Distribution of Spiders in Dune Habitats at the Baltic Sea Coast at Akmensrags, Latvia

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Abstract: We investigated spiders of two dune habitats on the Baltic Sea coast – white dunes and grey dunes. Samples were collected by use of 90 pitfall traps exposed 28 days. The traps were placed in three parallel transects situated perpendicularly to coastline. We identified 53 taxa of 15 families. Individuals of Linyphiidae, Lycosidae, Dictynidae, Gnaphosidae, Salticidae and Thomisidae were the most frequently found. Dominance structure of families changed along transects. *Argenna subnigra*, *Pardosa palustris*, *Pelecopsis parallela*, *Xerolycosa miniata* and S*itticus saltator* were the most frequent and were subdominant according to Engelmann's scale. Detrended Correspondence Analysis showed distribution of spiders according to vegetation succession from white dunes to grey dunes. Total number of spiders correlated positively with cover of mosses and lichens (N=30, r=0.81, p<0.01), vascular plant cover (N=30, r=0.86, p<0.01) and distance from white dune (N=30, r=0.84, p<0.01). Indicator Species Analysis identified 17 indicator species of two cluster groups: (1) for white dunes – *Pardosa agrestis*, *Micaria lenzi*, *M. subopaca* and *Sitticus saltator*, and (2) for grey dunes – *Steatoda albomaculata*, *Gonatium rubens*, *Pelecopsis parallela*, *Tapinocyboides pygmaeum*, *Alopecosa cuneata*, *Alopecosa pulverulenta*, *Hahnia nava*, *Argenna subnigra*, *Drassyllus pussillus*, *Zelotes longipes*, *Xysticus erraticus*, and *X. kochi*.

Key words: Araneae, fauna, dunes, vegetation, indicator species, Latvia.

Introduction

Coastal areas have high habitat diversity reflecting succession of vegetation. At the Latvian coastline white dunes is one of the most typical habitats but grey dunes is rare and distributed along Baltic Sea coastline. Embryonic dunes and white dunes are dynamic due to active sand movements by wind and water. They are covered by sparse grass vegetation (Kabucis 2001). Grey dunes are relatively stable and are covered by rather diverse permanent vegetation (Kabucis 2001). The dunes in Latvia are among the northernmost situated dunes in Europe and in comparison with the southern dunes have specific flora and fauna. Moreover, the dunes are protected habitats by the directive on conservation of the natural habitats and of wild fauna and flora of European Union 92/43/EEK (EEC 1992). At the same time coastal habitats are among the most threatened habitats, they are exposed to increasing recreation tourism, urban sprawl, forest planting to decrease erosion and other anthropogenic factors.

Animals living in extreme environmental conditions (e.g. deserts) or rapidly changing environments (e.g. coastal habitats) are adapted to live in these specific conditions (Hill, Wyse 1989). Nevertheless each particular habitat comprises characteristic species assemblage. Thus for each habitat specific indicator species exist (e.g. see Bonte et al. 2002 for dune habitats in Belgium).

Only a few studies on spiders of coastal habitats of the Baltic Sea were performed. Spider fauna on the high latitude dunes at Baltic Sea – Curonian (Kuršių) Spit (Lithuania) were studied by Žukauskiene (1966). It was stated that Lycosidae are the only dune specialist family. She also found 11 spider species typical to dune habitats of the Curonian Spit (Žukauskiene 1966). Relys (2000) also has listed several spider species typical for dune habitats in Lithuania. No study on spiders in dune habitats was done in Estonia and Latvia.

Almquist (1973) described dune spider assemblages at the Baltic Sea coast. Bonte et al. (2002, 2003a) has studied dune-inhabiting spiders along the North Sea coast of France, Belgium and the Netherlands. Duffey (1968) described spider fauna in the sand dunes of the coast of the Celtic Sea in Wales.

An aim of the current study was to describe fauna and distribution of ground-dwelling spiders in white and grey dunes at the Baltic Sea coast in one locality in Latvia.

Materials and methods

Samples of ground-dwelling spiders were collected at the Ziemupe Nature Reserve near Akmensrags, Latvia in the dunes of the Baltic Sea (Figure 1). The area is characterized by typical dune vegetation, including habitats of EU importance shifting dunes along the shoreline with *Amophila arenaria* (white dunes) and fixed coastal dunes with herbaceous vegetation (grey dunes) according to EU Habitats directive 92/43/EEK (Auniņš 2010).

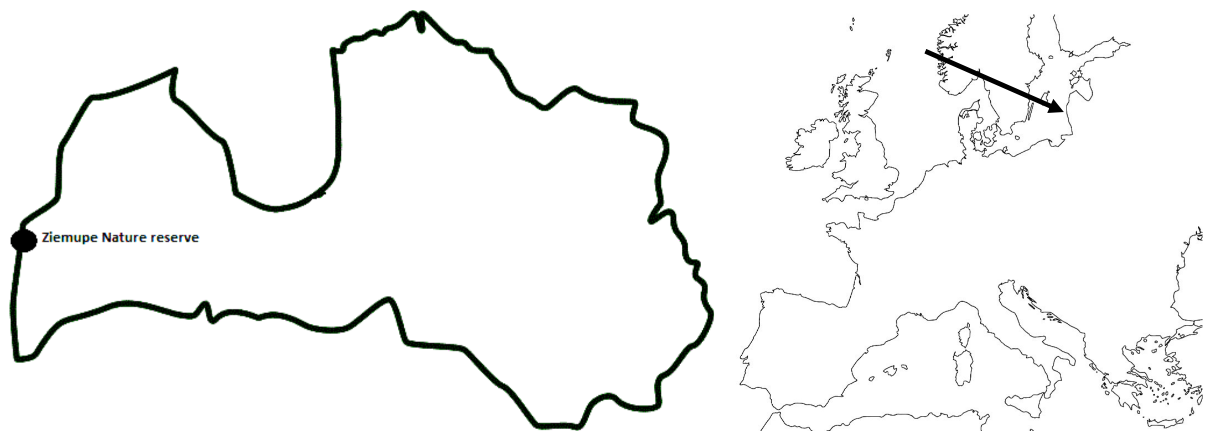

Figure 1. Location of the study site in Latvia and Europe
(black point indicates placement of the Ziemupe Nature Reserve, where the study was conducted).

Modified Barber's pitfall traps (plastic glasses with opening diameter 7.5 cm, height 9 cm, and volume 250 ml) were used. Traps were filled with 100 ml of 10% formaldehyde solution with additions of ethylene-glycol (10 ml) and a few drops of detergent added. Traps were arranged on three 60 m long parallel each other transects going from white dune inlands and perpendicular to the coastline, and placed 10 m apart from each other. 30 pitfall traps (distance between traps 2 m) were arrange on each transect and exposed for 28 days from May 22 until June 19, 2004. The first 12 traps on each transect represented white dune and transition zone from white dune to grey dune (approximately 25 m from the initial point). The next 13 traps (25–50 m from the initial point) represented grey dunes, and the last 5 traps (50–60 m from the initial point) represented transition zone from grey dunes to dry meadow.

Spiders were sorted out in vials with 70% alcohol. The species were identified by use of following keys: Locket, Millidge (1953), Nentwig et al. (2003), Almquist (2005, 2006), taxonomy follows Platnick (2010).

Vegetation on transects were described by Laime and Liepiņa (unpublished data) in accordance with Brown-Blanquet method. Vegetation was described around every pitfall trap, using quadratic sample plot with area of 1 m^2. The pitfall traps were located in the center of the vegetation plot.

Data of respective pitfall trap of each line were pooled before analyses, thus 30 data points were obtained. Data were log-transformed $y=lg(x+1)$ to approach normality. Detrended Correspondence Analysis (DCA) (Hill, Gauch 1980) was performed to assess habitat heterogeneity, Indicator Species Analysis (Dufrêne, Legendre 1997) and Cluster Analysis identified indicator species for habitats by use of PC-ORD 4 (McCune, Mefford 1999). In the

Cluster Analysis similarity was calculated as Sorensen's distance (Bray-Curtis) measure and the single linkage nearest neighbour method was used to form linkages. To characterize spatial distribution of spiders and influence of limiting factors Pearson product-moment correlation coefficient was calculated (Zar 1998). The dominance of taxa was characterized in accordance with Engelmann classification (1978).

Results

Fauna and dominance structure

Altogether we analyzed 1728 adult spider specimens representing 53 taxa belonging to 15 families (Annex 1). Linyphiidae (35.71%), Lycosidae (26.39%), Dictynidae (12.27%), Gnaphosidae (7.81%), Salticidae (6.89%) and Thomisidae (6.19%) were the most frequently found families in dune habitats. *Argenna subnigra* (12.27%), *Pardosa palustris* (7.52%), *Pelecopsis parallela* (5.03%), *Xerolycosa miniata* (11.40%) and S*itticus saltator* (5.90%) were among the most frequently found species. Remaining spider families and species were recedent or subrecedent. For Linyphiidae, 28% of all specimens remained unknown due to identification difficulties to species. The highest number – 11 species was recorded for Lycosidae. Other four families were represented by 5-9 species, and ten families – by 1-3 species.

The dominance structure of spider families varies along the transect (Figure 2). Salticidae dominated in white dunes, but Linyphiidae and Lycosidae showed higher dominance in grey dunes. Changes in relative population density were also recorded across habitats (Figure 3). Salticidae was significantly more abundant in white dunes in comparison to grey dunes, but Lycosidae, Thomisidae and Linyphiidae were significantly more abundant in grey dunes. The total number of specimens was also significantly increasing along the transect from coast to inland (Figure 4).

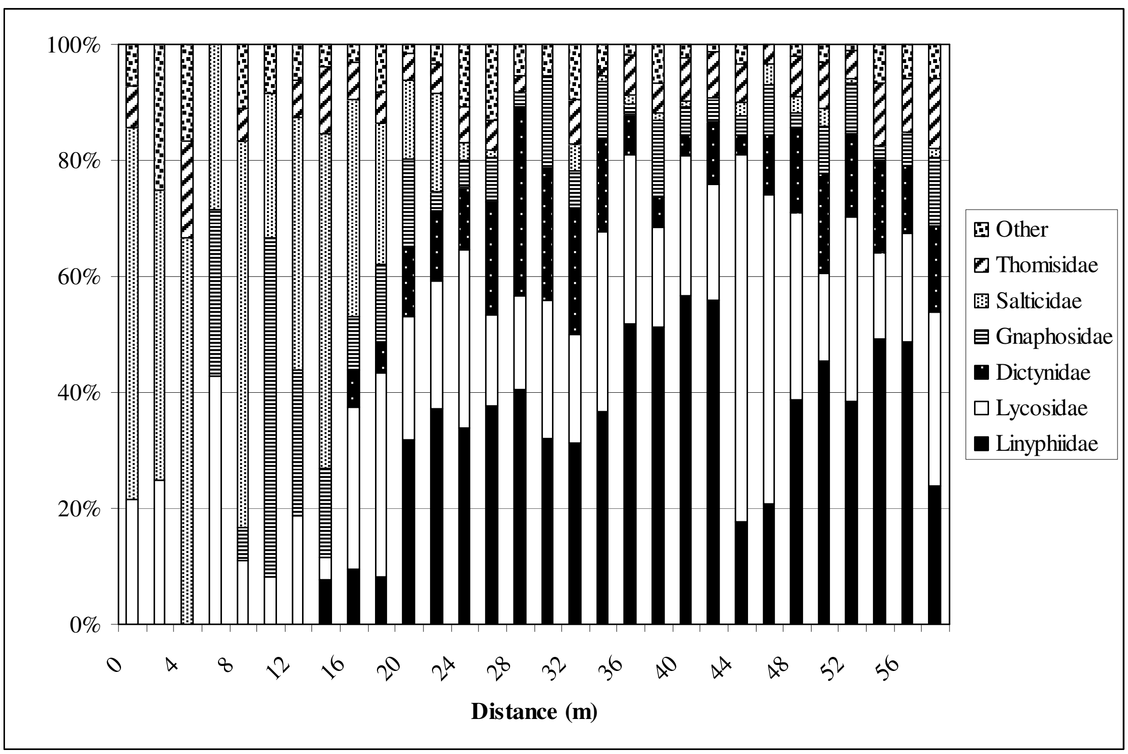

Figure 2. Dominance structure of dune living spider families at different distances (m) from white dune.

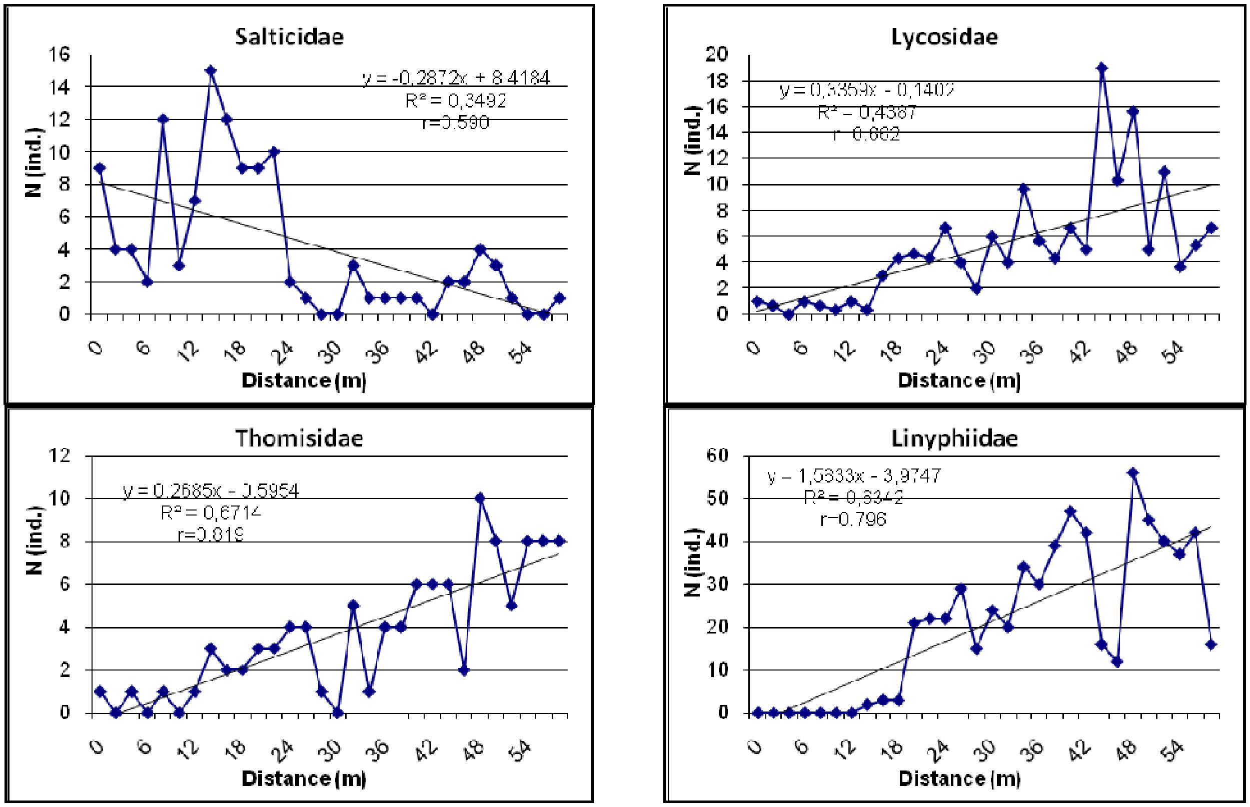

Figure 3. Changes in mean relative density (N. (ind.)) of Salticidae, Lycosidae, Thomisidae and Linyphiidae specimens at different distances (m) from white dune.

Detrended Correspondence Analysis

The first axis of DCA (eigenvalue 0.445) separates sample plots according to succession stages of dune vegetation (or distance from the sea) – white dunes are plotted on the right, but grey dunes and dry forested meadow – on the left (Figure 4). Implicitly, the first axis explained sand dynamics and vegetation succession. Inlands the sand dynamic is becoming weaker, thus positively influencing distribution of ground dwelling spiders. This evidence is supported also by vegetation data: (1) white dunes were characterized by *Tragopogon heterospermus*, *Leymus arenarius* and *Hieracium umbellatum*; (2) grey dunes were characterized by *Galium mollugo*, *Sedum acre*, *Carex arenaria*, *Halictotricon pubescens* and mosses *Hypnum cupressiforme*, *Climacium dendroides*. Second DCA axis (eigenvalue 0.125) factor cannot be clearly explained.

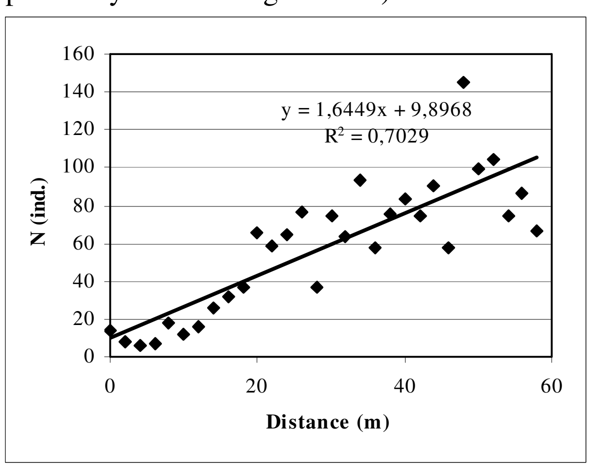

Figure 4. Changes in mean relative density (N (ind.)) of specimens at different distances (m) from white dune.

Total number of spiders correlated positively with coverage of mosses and lichens (N=30, r=0.808, p<0.01), vascular plant cover (N=30, r=0.857, p<0.01) and distance from white dune (N=30, r=0.838, p<0.01). By clustering all 30 samples, analysis showed only two distinct groups – white dune and grey dune (Figure 5).

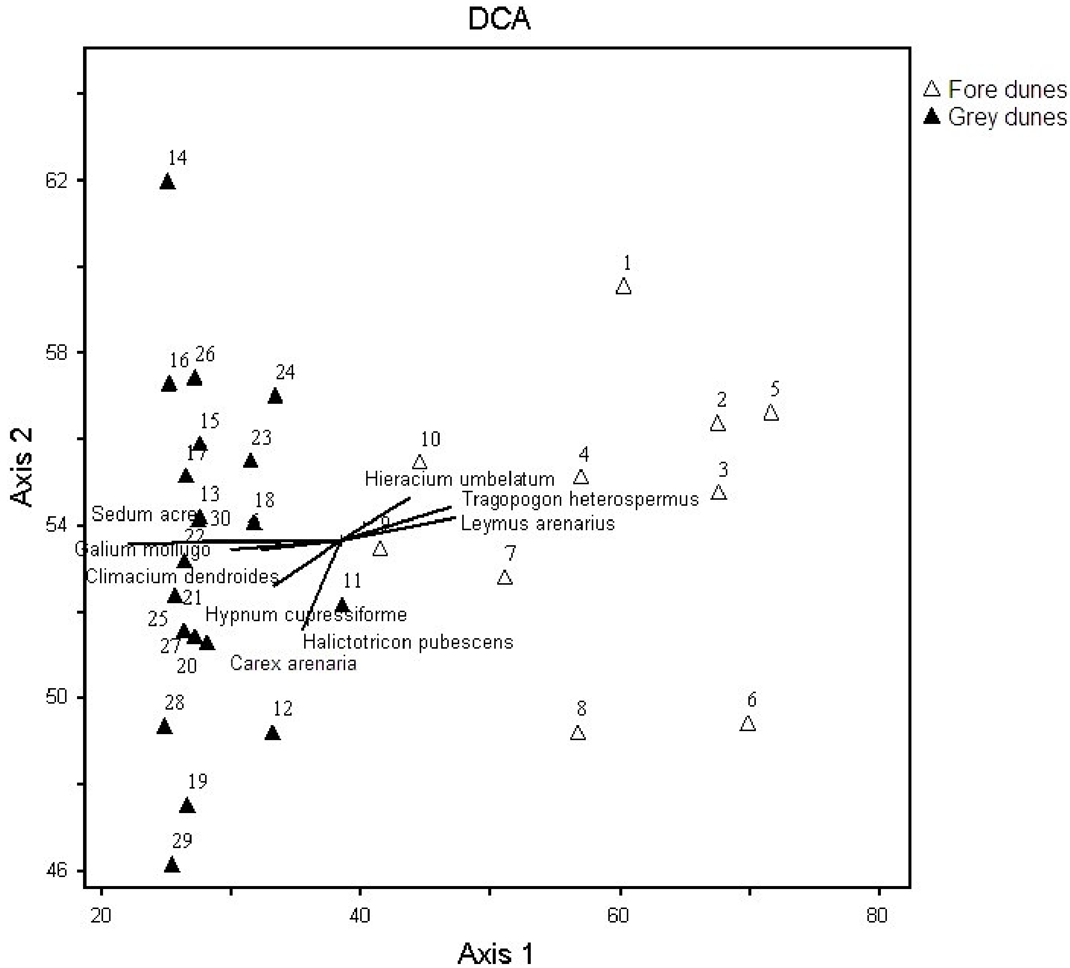

Figure 5. DCA (Detrended Correspondence Analysis) ordination of pitfall data based (number of pitfall traps are given) on the spider species distribution data with indication of habitat type and typical plant species (ordination along first and second axis).

Indicator species analysis

Indicator species analysis identified 17 indicator species of two cluster groups (Table 1): (1) white dunes were indicated by *Pardosa agrestis*, *Micaria lenzi*, *M. subopaca* and *Sitticus saltator* and (2) grey dunes were indicated by *Steatoda albomaculata*, *Gonatium rubens*, *Pelecopsis parallela*, *Tapinocyboides pygmaeum*, *Alopecosa cuneata*, *Alopecosa pulverulenta*, *Hahnia nava*, *Argenna subnigra*, *Drassyllus pussillus*, *Zelotes longipes*, *Xysticus erraticus* and *X. kochi*.

Discussion

Fauna and dominance structure

Majority of the identified taxa (39) could be characterized as dune living spiders (e.g. at least 3 specimens of each taxon were found there). Only one or two individuals represented other 14 species (Annex 1). These species might be immigrants from other habitats (e.g. pine forest) or they might not be captured by used method (e.g. only accidental captures by pitfall traps possible).

We detected 5 families, which do not make webs – Gnaphosidae, Lycosidae, Philodromidae, Thomisidae and Salticidae (Almquist 2005, 2006). Majority of species of Tetragnathidae was web-weavers, but for *Pachygnatha listeri* only juveniles make webs while adults are characterized as hunters (Almquist 2005). Other representatives of spider families Araneidae, Clubionidae, Dictynidae, Hahniidae, Linyphiidae, Miturgidae and Theridiidae are web-weavers (Almquist 2005, 2006).

According to analyses Linyphiidae and Lycosidae were dominant families in dune habitats at Akmensrags. Other 4 families were subdominant in dune habitats: Dictynidae, Gnaphosidae, Thomisidae and Salticidae. All of these families, except Linyphiidae and Dictynidae incorporate spider species what are hunting on ground and vegetation and are not weaving webs. None of the species were eudominant or dominant according to Engelmann's scale. Five the most frequent species in this study were subdominants: (1) *Xerolycosa miniata*, what is supported by Almquist (2005) stating that it occurs in meadows, dunes and sandy shores; (2) *Pelecopsis parallela* which is described to occur in open habitats (Heimer, Nentwig 1991); (3) *Pardosa palustris*, which is also identified as indicator species in dune habitats – eutrophic wet dune valleys (Bonte et al. 2002) and prefer to live in meadows, both dry and damp (Almquist 2005); (4) *Sitticus saltator*, which was distributed in mesotrophic dune grasslands (Bonte et al. 2000) and (5) *Argenna subnigra*, what was also found in white dune, dune heath and dune meadows in Wales (Duffey 1968) and in accordance to Almquist (2006) is dune species. Also after Hanggi et al. (1995) all species, except *Sitticus saltator*, were found in coastal habitats, moist meadows, oligotrophic grasslands and *Pardosa palustris* also in fields and gardens. *Sitticus saltator* after Schultz and Finch (1996) in higher numbers was found in coastal dune habitats.

Relatively great proportion (28.53%) of total number comprised undetermined Linyphiidae specimens. We explain high abundance of Linyphiidae by ballooning of species of this family (Bonte et al. 2003b) and by migration from pine forest situated in close proximity of the sample area (Bonte et al. 2000). Specimens were undetermined due to identification difficulties.

Limiting factors of spider fauna in coastal dunes

DCA arranged sample plots by vegetation succession stages. Vegetation in dunes is driven by sand movements, thus as already stated by Bonte et al. (2003a; 2004) the main factor of spider distribution in dunes is sand dynamics. We also found significant positive correlation between population density of spiders and coverage of flowering plants. Bonte et al. (2002, 2003a) discuss other factors influencing spider distribution in dunes – soil temperature, soil and aerial humidity, and height of vegetation. Not only in dunes but also in other habitats structure of vegetation has significant influence on spiders (Duffey 1966). Almquist (1973) analyzed connection between vegetation cover and spider population density, and stated that near the sea density is lower than closer to the inland side of dunes. Possibly there are more factors – density of vegetation, salinity, prey availability etc. These factors might be explored in further research.

Indicator species

Dunes, especially white dunes, are instable ecosystem due to permanent disturbance by wind, seawater and salts. Vegetation succession is often interrupted by storms what can reset the process to bare sand. Overgrowing by shrubs might be observed more to the inland – in grey dunes.

Since this study is based on observations during one month only the results should be treated with caution – annual variation and weather dependence cannot be evaluated in this research.

Likewise among plants also among spiders there are true dune inhabitants – dune indicator species. In this study we found 17 dune indicator species – 4 for sand dunes and 13 for grey dunes. Four of the 17 species: *Argenna subnigra*, *Pelecopsis parallela*, *Pardosa palustris* and *Sitticus saltator* also were among most frequent species. Bonte et al. (2002) found 20 species in total – 8 species for bare sand, 8 species for Marram grass and moss dominated dunes. One of species (*Sitticus saltator*) in common with our research and eight species for grey dunes (moss dominated Marram grass dunes near the inner dune front), one species (*Zelotes longipes*) in common with our research. There are eight more species which indicated grey dunes in our research, but were identified by Bonte et al. (2002) as indicators of other dune habitat types: (1) *Gonatium rubens* and *Alopecosa pulverulenta* indicated eutrophic vegetation; (2) *Xysticus kochi* – thermophiliuos grasslands; (3) *Alopecosa cuneata* and *Xysticus erraticus* – high dwarf shrubs; (4) *Pardosa palustris* – eutrophic dune valleys and (5) *Hahnia nava* – wet rough litter rich vegetation and (6) *Pelecopsis parallela* – dry mesotropic grasslands. We can explain these differences with more detailed classification and wider cover of dune habitats in Bonte et al. (2002) research. In total, Bonte et al. (2002) found 125 species, 20 of them in common with our research. Duffey (1968) totally found 191 dune spider species, 26 of them were common, but only 7 of them were indicator species – *Alopecosa pulverulenta*, *Drassyllus pussillus*, *Gonatium rubens*, *Argenna subnigra*, *Xysticus cristatus*, *X. kochi* and *Sitticus saltator*.

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References

Almquist S. 1973. Spider associations in coastal sand dunes. – *Oikos* **24**: 444-457.

Almquist S. 2005. Swedish Araneae, Part 1 – families Atypidae to Hahniidae. – *Insect Systematics & Evolution* **62**: 1-284.

Almquist S. 2006. Swedish Araneae, part 2 – families Dictynidae to Salticidae. – *Insect Systematics & Evolution* **63**: 285–603.

Auniņš A. (ed.) 2010. [European Union protected habitats in Latvia]. Latvian Fund for Nature, Riga: 1-319 (in Latvian).

Bonte D., Baert L., Maelfait J.-P. 2002. Spider assemblage structure and stability in heterogenous coastal dune system (Belgium). *The Journal of Arachnology* **30**: 331-343.

Bonte D., Criel P., Vanhoutte L., Von Thournout I., Maelfait J.-P. 2003a. Regional and local variation of spider assembladges (Araneae) from coastal grey dunes along the North Sea. – *Journal of Biogeography* **3**: 901-911.

Bonte D., Criel P., Vanhoutte L., Von Thournout I., Maelfait J.-P. 2004. The importance of habitat productivity, stability and heterogeneity for spider species richness in coastal grey dunes along the North Sea and its implication for conservation. – *Biodiversity and Conservation* **13**: 2119-2134.

Bonte D., Hoffmann M., Maelfait J.-P. 2000. Seasonal and diurnal migration patterns of the spider fauna of coastal grey dunes. – *Ekológia* (Bratislava) **19/4** suppl.: 5-16.

Bonte D., Vanderbroecke N., Lens L., Maelfait J.-P. 2003b. Low propensity for aerial dispersal in specialist spiders from fragmented landscapes. – *Proceedings of the Royal Society of London* B **270**: 1601-1607.

Duffey E. 1966. Spider ecology and habitat structure (Arach., Araneae). – *Senckenbergiana Biologica* **47**: 45-49.

Duffey E. 1968. An ecological analysis of the spider fauna of sand dunes. – *Journal of Animal Ecology* **37**: 641-674.

Dufrêne M., Legendre P. 1997. Species assemblages and indicator species: the need for a flexible asymmetrical approach. – *Ecological Monographs* **67**: 345-366.

Eberhards G. 2003. The Sea Coast of Latvia. University of Latvia, Riga: 1-292. (in Latvian, English abstract).

EEC. 1992. Council Directive 92/43/EEC of 21 May 1992 on the Conservation of natural habitats and of wild fauna and flora

Engelmann A.-D. 1978. Dominant Klassifizierung von Bodenarthropoden. – *Pedobiologia* **18**: 378-380.

Hänggi A., Stöckli E., Nentwig W. 1995. Habitats of Central European Spiders. Characterisation of the habitats of the most abundant spider species of Central Europe and associated species. *Miscellanae Faunistica Helvetica* **4**: 460 pp.

Heimer S., Nentwig W. 1991. Spinnen Mitteleuropas: ein Bestimungbuchs. Verlag Paul Parley, Berlin und Hamburg: 543 pp.

Hill R.W., Wyse G.A. 1989. Animal physiology, 2nd ed., Harper & Row, Publishers, New York: 1-657.

Hill M.O., Gauch H.G. 1980. Detrended correspondence analysis: an improved ordination technique. – *Vegetatio* **42**: 47-58.

Kabucis I. (ed.) 2001. [Habitats of Latvia. Classification]. Latvian Fund for Nature, Rīga: 1-96 (in Latvian).

Locket G.H., Millidge A.F. 1953. British Spiders, 2. Metchim & Son Ltd., London: 1-449.

McCune B., Mefford M.J. 1999. Multivariate analysis of ecological data, version 4.17. MjM Software, Gleneden Beach.

Nentwig W., Hänggi A., Kropf C., Blick T. 2003. Spinnen Mitteleuropas. Version 8.12.2003. An internet identification key. Online at http://www.araneae.unibe.ch (Last accessed: 10.12.2009).

Platnick N.I. 2010. The World Spider Catalog. Version 10.5 American Museum of Natural History. New York. Online at http://research.amnh.org/entomology/spiders/catalog (Last accessed: 14.05.2010).

Relys V. 2000. Contribution to the knowledge of the spider (Araneae, Arachnida) fauna of Lithuania. – *Acta Zoologica Lituanica* **10**: 47-53.

Relys V., Spuņģis V. 2002. Check list of spiders (Arachnida, Araneae) of Latvia. Online at http://leb.daba.lv/Aranea.htm Last accessed: 20.04.2010.

Schultz W., Finch O.-D. 1996. Biotoptypenbezogene Verteilung der Spinnenfauna der nordwestdeutschen Küstenregion. Cuvillier Verlag, Göttingen: 1-141.

Zar J.H. 1998. Biostatistical analysis, 4th ed., Prentice Hall, Upper Saddle River, NJ: 1-929.

Žukauskiene J. 1966. [Soil invertebrates of Kuršių Nerija (7. Spiders)]. *Proceedings of Academy of Sciences of Lithuanian SSR*, Series B2, **40**: 193-199 (in Russian).

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Table 1

Indicator species for clustergroups: white dune and grey dune.

Indicator species	**Group of cluster analysis**	**Relative frequency in group (%)**	**P**
Micaria lenzi	White dune	50	0.0460
M. subopaca		40	0.0340
Pardosa agrestis		40	0.0300
Sitticus saltator		100	0.0110
Steatoda albomaculata		40	0.0320
Gonatium rubens	Grey dune	50	0.0110
Pelecopsis parallela		95	0.0010
Linyphiidae gen. spp.		100	0.0010
Tapinocyba pygmaea		40	0.0270
Alopecosa cuneata		85	0.0010
A. pulverulenta		60	0.0060
Pardosa palustris		100	0.0010
Hahnia nava		75	0.0070
Argenna subnigra		100	0.0010
Drassodes pubescens		30	0.0350
Zelotes longipes		50	0.0170
Xysticus erraticus		65	0.0140
X. kochi		65	0.0360

Annex 1

A list of spider species collected by pitfall traps, dominance % and they presence in three transects at Akmensrags dune habitats. D – dominance, N – number of individuals.

Family / Species	**Sample plots**																														**D**	**N**
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**	**21**	**22**	**23**	**24**	**25**	**26**	**27**	**28**	**29**	**30**		
Theridiidae																															1,27	
Asagena phalerata (PANZER, 1801)							x	x			x							x	x	x	x		x			x			x		0,87	15
Paidiscura pallens (BLACKWALL, 1834)																													x		0,06	1
Steatoda albomaculata (DEGEER, 1778)		x	x		x	x									x																0,35	6
Linyphiidae																															**35,30**	
Entelecara erythropus (WESTRING, 1851)																									x			x			0,12	2
Gonatium rubens (BLACKWALL, 1833)													x	x	x	x					x		x	x	x	x				x	1,04	18
Gongylidiellum murcidum SIMON, 1884											x																				0,06	1
Pelecopsis paralella (WIDER, 1834)									x			x	x	x	x	x	x	x	x	x	x	x		x	x	x	x	x	x	x	**5,03**	87
Porrhomma sp.																													x		0,06	1
Tapinocyboides pygmaeus (MENGE, 1869)														x	x		x			x			x		x			x	x		0,46	8
Linyphidae Genus sp.								x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	**28,53**	493
Walckenaeria antica (WIDER, 1834)														x		x						x	x			x					0,41	7
Tetragnathidae																															0,35	
Pachygnatha listeri SUNDEVALL, 1830														x			x	x		x											0,35	6
Araneidae																															0,06	
Hypsosinga pygmaea (SUNDEVALL, 1831)														x																	0,06	1
Lycosidae																															**26,39**	
Alopecosa cuneata (CLERCK, 1757)									x	x	x		x	x	x	x			x	x	x	x	x	x	x	x	x	x	x	x	2,08	36
Alopecosa fabrilis (CLERCK, 1757)									x										x						x						0,17	3
Alopecosa pulverulenta (CLERCK, 1757)												x	x			x	x	x		x					x	x	x	x	x	x	1,62	28
Pardosa agrestis (WESTRING, 1861)	x				x				x	x								x								x					0,52	9
Pardosa palustris (LINNAEUS, 1758)									x		x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	**7,52**	130
Pardosa prativaga (L. KOCH, 1870)															x	x		x			x									x	0,41	7
Pardosa pullata (CLERCK, 1757)							x		x		x	x	x	x		x	x	x	x		x	x			x				x		1,45	25
Pardosa sphagnicola (DAHL, 1908)												x							x						x		x	x	x	x	0,64	11
Trochosa ruricola (DEGEER, 1778)											x											x									0,23	4
Trochosa terricola THORELL, 1856										x			x														x	x		x	0,35	6
Xerolycosa miniata (C.L. KOCH, 1834)	x	x		x		x	x	x	x	x	x	x	x	x	x	x	x	x		x			x	x	x	x	x	x	x	x	**11,40**	197
Pisauridae																															0,06	
Pisaura mirabilis (CLERCK, 1757)										x																					0,06	1
Hahniidae																															1,85	
Hahnia nava (BLACKWALL, 1841)									x	x		x	x	x	x	x	x	x		x		x			x	x		x	x	x	1,85	32
Dictynidae																															**12,27**	
Argenna subnigra (O.P.-CAMBRIDGE, 1861)									x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	**12,27**	212
Corinnidae																															0,29	
Phrurolithus festivus (C.L. KOCH, 1835)	x									x				x																x	0,29	5
Miturgidae																															0,17	
Cheiracanthium erraticum (WALCKENAER, 1802)					x																										0,06	1

Annex 1, continuation

Cheiracanthium virescens (SUNDEVALL, 1833)																x									x						0,12	2
Clubionidae																															0,64	
Clubiona diversa O. P.-CAMBRIDGE, 1862													x	x		x										x				x	0,58	10
Clubiona neglecta O. P.-CAMBRIDGE, 1862												x																			0,06	1
Gnaphosidae																															**7,81**	
Drassodes lapidosus (WALCKENAER, 1802)									x		x							x		x							x		x	x	0,69	12
Drassodes pubescens (THORELL, 1856)							x				x		x			x		x		x		x			x	x	x	x	x		0,81	14
Drassyllus praeficus (L. KOCH, 1866)											x						x			x	x										0,35	6
Drassyllus pusillus (C.L. KOCH, 1833)								x								x			x								x			x	0,41	7
Haplodrassus singifer (C.L. KOCH, 1839)															x								x	x		x	x			x	0,46	8
Micaria lenzi BÖSENBERG, 1899					x	x		x	x	x	x							x		x											0,64	11
Micaria subopaca WESTRING, 1861				x		x	x	x			x	x																			0,52	9
Zelotes electus (C.L. KOCH, 1939)				x			x		x	x	x		x	x		x	x	x		x	x		x	x	x	x	x			x	3,07	53
Zelotes longipes (L. KOCH, 1866)												x		x		x				x	x	x	x	x			x	x			0,87	15
Philodromidae																															0,06	
Thanatus striatus C.L. KOCH, 1845														x																	0,06	1
Thomisidae																															**6,19**	
Ozyptila scabricula (WESTRING, 1851)													x				x			x	x				x				x		0,46	8
Xysticus bifasciatus C.L. KOCH, 1837												x									x				x		x	x			0,29	5
Xysticus cristatus (CLERCK, 1757)			x		x		x	x	x	x	x		x	x	x		x		x	x	x	x	x	x	x	x	x	x	x	x	2,72	47
Xysticus erraticus (BLACKWALL, 1834)										x			x				x		x	x	x	x	x		x	x	x	x	x	x	1,56	27
Xysticus kochi THORELL, 1872	x								x		x	x		x			x	x	x	x			x	x	x		x		x		1,16	20
Salticidae																															**6,89**	
Euophrys frontalis (Walckenaer, 1802)												x																			0,06	1
Phlegra fasciata (HAHN, 1826)									x					x			x	x							x	x	x			x	0,69	12
Sitticus saltator (O.P.-CAMBRIDGE, 1868)	x	x	x	x	x	x	x	x	x	x	x	x	x							x	x		x	x	x						5,90	102
Sitticus sp.								x																							0,06	1
Talavera aequipes (O.P.-CAMBRIDGE, 1871)																			x						x						0,12	2
Talavera sp.																										x					0,06	1