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THE INVAZIVE ENTOMOFAUNA OF THE HEMIMETABOLA GROUP FOR REPUBLIC OF MOLDOVA

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Abstract
In Moldova is investigated invasive entomofauna with the economic and ecological impact. Until now settled 118 species of the Hemimetabola group, belonging of 2 subclasses, 2 superorder and 7 orders. These 118 species were corellation with the database of Fauna Europaea and recorded are 24 species (20.3%), but for 94 (79.6%) mentioned with the "absent" and "no data". In the meantime there were recorded 12 other species: Blatta orientalis, Cimex lectularius, Lepisma saccharina, Periplaneta americana, Trialeurodes vaporariorum – 1983, Blattella germanica – 2003, Leptoglossus occidentalis – 2010, Tachycines asynamorus, Dociostaurus tartarus – 2011, Scaphoideus titanus, Perillus bioculatus – 2013, Nezara viridula – 2014. According periods penetration it was found that 1 species have entered the XVII century, 1 in the XVIII, 14 in the XIX, 73 in the XX and 25 in the XXI. The registration invasive insects in countries of interest is in: Bulgaria – 48 species; Poland – 40; Romania – 25; other countries –5.

Keywords: the invazive entomofauna, Hemimetabola, Republic of Moldova.

1. INTRODUCTION

The humanity is living in a period of world history when the intercalation of thousands of organisms in various parts of the planet, causing significant changes in the nature and economy. After that significant changes in the stability of natural populations of organisms on Earth.

At the same time, adjusting population density of nonnative species with the ecological and economic impact on host plants, according to the methods of plant protection is special important (Vereshchaghin, 1914; Alexianu, 1943; Boguleanu, 1994; Cean, 2009; Iuşan, 2009; Perju et al., 2009; Stahi, 2011; Timus and Derjanschi, 2012; Derjanschi et al., 2012; Timus et al., 2013)

In this context, it is necessary for environmental problems and biodiversity of flora and fauna to be investigated and dealt with appropriately as possible (Bucina and Busuioc, 1970; Olteanu et al., 2001; Timus, 2010, 2013; Tanaskovici et al., 2013; Ruicănescu, 2009).

For this reason at the Zoological Institute of the Academy of Sciences of Moldova, Laboratory of Entomology and State Agrarian University of Moldova, Department of Plant Protection, entomological subjects it searches the invasive entomofauna to know the composition of species, bioecological aspects and take measures to combat the economic and environmental impact significantly. By the year 2014 have established 297 species of insects which is the first database of

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invasive entomofauna from Republic of Moldova, prepared in accordance with example the countries of interest: România (Rakosy et al., 2009), Poland (Glowacinski et al., 2011) and Bulgaria (Tomov et al., 2009).

In the current work is the database according to the classification groups: Hemimetabola with 118 of species (part of I) and Holometabola with 179 species (part of II – Coleopterofauna with 100 of species; III – supraorder Mecopetroidea with 79).

The research was performed within the project 11.817.08.13F funded by Supreme Council for Sciences and Technological Development of Academy of Sciences of Moldova.

2. MATERIALS AND METHODS

Research the invasive entomofauna from the superorder Mecopteroidea was performed according to: a) analysis of the individual insect host-plants of agricultural land and the cultural landscapes (parks, squares, alleys, niches without control); b) literature in the archives and the libraries sectional "old book"; c) in the conjunction with databases of interest to the countries: Romania, Poland and Bulgaria. In the agricultural fields and the cultural landscapes, the individuals specimens of insects harvested during the growing season were installed by the methods of collecting and their conservation (Croitoru et al., 2012).

3. RESULTS AND DISCUSSIONS

From the analysis of 118 species of insects from the Hemimetabola group with the status of invasive was found to be part of 2 subclasses: 1) Apterygota – lower insects –Thysanura order and 2) Pterygota – upper insects. The insects upper part of 2 supraorders: *Orthopteroidea* with 3 orders (type of mouthparts gnawing both active phases): Blattodea, Orthoptera, Dermaptera and *Hemipteroidea* with 3 orders (type of mouthparts piercing sucking both active phases): Homoptera, Hemiptera, Thysanoptera (Table 1 and 2).

From these insect species, dominant are from the Homoptera and Hemiptera order (Figure 1).

From the chronological analysis the invasive insects from the Hemimetabola group began in XVII century and has held up to date. The previous species were recorded:

1) in the XVII century – *Periplaneta americana* first observed in America in 1625, also in this century and in some European countries, including Poland; 2) in the XVIII century – *Cimex lectularius* – Poland; 3) in the XIX century, the number rose to 14 species: *Acheta domesticus*, *Calliptamus italicus* and *Blatta orientalis* – 1853 (Romania); *Dactylosphaera vitifoliae* – 1862 (Poland); *Myzus persicae* – 1866 (Poland), *Coccus hesperiadum* – 1883 (Poland), *Lepisma saccharina* – 1885 (Romania), *Chromaphis juglandicola* and *Panaphis juglandis* – 1894 (Poland), *Blattella germanica* and *Aspidiotus nerii* – 1897 (Romania); *Eriosoma lanigerum* – 1898 (Poland), *Diaspidiotus perniciosus* – 1898 (Romania), *Dociostaurus maroccanus* – 1899 (Romania); 4) in the XX century, were recorded 73 species from various ecological niches; 5) in the XXI century (2010-2014) already recorded 25 species (Figure 2).

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Table 1. The invazive entomofauna from Hemimetabola group registered in countries of interest and Republic of Moldova

Order / subclass, superorder		**Romania**		**Bulgaria**		**Poland**		**Other country**		**FaEu / Republic of Moldova**					
the name	number of species	total	%	total	%	total	%	total	%	present	%	absent		no date	%
Subclass Apterygota															
Thysanura	2	2	100	0	0	0	0	0	0	0	0	0	0	2	100
Subclass Pterygota, superorder *Orthopteroidea*															
Blattodea	3	2	66.6	0	0	1	33.3	0	0	0	0	0	0	3	100
Orthoptera	9	4	44.4	3	33.3	2	22.2	0	0	2	22.2	7	77.7	0	0
Dermaptera	1	0	0	1	100	0	0	0	0	0	0	0	0	1	100
Subclass Pterygota, superorder *Hemipteroidea*															
Homoptera	76	13	17.1	28	36.8	32	27.1	3	3.9	17	22.3	46	60.5	13	17.1
Hemiptera	18	4	22.2	9	50.0	3	16.6	2	11.1	3	16.6	15	83.3	0	0
Thysanoptera	9	0	0	7	77.7	2	22.2	0	0	2	22.2	1	11.1	6	66.6
7	118	25	21.1	48	40.6	40	33.8	5	4.2	24	20.3	69	58.4	25	21.1

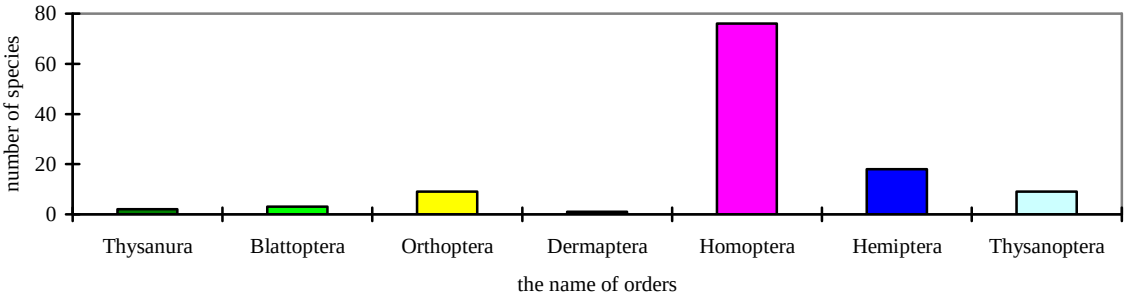

Figure 1. The invasive insects at the level order from Hemimetabola group

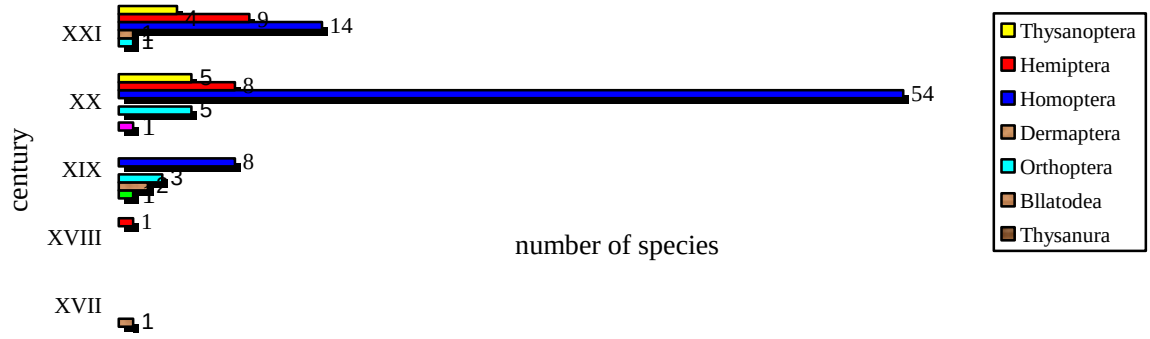

Figure 2. The evolution invasive entomofauna from Hemimetabola group

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After chronological correlation of databases countries of interest, to mention that most species were recorded: in Bulgaria – 48 species or 40.6% from Hemimetabola group and 16% from all the invazive entomofauna investigation (Dermaptera – 1, Orthoptera – 3, Thysanoptera – 7, Hemiptera – 9, Homoptera – 28); in Poland – 40 species or 33,8%, respectively 13,4% (Orthoptera – 2, Blattodea – 1, Thysanoptera – 2, Hemiptera – 3, Homoptera – 32); in Romania – 25 species or 21.1%, respectively 8.4% (Thysanura – 2, Orthoptera – 4, Blattodea – 2, Hemiptera – 4, Homoptera – 14); in the other country 5 species or 4.2%, respectively 1.6% (Hemiptera – 2, Homoptera – 3) (Figure 3.).

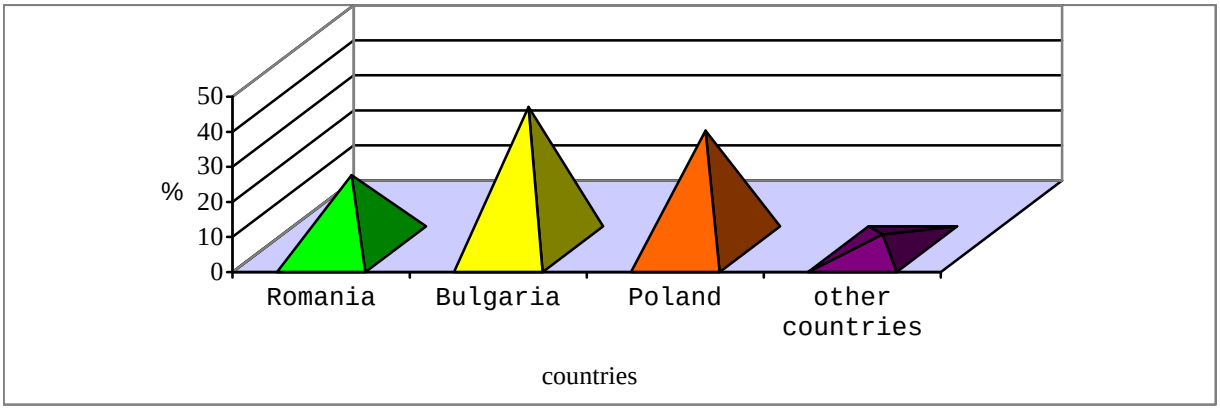

Figure 3. The registration invasive of insects in the countries of interest for Republic of Moldova

The invasive entomofauna from Hemimetabola group has been correlation with the database of Fauna Europaea and for Republic of Moldova 94 species (79.6%) mentioned with the „absent" and „no date".

Of these in the our country were recorded 12 species: 1 of the Thysanura order: *Lepisma saccharina* – 1983; 3 of the Blattodea order: *Periplaneta americana, Blatta orientalis* – 1983, *Blattella germanica* – 2003; 2 of the Orthoptera order: *Tachycines asynamorus, Dociostaurus tartarus* – 2011; 2 of the Homoptera order: *Trialeurodes vaporariorum* – 1983, *Scaphoideus titanus* – 2013; 4 of the Hemiptera order: *Cimex lectularius* – 1983, *Leptoglossus occidentalis* – 2010, *Perillus bioculatus* – 2013, *Nezara viridula* – 2014. The other 82 species requires research and publication of results in scientific articles European value, because most of these species are found in one of the countries of interest.

After summarizing the alien species of the insects can be seen that most of them develop at home (social inconvenience and destroyed grain from warehouses – Thysanura order, Blattoptera, Dermaptera) in the fields of agricultural plants (fruit, vegetable, etc. – Homoptera, Hemiptera, Thysanoptera) and eaten by domestic animals (to pasture – Orthoptera order). The successful adaptation of species into new ecological niches from Hemimetabola group in diverse habitats, including the republic landscapes was achieved due to favorable climatic conditions, the presence of preferred host plants, diverse nutrient regime (monophagous, oligophagous and polyphagous) and high prolificacy.

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Migration and adaptation of invasive insects is significant increase compared to those recorded, for example in the XVII century. Thus, the responsible for the fields of scientific research and Plant Protection are obliged to publish the results for decision making by ministries and departments of rigor in time. They also warn the agricultural sector to combat urgent the first hotbed and the following the populations invasive insects with significant economic and environmental impact.

Table 2. The invazive entomofauna from Hemimetabola group

No. ord	Family, genus, species / Order, subclass, superorder	1625	1780-1789	1790-1799	1800-1809	1810-1819	1820-1829	1830-1839	1840-1849	1850-1859	1860-1869	1870-1879	1880-1889	1890-1899	1900-1909	1910-1919	1920-1929	1930-1939	1940-1949	1950-1959	1960-1969	1970-1979	1980-1989	1990-1999	2000-2009	2010-2014
Subclass **Apterygota**																										
	Lepismatidae	Ord. **Thysanura**																								
1.	*Lepisma saccharina*, 1758												Ro													
2.	*Thermobia domestica*, 1873																							Ro		
Subclass P**terygota,** superorder *Orthopteroidea*																										
	Blattidae	Ord. **Bllatodea**																								
3.	*Periplaneta americana*, 1758	Po																								
4.	*Blatta orientalis*, 1758									Ro																
	Pseudomopidae																									
5.	*Blattella germanica*, 1767													Ro												
		Ord. **Orthoptera**																								
	Rhaphidophoridae																									
6.	*Tachycines asynamorus*, 1902															Po										
	Gryllidae																									
7.	*Acheta domesticus*, 1758									Ro																
	Acrididae																									
8.	*Calliptamus italicus*, 1758									Ro																
9.	*Dociostaurus tartarus*, 1921																				Bg					
10.	*Dociostaurus maroccanus*, 1815													Ro												
11.	*Notostaurus albicornis*, 1848																				Bg					
12.	*Ramburiella turcomana*, 1846																				Bg					
	Tettigoniidae																									
13.	*Meconema meridionale*, 1860																								Ro	
	Meconematidae																									
14.	*Cyrtaspis variopicta*, 1860																Po									
	Labiidae	Ord. **Dermaptera**																								
15.	*Labia minor*, 1758																								Bg	
Subclass P**terygota,** superorder *Hemipteroidea*																										
	Adelgidae	Ord. **Homoptera**																								
16.	*Dreyfusia nordmannianae*, 1890																Bg									
17.	*Gilletteella cooleyi*, 1907																	Po								
18.	*Pineus strobi*, 1837																	Po								
	Aleyrodidae																									
19.	*Bemisia tabaci*, 1889																				Ro					
20.	*Massilieurodes chittendeni*, 1928																							Po		
21.	*Trialeurodes vaporariorum*, 1856																Ro									
	Aphididae																									
22.	*Aphis forbesi*, 1899																		Ro							
23.	*Aphis gossypii*, 1877														Ro											
24.	*Aphis spiraephaga*, 1961																			Po						
25.	*Aphis spiraecola* 1914																								Bg	

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26.	*Acyrthosiphon caraganae*, 1908																					Bg				
27.	*Acyrthosiphon primulae*, 1913																							Bg		
28.	*Acyrthosiphon ignotum*, 1914																		Po							
29.	*Appendiseta robiniae*, 1907																						Bg			
30.	*Brachycaudus rumexicolens*, 1917																									A
31.	*Chaetosiphon fragaefolii*, 1901															Bg										
32.	*Dactynotus erigeronensis*, 1878																		Po							
33.	*Hyadaphis tataricae*, 1935																	Po								
34.	*Hyalopterus amygdali*, 1840															Po										
35.	*Macrosiphum euphorbiae*, 1878																Ro									
36.	*Macrosiphoniella sanborni*, 1908																		Bg							
37.	*Myzus ascalonicus*, 1946																		Po							
38.	*Myzus ornatus*, 1932																		Bg							
39.	*Myzus persicae*, 1776									Po																
40.	*Myzus varians*, 1912															Bg										
41.	*Neomyzus circumflexum*, 1876															Po										
42.	*Impatientium asiaticum*, 1929																				Ro					
43.	*Prociphilus fraxinifolii*, 1879																							Bg		
44.	*Pterochloroides persicae*, 1899																									A
45.	*Rhopalosiphum maidis*, 1856													Ro												
46.	*Rhopalosiphum rufiabdominale*, 1899																							Bg		
47.	*Rhopalosiphum insertum*, 1849																							Bg		
48.	*Rhodobium porosum*, 1900																		Bg							
49.	*Rhopalosiphoninus latysiphon*, 1912																	Po								
	Asterolecaniidae																									
50.	*Asterolecanium epidendri*, 1844																				Po					
	Callaphididae, Phyllaphididae																									
51.	*Chromaphis juglandicola*, 1843												Po													
52.	*Panaphis juglandis*, 1778												Po													
53.	*Myzocallis walshii*, 1917																							Bg		
	Coccidae																									
54.	*Ceroplastes japonicus*, 1921																							Bg		
55.	*Coccus hesperidum*, 1758											Po														
56.	*Eucalymnatus tessellatus*, 1873																			Po						
57.	*Parthenolecanium fletcheri*, 1893																		Bg							
58.	*Pulvinaria floccifera*, 1870																			Po						
59.	*Saissetia coffeae*, 1852														Po											
60.	*Saissetia nigra*, 1861																				Po					
61.	*Saissetia oleae*, 1791															Ro										
	Cicadellidae																									
62.	*Empoasca punjabensis*, 1940																							Bg		
63.	*Japananus hyalinus*, 1900																							Bg		
64.	*Macropsis elaeagni*, 1964																							Bg		
65.	*Scaphoideus titanus*, 1932																							Bg		
	Diaspididae																									
66.	*Aspidiotus nerii*, 1833												Ro													
67.	*Chrysomphalus aonidum*, 1758															Ro										
68.	*Chrysomphalus dictyospermi*, 1889															Ro										
69.	*Diaspidiotus osborni*, 1898																			Bg						
70.	*Diaspidiotus perniciosus*, 1881												Ro													
71.	*Diaspis boisduvalii*, 1869																			Po						
72.	*Diaspis bromeliae*, 1778																				Po					

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73.	*Gymnaspis aechmeae*, 1898																		Po						
74.	*Hemiberlesia lataniae*, 1869																		Bg						
75.	*Hemiberlesia rapax*, 1881																		Bg						
76.	*Parlatoria oleae*, 1880																	Bg							
77.	*Parlatoria proteus*, 1843															Po									
78.	*Pinnaspis aspidistrae*, 1869															Po									
79.	*Pinnaspis strachani*, 1899																		Po						
80.	*Pseudaulacaspis pentagona*, 1886																				Bg				
81.	*Unaspis euonymi*, 1881																Bg								
	Hormaphididae																								
82.	*Cerataphis lataniae*, 1867														Po										
	Flatidae																								
83.	*Metcalfa pruinosa*, 1830																							Bg	
	Membracidae																								
84.	*Stictocephala bisonia*, 1997														A										
	Margarodidae																								
85.	*Icerya purchasi*, 1878																		Bg						
	Pemphigidae																								
86.	*Eriosoma lanigerum*, 1802											Ro													
87.	*Pemphigus borealis*, 1909																	Po							
	Pseducoccidae																								
88.	*Pseudococcus longispinus*, 1867															Po									
89.	*Pseudococcus maritimus*, 1900																			Po					
90.	*Rhizoecus cacticans*, 1946																				Po				
	Phylloxeridae																								
91.	*Daktulosphaera vitifoliae*, 1855									Po															
	Anthocoridae	Ord. **Hemiptera**																							
92.	*Amphiareus obscuriceps*, 1909													Bg											
93.	*Lyctocoris campestris*, 1794													Bg											
94.	*Xylocoris flavipes*, 1875																				Bg				
	Cimicidae																								
95.	*Cimex lectularius*, 1758			Po																					
	Coreidae																								
96.	*Leptoglossus occidentalis*, 1910																							Ro	
	Lygaeidae																								
97.	*Orsillus depressus*, 1852																							Ro	
98.	*Arocatus longiceps*, 1872																							Ro	
99.	*Oxycarenus lavaterae*, 1787																							Bg	
	Miridae																								
100	*Taylorilygus apicalis*, 1861																							Bg	
101	*Tuponia elegans*, 1867																		Bg						
	Nabidae																								
102	*Nabis capsiformis*, 1838																							Bg	
	Pentatomidae																								
103	*Nezara viridula*, 1758																	Bg							
104	*Podisus maculiventris*, 1832																								A
105	*Perillus bioculatus*, 1775																		Po						
	Tingidae																								
106	*Corythucha ciliata*, 1832																				Ro				
107	*Stephanitis oberti*, 1857																								A
108	*Stephanitis rhododendri*, 1905																							Bg	
109	*Stephanitis takeyai*, 1955																						Po		
	Aeolothripidae	Ord. **Thysanoptera**																							
110	*Franklinothrips megalops*, 1912																							Bg	
111	*Karnyothrips flavipes*, 1912															Bg									
	Thripidae																								

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112	*Echinothrips americanus*, 1913																							Bg	
113	*Frankliniella occidentalis*, 1895																					Po			
114	*Heliothrips haemorrhoidalis*, 1833															Bg									
115	*Parthenothrips dracaenae*, 1854																						Bg		
116	*Pseudodendrothrips mori*, 1908																						Bg		
117	*Thrips simplex*, 1930																				Bg				
118	*Chaetanaphothrips orchidii*, 1907																					Po			

4. CONCLUSIONS

The database of invasive entomofauna from the Hemimetabola group consists of the 118 species and part of 2 subclasses (Apterygota and Pterygota), 2 supraorders (Orthopteroidea and Hemipteroidea) and 7 orders (Thysanura – 1 species, Blattodea – 3, Orthoptera – 9, Dermaptera – 1, Homoptera – 76, Hemiptera – 18, Thysanoptera – 9). After the number of species dominates insects from Homoptera (76 or 64,4%) and Hemiptera order (18 or 15,2%).

The chronological registration insects in this group began in the XVII century with *Periplaneta americana*; in the XVIII century – *Cimex lectularius* (Poland); in the XIX ceuntry *Acheta domesticus, Calliptamus italicus* and *Blatta orientalis* – 1853 (Romania); *Dactylosphaera vitifoliae* – 1862 (Poland); *Myzus persicae* – 1866 (Poland), *Coccus hesperiadum* – 1883 (Poland), *Lepisma saccharina* – 1885 (Romania), *Chromaphis juglandicola* and *Panaphis juglandis* – 1894 (Poland), *Blattella germanica* and *Aspidiotus nerii* – 1897 (Romania); *Eriosoma lanygerum* – 1898 (Poland), *Diaspidiotus perniciosus* – 1898 (Romania), *Dociostaurus maroccanus* – 1899 (Romania); in the XX ceuntry were recorded 73 species from various ecological niches; in the XXI century (2010-2014) the 25 species. After corellations local database with the Fauna Europaea that are registered the 24 (20.3%) species, but for the 94 (79.6%) mentioned „absent" and „no date". Of these, meanwhile were recorded the 12 species (10.1%) in our country: *Lepisma saccharina* – 1983 (Thysanura); *Periplaneta americana, Blatta orientalis* – 1983, *Blattella germanica* – 2003 (Blattodea); *Tachycines asynamorus, Dociostaurus tartarus* – 2011 (Orthoptera); *Trialeurodes vaporariorum* – 1983, *Scaphoideus titanus* – 2013 (Homoptera); *Cimex lectularius* – 1983, *Leptoglossus occidentalis* – 2010, *Perillus bioculatus* – 2013, *Nezara viridula* – 2014 (Hemiptera).

In total are dated the 36 species of insects (30.4%), and the 82 (69.4%) require research and publication of results in scientific articles European value after the model of interest countries (Romania, Bulgaria, Poland), because most of these species are found in one of these countries and others not shown, for example Ukraine.

The invazive insects registration in countries of interest to the Republic of Moldova is: in Bulgaria – 48 species (Dermaptera – 1, Orthoptera – 3, Thysanoptera – 7, Hemiptera – 9, Homoptera – 28); in Poland – 40 species or 33.8% (Orthoptera – 2, Blattodea – 1, Thysanoptera – 2, Hemiptera – 3, Homoptera – 32); in Romania – 25 species or 21,1% (Thysanura – 2, Orthoptera – 4, Blattodea – 2, Hemiptera – 4, Homoptera – 14); in other country 5 species or 4,2%, respectively 1.6% (Hemiptera – 2, Homoptera – 3).

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