

# DISTRIBUTION AND ABUNDANCE OF GEOTRUPIDAE IN DIFFERENT HABITATS OF CURONIAN SPIT

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Investigation of beetles in Curonian Spit in different dunes habitat and colony of Great Cormorants have been carried out in 2008 – 2010 and 2012 years. Dunes in different stages of development and different degree of human exposure have been selected (gray and white dunes, alder forest in dunes, pine forest, Mountain pine forest, and burned Mountain pine forest, burned and cut Mountain pine forest, old mixed forest), also four sites in colony of Great Cormorants with different degree of dune forest habitat disturbance have been selected. Beetles belonging to three species: *Anoplotrupes stercorosus* (Scriba 1791), *Geotrupes (Geotrupes) stercorarius* (Linnaeus 1758) and *Trypocopris (Trypocopris) vernalis* (Linnaeus 1758), were found during the investigation. Main distributed areas of the Geotrupidae beetles are old mixed forest and eastern side of Great Cormorants colony, where beetles of *A. stercorosus* predominated (average number of specimens each year  $1303,75 \pm 405,6$  in old mixed forest and 1662 specimens in Eastern side of Colony at 2012). In central part of Great Cormorants colony beetles of *T. vernalis* predominated (189 specimens of *T. vernalis* and 80 specimens of *A. stercorosus*). First specimens of Geotrupidae appear in first decade of May, the highest abundance of Geotrupidae beetles was established from first decade of July to first decade of September.

Key words: Geotrupidae, Curonian Spit, Great Cormorants colony, habitats preference, abundance.

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## INTRODUCTION

Knowledge of beetles compositions in various temporary and unstable habitats of Curonian Spit are poor for this time. Forest habitat changes are very significant in territory of Great Cormorant colony. The Great Cormorant colony was established near Juodkrantė in old old-growth mixed forest, where predominated old pines.

Birds occupy new forest territories each year, dead forest places are expanding.

The six species of Geotrupidae are known in Lithuania (Tamutis et al. 2011). *Anoplotrupes stercorosus* (Scriba 1791) and *Trypocopris (Trypocopris) vernalis* (Linnaeus 1758), which at the larval stage feed on the partly decomposed plant litter together with faeces of small mammals it contains, the faeces of large animals, if available, are both forest species; the latter one ought to be considered a forest generalist. By digging tunnels and bringing plant litter underground they contribute to soil fertilization (Byk 2011).

Table 1. Abundance of Geotrupidae beetles in different investigated habitats during the research period

Habitats	<i>Trypocopris vernalis</i>				<i>Anoplotrupes stercorosus</i>				<i>Geotrupes stercorarius</i>		
	Number of specimens in				Number of specimens in						
	2008	2009	2010	2012	2008	2009	2010	2012	2008	2009	2010
Burnt Mountain pine stock	7	14	9	4	0	0	0	0	0	0	0
Burnt and cut Mountain pine stock	0	1	3	1	0	0	30	0	0	0	0
Mountain pine forest		13	59	16		0	0	1	0	0	0
<i>Pinus silvestris</i> forest	8	15	22	6	4	3	39	6	0	0	0
Old mixed forest	17	6	33	9	866	1248	1768	1478	0	0	0
Alder forest	0	0	0	0	33	44	88	42	0	3	0
Brown dune overgrown with lichen and moss	0	0	0	0	1	0	0	0	0	0	0

Table 2. Abundance of Geotrupidae beetles in different investigated habitats of Great Cormorants colony, N - number of specimens, % of Geotrupidea in investigated plot

Species	plot 3A		plot 3B		plot 3C		plot 3 D	
	N	%	N	%	N	%	N	%
<i>Trypocopris vernalis</i>	70	74,5	24	55,8	189	70,26	30	1,77
<i>Anoplotrupes stercorosus</i>	24	25,5	19	44,2	80	29,74	1662	98,23

There is lack of a comprehensive study of Geotrupidae distribution and selection of different habitats. The aim of the investigations - evaluate habitat preferences, distribution and abundance of the Geotrupidae beetles in various open dune habitats and dune forest habitats.

## MATERIAL AND METHODS

Investigation on Coleoptera fauna of different dune habitats in Curonian spit (Lithuania) have been carried out in 2008 – 2010 and 2012. The investigation of dune forest habitat changed by Great Cormorant colony activities started in 2012. Dunes in different stages of development and different degree of human exposure have been selected:

- natural volatile dunes in Nagliai (brown dune overgrown with lichen and moss (plot 4), grey dune with lichen, moss and Poaceae (plot 5) and white dunes (plot 8), alder forest in dunes (plot 6);

- natural old-growth mixed forest in Juodkrantė (plot 3);

- dune forest habitats in Alksnynė - pine *Pinus silvestris* forest (plot 2); Mountain pine forest (plot 10), burnt in 2006 Mountain pine stock (plot 0), burnt in 2006 and cut Mountain pine stock (plot 1).

- Four sites in colony of Great Cormorants with different degree of dune forest habitat disturbance have been selected: side of colony where new nests were building in the recent years, grass and moss cover drying (plot 3 A);

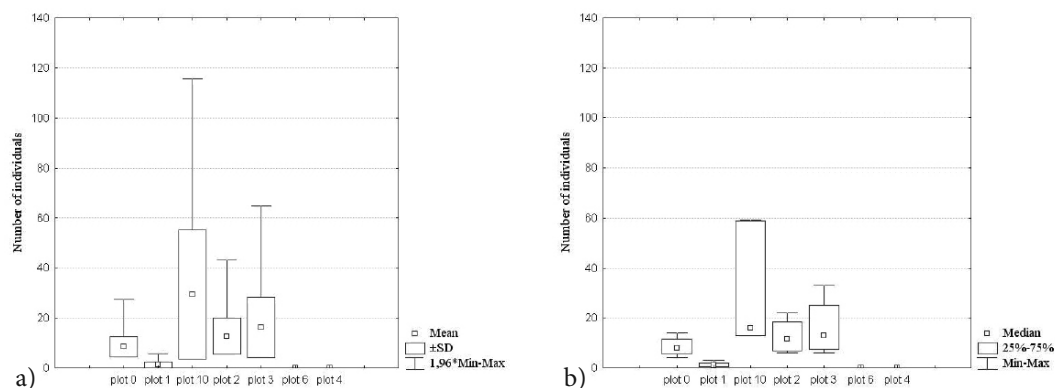


Fig. 1. Mean  $\pm$  Standard Deviation and 1,96 Min – Max (a) and Median, percentiles and Min- Max (b) of *T. vernalis* abundance in different investigation plots during the research in 2008-2010, 2012.

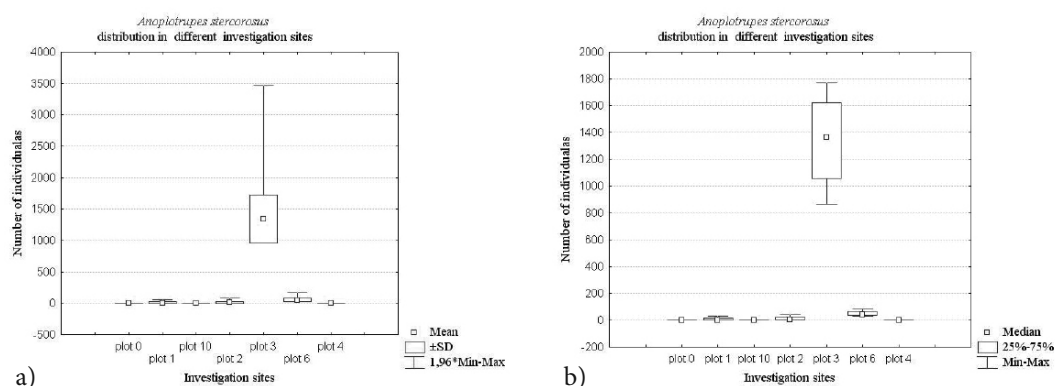


Fig. 2. Mean  $\pm$  Standard Deviation and 1,96 Min – Max (a) and Median, percentiles and Min- Max (b) of *A. stercorosus* abundance in different investigation plots during the research in 2008-2010, 2012.

- epicenter of colony, where nesting activity of Cormorant is high and forest habitats was affected most – the grass and moss cover fall away, the old pine trees are dead or drying (plot 3 B); center of colony, where pine trees are now dead, grass cover partly rebuilds, overgrew *Sambucus* sp. shrubs (plot 3 C); old colony part, where pine trees are dead and fall down, grown young *Picea abies* and *Betula pubescens*, *Quercus robur* of different ages, large part of the areas overgrown with tall mesophilic and mesotrophic and eutrophic herbs (plot 3 D).

The pit-fall traps have been used during the investigation. In each of the research areas there were installed 5 Barber pitfall traps. Beetles were collected from the traps every 14 days from May till first decade of November. 7995 specimens of

Geotrupidae have been caught and determined. The collected material was analysed using the acceptable statistical methods using the programs Excel and STATISTICA software.

## RESULTS

Beetles belonging to three species: *Anoplotrupes stercorosus* (Scriba 1791) (7436 specimens), *Geotrupes (Geotrupes) stercorarius* (Linnaeus 1758) (3 specimens) and *Trypocopris (Trypocopris) vernalis* (Linnaeus 1758) (556 specimens), were found during the investigation.

The Geotrupidae were found in all dune forest habitats (Table 1, Table 2), but not found in open dune habitats, only in brown dune overgrown with

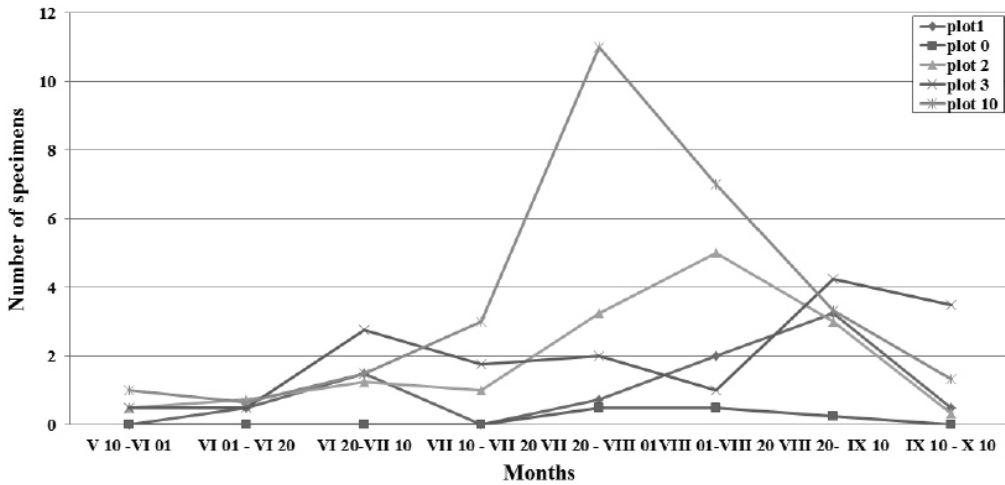


Fig. 3. Seasonal activity of *T. vernalis* in different habitats (Means of different years).

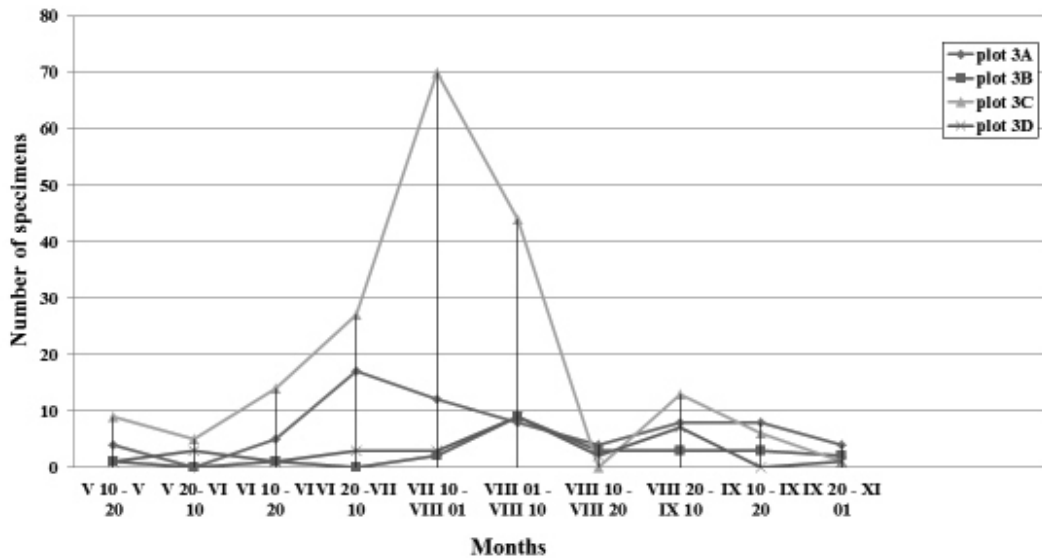


Fig. 4. Seasonal activity of *T. vernalis* in different parts of Great Cormorants colony in 2012.

lichen and moss (Nagliai) was found 1 specimen of *A. stercorosus* in 2012. Beetles belonging to two species - *T. vernalis* and *A. stercorosus*, were found in eight investigated sites: all investigation plots of Cormorants colony in Juodkrantė, burnt and cut Mountain pine stock (plot 1), Mountain pine forest (plot 10), dune pine *Pinus silvestris* forest (plot 2) in Alksnynė, old grown mixed forest in Juodkrantė (plot 3). In alder forest in dunes in Nagliai (plot 6) were found beetles belonging to *A. stercorosus* and *G. stercorarius*

species, while in burnt Mountain pine stock in Alksnynė (plot 0) were found Geotrupidae beetles belonging only to *T. vernalis* species. The highest abundance of Geotrupidae was established in old-growth mixed forest in Juodkrantė (plot 3) - 5425 specimens, and in old part of Cormorants colony (plot 3D) - 1692 specimens. *T. vernalis* dominated in mountain pine forest in Alksnynė (plot 10) - 88 specimens in total (98,9 % of all Geotrupidea in this investigation plot) during the investigation period and in two plots in new part

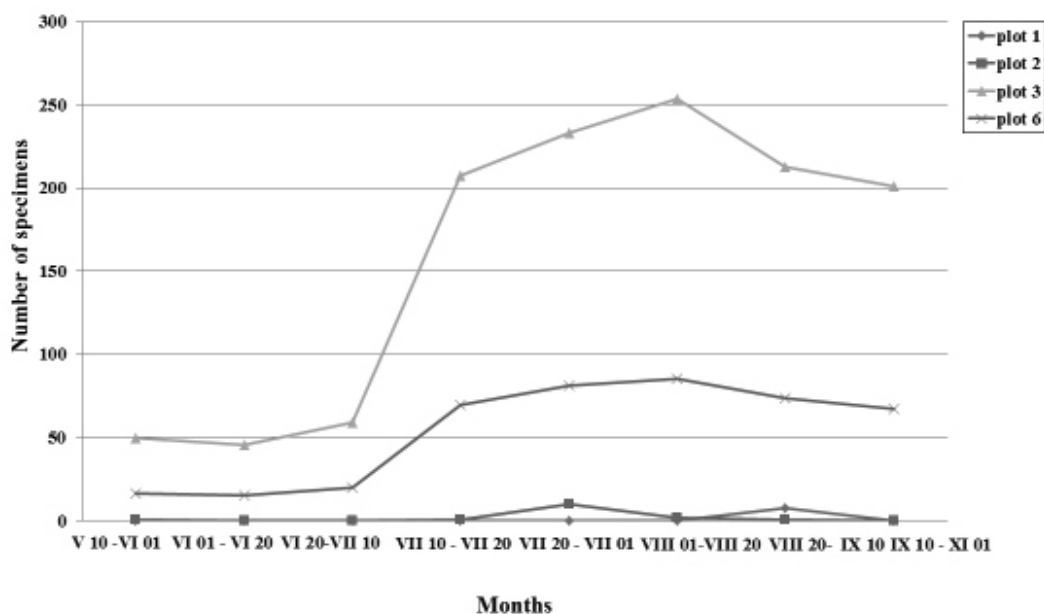


Fig. 5. Seasonal activity of *A. stercorosus* in different habitats (Means of different years).

of Cormorant colony: plot 3A – 70 specimens in total during the investigation period (74,5 % of all Geotrupidea in this investigation plot) and plot 3 C – respectively 189 specimens (70,3%). *A. stercorosus* predominated in old-growth mixed forest in Juodkrantė (plot 3) – 5360 specimens in total (98,8 % of all Geotrupidea in this investigation plot) and in old part of Cormorants colony (plot 3 D) – 1662 specimens in totally (98,2%). The beetles abundance of this two species of Geotrupidae was quite similar in pine forest in Alksnynė (plot 2) (*T. vernalis* 49,5%, *A. stercorosus* 50,5%,  $t = -0,0265$ ,  $p = 0,97$ ) and epicenter of cormorants colony (plot 3B) (*T. vernalis* 55,8 %, *A. stercorosus* 44,2%) (Table 2, Fig. 1). *A. stercorosus* predominated by specimens number in totally in burnt and cut Mountain pine stock in Alksnynė (plot 1) (*T. vernalis* 14,3%, *A. stercorosus* 85,7%), but this result was impacted by pick of diversity of *A. stercorosus* in 2010, analyzing the means of individuals captured each year differences in species number wasn't significant ( $t$ -value  $-0,830417$ ,  $p = 0,44$ ) (Fig 1, Fig. 2).

Beetles of Geotrupidae have been observed during warm season from May until November. Two picks of *A. stercorosus* activities was distinguished in Cormorants colony – June 10–20 and August 01 till September 10, abundance of *A. stercorosus* beetles was more than two times higher during the second pick of activities in August – September (Fig. 6). While analyzing the activities of *A. stercorosus* beetles in other investigation sites, one pick of activities was distinguished – from July 10 until August 20 (Fig. 5). In Cormorants colony were distinguished two picks of *T. vernalis* too – from June 20 till August 01 and from August 20 till September 10 (Fig. 4), abundance of *T. vernalis* beetles was about 7 times higher during the first activities pick in plot 3 C and about two times higher in the rest of plots in Cormorants colony. While analyzing the activities of *T. vernalis* beetles in other investigation sites, one pick of activities was distinguished in burnt and cut Mountain pine stock (plot 1) (July 20 - August 01) and pine forest (plot 2). The abundance of *T. vernalis* was low in other investigation sites throughout the investigation during all season (Fig. 3).

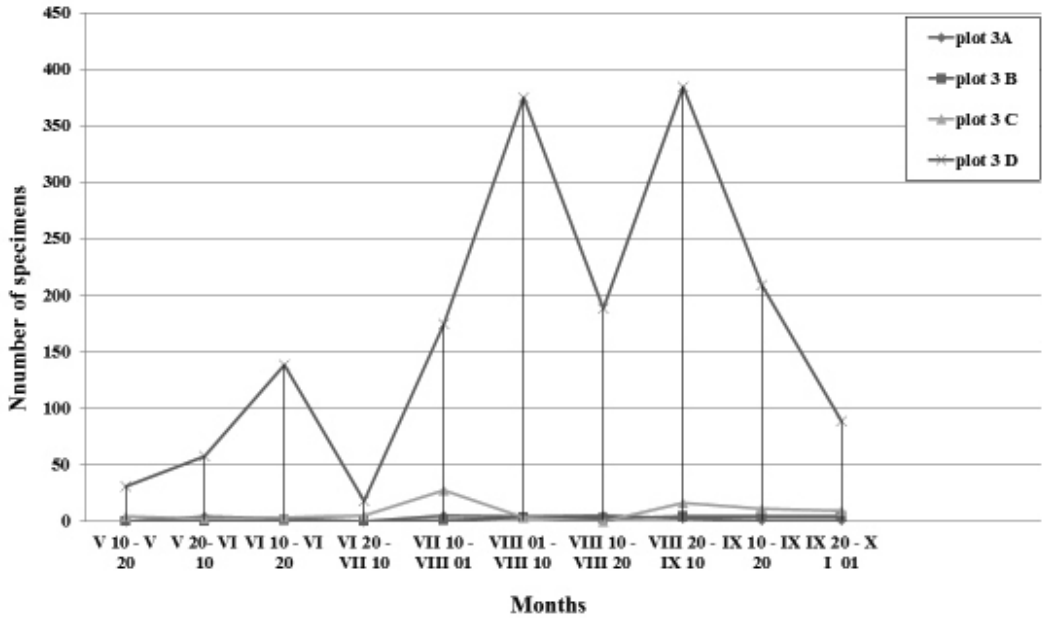


Fig. 6. Seasonal activity of *A. stercorosus* in different parts of Great Cormorants colony in 2012.

## DISCUSSION

Beetles of Geotrupidae family prefer forest dune habitats, it is conditioned by the development biology of these beetles. Even fire damaged Mountain pine forest remained elements of forest fauna. Exceptionally important role was played by the Geotrupidae beetle in decomposition of forest litter and wild animal droppings (Olszewski 1979). Results of the investigation show that beetle of *A. stercorosus* prefer forest with thicker layer of leaf litter and it was especially abundant in such habitats in Curonian spit as natural old-growth mixed forest, old part of Great cormorants colony, where forest habitats recovery from mixed forest with *Pinus silvestris* predominating in to mixed forest with predominating of deciduous trees. Larvae of *A. stercorosus* feed on leaf litter buried by imagoes at the depth of 30 cm. Such litter, buried in the form of provision mass enriches deeper, mineral soil layers in organic material. Exceptionally important role was played by the Geotrupidae beetle in decomposition of forest litter and wild animal droppings (Olszewski 1979). Imagoes of this species feed on moldy litter, animal droppings, fruiting bodies of umbrella

mushrooms and tree juice (Rojewski 1980, Burakowski et al. 1983).

During the study of habitat preferences of the beetle *A. stercorosus* in the Białowieża Forest (Byk & Semkiw 2010) has been proved the statistical validity of disparities in the abundance of *A. stercorosus*. The forest dung beetle is more abundant in the forests of fresh habitats than in the forests of moist, boggy or alder habitats. Optimal living conditions for the beetle can be found in habitats of the fresh broadleaved forest, fresh mixed broadleaved forest, moist broadleaved forest and fresh coniferous forest. Beetles of *T. vernalis* were found in habitats with very poor litter such as burnt Mountain pine forest, forest damaged by Cormorants activities. The study aimed at discovering the changes in abundance and composition of Geotrupidae communities in the developmental cycle of pine stands was carried out in Poland (Byk 2011). According to this study the collection of *T. vernalis* decreased from the first phase of the forest developmental cycle until the pole timber stage, and then increased at the stage of the mature stand. The high abundance of Geotrupidae in Great Cormorants colony is an important factor in

damaged forest soil restoration.

Tamutis V., Tamutė B., Ferenca R. 2011. A catalogue of Lithuanian beetles (Insecta, Coleoptera). *ZooKeys*, 121: 1-494.

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