got into the traps.

2. Kanio Raistas botanical-zoological preserve, lake Ešerinis, 07 08 2008, 1♂ (A. Aliukonis).

Investigations were carried out in the eastern part of the lake. This lake is referred to the mesotrophic fragmentic overgrowth lake type, regarded as a protected habitat type in EU, listed in Annex I of the Habitat directive as "Oligotrophic to mesotrophic standing waters with vegetation of the *Littorelletea uniflorae* and/or of the *Isoëto-Nanojuncetea*" (3130). The lake is closely surrounded by the forest. The coastal area is dominated by *Carex* spp. and *Juncus* spp. *Nymphaea* sp. sparsely occurs in the water. *Isoetes lacustris* is observed at the bottom of the lake. Its surface vegetation is almost absent. Freshly caught bass were used as bait.

3. Ešerinis I telmological preserve, the Ešerinis I lake, 29 09 2008, 1♂ (A. Aliukonis).

Investigations were carried out in the eastern part of the lake. This lake is referred to the mesotrophic beltic fragmentic overgrowth lake type, regarded as a protected habitat type in EU, listed in Annex I of the Habitat directive as "Oligotrophic to mesotrophic standing waters with vegetation of the *Littorelletea uniflorae* and/or of the *Isoëto-Nanojuncetea*" (3130). The lake is closely surrounded by the forest. *Carex* spp. and *Juncus* spp. are found in the coastal area. *Schoenoplectus* sp. and *Phragmites australis* grow in the water body, *Lobelia dortmanna* is observed at the bottom of the lake. The water surface vegetation is relatively abundant.

4. Lake Ilgis, 27 06 2008, 1♀ (A. Aliukonis).

Studies were carried out in the western part of the lake. This lake is referred to the mesotrophic fragmentic overgrowth lake type. It is not considered as a protected habitat type in the EU. The lake is surrounded by forest. Distance from water to the forest is up to 5 meters. The coastal area is dominated by *Carex* spp., water plants are scarce. The water surface vegetation is almost absent. *D. latissimus* female was trapped accidentally in the trap with a narrow manhole (22 mm diameter) used for monitoring of *Graphoderus bilineatus*. The iteration conducted on the 1st of August 2008, did not reveal the species repeatedly.

5. Snieginis telmological preserve, the Karosinėlis lake, 05 10 2008, 2♂, 1♀ (A. Aliukonis).

Investigations were carried out in the northern part of the lake. This lake is referred to the mesotrophic fragmentic overgrowth lake type. It is not considered as a protected habitat type in EU. The lake is surrounded by bogs and marshes of intermediate type; distance to the forest is 10–20 meters. The coastal area is dominated by *Carex* spp. and *Sphagnum* spp. *Schoenoplectus* sp. sparsely occurs in the water. The water surface vegetation is almost absent.

6. Krakinis telmological preserve, the Krakinis lake, 03 10 2008, 1♂ (A. Aliukonis).

Investigations were carried out in the western – northwestern part of the lake. This lake is referred to the dystrophic quagmire overgrowth lake type. It is not considered as a protected habitat type in the EU. The lake is surrounded by the bog woodland; distance to the forest is 5–30 meters. The coastal area is dominated by *Sphagnum* spp., *Rhynchospora* sp., and Ericaceae plants. *Schoenoplectus* sp. sparsely occurs in the water. The water surface vegetation is almost absent. A lot of *Perca fluviatilis* got into the traps.

7. Kanio Raistas botanical-zoological preserve, lake Lydekėlis, 31 07 2008, 2♂♂ (A. Aliukonis), 16 09 2008, 1♂1♀ (A. Aliukonis, G. Švitra).

Studies were performed in the north-eastern part of the lake. This lake is referred to the dystrophic quagmire overgrowth lake type, regarded as a protected habitat type in EU, listed in Annex I of the Habitat directive as "Natural dystrophic lakes and ponds" (3160). The lake is surrounded by bogs; distance to the forest is more than 50 meters. The coastal area is dominated by *Carex* spp. and *Sphagnum* spp. *Phragmites australis* sparsely occurs as well. The water is rich in *Myriophyllum verticillatum*. The water surface is clear of vegetation.

8. Kanio Raistas botanical-zoological preserve, the Lydekėlis lake, 24 09 2008, 2♂♂ (A. Aliukonis).

The research was carried out in the northern part of the lake. This lake is referred to the mesotrophic fragmentic overgrowth lake type. It is not considered as a protected habitat type in the EU. The lake is surrounded by the forest; distance to the forest is no more than 5 meters. *Carex* spp. are relatively abundant on the coast, while *Phragmites australis* are scarce. The water surface is clear of vegetation. Repeated sampling was performed on 8 of October, 2008. Only five traps were used, but *Dytiscus latissimus* beetles were not caught.

9. Kanio Raistas botanical-zoological preserve, the Minėlis Lake, 30 10 2008, 4♂♂; 10 11 2008, 4♂♂ (A. Aliukonis).

Sampling was carried out in the northern and the eastern parts of the lake (Fig. 2). This lake is referred to the dystrophic quagmire overgrowth lake type, regarded as a protected habitat type in the EU, listed in Annex I of the Habitat directive as "Natural dystrophic lakes and ponds" (3160). The lake is surrounded by bogs; distance to the forest is 10–20 meters. The coastal area is dominated by *Carex* spp. and *Sphagnum* spp. The water is rich in *Myriophyllum verticillatum*. The water surface is clear of vegetation. Iterations were conducted on 29 of November and on 6 of December, 2008. The edges of the lake were frozen; traps were set in ice-holes, but *D. latissimus* was not registered.

10. Žiežūlinis geomorphological preserve, the Žiežūlinis lake, 10 10 2008, 1♂ (A. Aliukonis).

The studies were carried out in the northern part of the lake. This lake is referable as the mesotrophic fragmentic overgrowth lake type. It is not considered as a protected habitat type in the EU. The lake is surrounded by bogs; distance to the forest is 10–20 meters. *Carex* spp., *Sphagnum* spp. and *Phragmites australis* grow in the coastal area. The water surface is clear of vegetation.

23 specimens (19 males and four females) of *Dytiscus latissimus* were caught during the research in the Labanoras Regional Park. The analysis of the results shows that habitat selection does not depend on lake's nutrient richness (only dystrophic and mesotrophic lakes were investigated) ( $\chi^2=0.06$ ,  $P=0.80$ ). *D. latissimus* was detected in 44% of dystrophic ( $n=9$ ) and 50% of mesotrophic ( $n=12$ ) lakes. Type of water fringe vegetation does not affect habitat selection of beetles as well ( $\chi^2=1.06$ ,  $P=0.59$ ) (studies were carried out in quagmire, fragmentic and beltic fragmentic overgrowth types of lakes). *D. latissimus* was found in 50% of lakes with the quagmire ( $n=8$ ), 56% of lakes with the fragmentic ( $n=9$ ) and 25% of lakes with the beltic fragmentic ( $n=4$ ) overgrowth type respectively. Therefore, the distance from the coast of the lake to the forest affects the habitat selection (distance measured visually, with the accuracy of 5 meters) (Mann -

Whitney test,  $U=27$ ,  $p=0.04$ ). The average distance from the coastline to the forest of the lakes containing *D. latissimus* is 16.5 meters, while of those not containing *D. latissimus* – 5.9 meters.

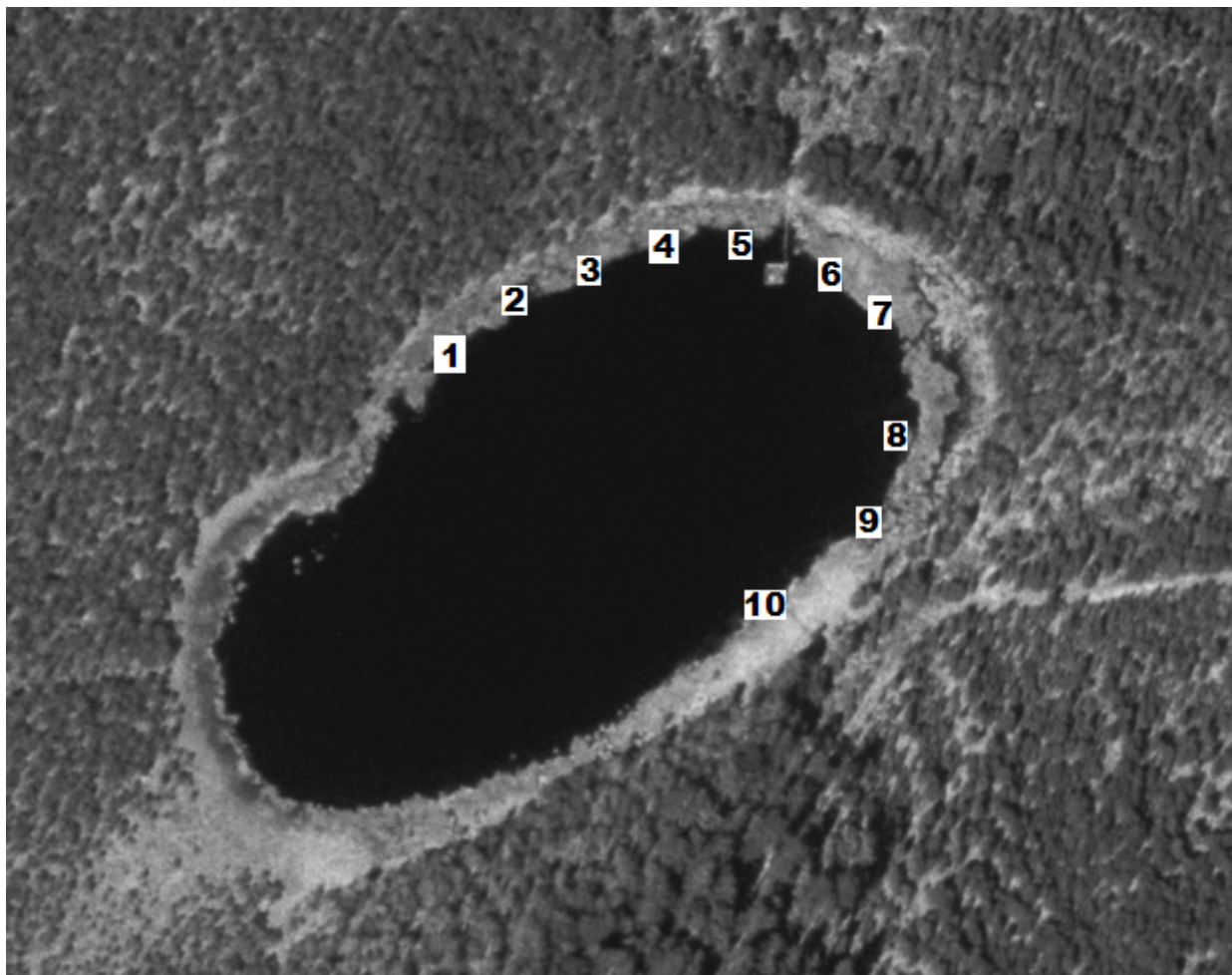


Figure 2. The layout of traps for *Dytiscus latissimus* in the Minėlis Lake in 2009.

In order to evaluate population dynamics of *Dytiscus latissimus* within a year, nine repeated samplings were conducted in lake Minėlis. Adults were registered in all samples (Table 2). Seven individuals of *D. latissimus* were marked (small incision(s) on the left/right epipleura or both). The results showed that most abundant samples were obtained in the second half of May. It seems that fresh fish is not the best bait, as only one individual was captured in a single sample when it was used. It should be noted that recently hatched relatively small male with still unsteady chitin was found dead in a trap on the 4<sup>th</sup> of July. In order to prevent the loss of beetles in future, the research was interrupted for more than two months.

50 specimens (35 males and 15 females) of *D. latissimus* were registered during the research. Unfortunately, the data obtained is not sufficient to evaluate the real size of the species population in lake Minėlis. The studies were carried out only along half of the length of the coastline, and five of seven marked beetles (5♂ and 2♀) were recaptured (Table 2). It indicates that the local population size is limited.

Another interesting observation from the research can be drawn while comparing the catches of different *Dytiscus* species in lake Minėlis. *Dytiscus latissimus* were caught in 50 cases, while all the remaining species of the genus *Dytiscus* together were caught only

in 18 cases. Therefore, *D. latissimus* can be considered as a dominant species of the genus *Dytiscus* in the studied lake. It was more abundant than the species of the genus *Graphoderus* as well. Only *Cybister lateralimarginalis* (325 catches) surpassed *D. latissimus* in quantities.

Table 2. Results of *Dytiscus latissimus* population abundance and dynamics studied in the Minėlis lake in 2009 (the underlined figures indicate the number of beetles marked during the trapping occasion and their numeric index; shadowed boxes indicate recaptured individuals).

Trap No.	Dates of trapping occasions									
	25 04	03 05	16 05	24 05	10 06	04 07	22 09	26 09*	14 10	Viso
1.	1♀			1♂2♀		1♀ <sup>3</sup>	1♂		1♂	3♂4♀
2.			1♂ <sup>4</sup>	1♀	1♀					1♂2♀
3.			1♀ <sup>5</sup>							1♀
4.		2♂ <sup>1,2</sup>	1♂ <sup>6</sup>	2♂1♀					1♂	6♂1♀
5.				1♂1♀		2♂ <sup>1</sup>		1♂	1♂ <sup>4</sup>	5♂1♀
6.			4♂(1 <sup>1</sup> )							4♂
7.				1♀	2♂ <sup>2,7</sup>	1♂ <sup>2</sup>	1♂			4♂1♀
8.			5♂1♀	2♂		2♂				9♂1♀
9.	1♂						1♂			2♂
10.		1♀ <sup>3</sup>	1♀		1♀		1♂1♀			1♂4♀
♂	<b>1</b>	<b>2</b>	<b>11</b>	<b>6</b>	<b>2</b>	<b>5</b>	<b>4</b>	<b>1</b>	<b>3</b>	<b>35</b>
♀	<b>1</b>	<b>1</b>	<b>3</b>	<b>6</b>	<b>2</b>	<b>1</b>	<b>1</b>	<b>0</b>	<b>0</b>	<b>15</b>
<b>All</b>	<b>2</b>	<b>3</b>	<b>14</b>	<b>12</b>	<b>4</b>	<b>6</b>	<b>5</b>	<b>1</b>	<b>3</b>	<b>50</b>

\* fresh fish was used as bait

## Discussion

Research of *Dytiscus latissimus* in Lithuania in the Labanoras Regional Park in 2008–2009 proved that scarce data on its distribution is more due to the lack of inventories than to the rarity of the species itself. In our opinion, the species status fully corresponds the rarity category 4 (Undetermined) in the Lithuanian Red Data Book.

Ten new finding sites were registered during the research all of them in Švenčionys administrative district. 67 individuals were caught, and the estimated ratio of male and female individuals is approximately 3:1.

Our conclusion that the distance from the shore of the lake to the forest positively affects habitat selection of the species is supported by literary sources (Maehl, 2006). It states that trees, shrubs and high helophyts overshadow aquatic plants in the littoral zone. Possibly, overshadowing reduces the amount of available energy, needed for the development of larvae.

The reseach was not carried out in oligotrophic and eutrophic lakes, therefore, it can not be stated that dystrophic and/or mesotrophic lakes are more suitable habitat types. Though the data on suitability of the dystrophic and mesotrophic lakes was compared, however, the obtained difference was statistically not significant.

*Myriophyllum verticillatum* grew abundantly in Minėlis and Lydekėlis that are the only lakes where *D. latissimus* was caught repeatedly and more than one individual. It may be that this plant is the indicator of the optimal habitat for the investigated beetle species. This presumption is supported by the fact that usually many caddisfly larvae, that are the main food for the beetles, are found on that plant.

Physico–chemical parameters of the lakes were not measured. This might have allowed better assessment of individual suitability of habitat for this species. Repeated

sampling of inventory surveys in all investigated lakes would have allowed better assessment of the species abundance in the Labanoras Regional Park.

*Dytiscus latissimus* was found in two habitat types protected in the EU, listed in Annex I of the Habitat directive as "Oligotrophic to mesotrophic standing waters with vegetation of the *Littorelletea uniflorae* and/or of the *Isoëto–Nanojuncetea*" (3130) and "Natural dystrophic lakes" (3160).

The most abundant catches of the species in lake Minėlis in 2009 were obtained in the second half of May (respectively, 14 and 12 individuals in 2 trapping occasions) that correspond to the available bibliographical source (Ivinskis, 2006).

Research on the habitat preferences, possible threats and population ecology of *Dytiscus latissimus* should be carried out further, since the abundant population of the protected species observed in lake Minėlis in the Labanoras Regional Park is a significant fact on the European scale.

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***Dytiscus latissimus* Linnaeus, 1758 (Coleoptera, Dytiscidae) gausumo ir populiacijos dinamikos tyrimai Labanoro regioniniame parke (Lietuva) 2008–2009 metais**

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**Santrauka**

Pateikiami 2008–2009 metais surinkti duomenys apie naujas plačiosios dusios (*Dytiscus latissimus*) radavietes Labanoro regioninio parko ežeryne, Švenčionių rajone. Tirtas 21 ežeras, aptikta 10 naujų plačiosios dusios radaviečių, kas rodo, jog rūšis kur kas dažnesnė, nei anksčiau buvo manoma. Rūšis aptikta distrofiniuose ir mezotrofiniuose ežeruose. Maksimalus sugautų individų skaičius vieno gaudymo metu – 14 individų (10-tyje gaudyklių per parą). Didžiausias rūšies skaitlingumas stebėtas gegužės mėnesio antroje pusėje. Nustatytas bendras patinų ir patelių santykis – 3:1. 2009 metų eigoje pakartotinai (9 kartus) gaudyta viename konkrečiame vandens telkinyje, dalis vabalų buvo pažymėta. Tyrimai leido nustatyti buveinių pasirinkimo dėsningumus, sąsajas su Europos Bendrijos svarbos buveinėmis, populiacijos dinamiką viename iš ežerų.

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