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3 Plant quarantine alarm: as much as 20 new alien insect pest species including *Drosophila suzukii* appeared in the
4 Caucasus in the last seven years

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22 **Abstract** In 2011-2017 an unusually high number of invasive pests new to European Russia were detected for the
23 first time in Sochi on the Black Sea coast of the Caucasus. We present the first reports of two pests new for the
24 Caucasus and European Russia found in 2017: *Drosophila suzukii* (a pest of fruit, included to EPPO A2 list) and
25 *Otiorhynchus armadillo* (a pest of agricultural and ornamental plants). Other recently established insects: a
26 polyphagous pest *Halyomorpha halys* (first record in 2014); pests of palm trees included to EPPO A2 list:
27 *Paysandisia archon* (2014) and *Rhynchophorus ferrugineus* (2012); a pest of Solanaceae: *Epitrix hirtipennis* (2013);
28 a pest of ornamental flowers: *Luperomorpha xanthodera* (2016); a pest of soybeans: *Medythia nigrobilineata*
29 (2016); a pest of wine production: *Harmonia axyridis* (2012); a pest of strawberry: *Stelidota geminata* (2013); pests
30 of *Eucalyptus*: *Ophelimus maskelli* (2011), *Glycaspis bremblecomblei* (2014), *Leptocybe invasa* (2014); a pest of
31 Cupressaceae: *Lamprodila festiva* (2013); a pest of *Gleditsia*: *Dasineura gleditchiae* (2011), a pest of *Buxus*:
32 *Cydalima perspectalis* (2012); a pest of *Albizia*: *Acizzia jamatonica* (2014); a pest of *Cercis*: *Cacopsylla pulchella*
33 (2014). Probably most of insects were introduced with imported planting material during the landscaping of the city
34 of Sochi in preparation for the Olympic Games (held in 2014). Quarantine measures should be taken to prevent
35 dispersal of these pests to other regions of the Caucasus and countries of the Black Sea region. Attention should be
36 paid to a new pest for Europe *Medythia nigrobilineata*.

37 **Keywords** Invasive species; spotted-wing drosophila; *Drosophila suzukii*; *Otiorhynchus armadillo*; quarantine
38 pests; the Caucasus

39

40 **Introduction**

41 The rapid spread of invasive pests is a great economic and ecological problem of the 21st century (Beenen and
42 Roques 2010). In 2011-2017 an unusually high number of invasive pests new to European Russia were firstly
43 detected in subtropics of the Northwest Caucasus, namely in the city of Sochi.

44 We present the first reports of two pests new for the Caucasus and European Russia found in 2017: *Drosophila*
45 *suzukii* and *Otiorhynchus armadillo* and review of other 18 invasive pests firstly recorded for Russia in Sochi in the
46 last 7 years. Most of this information has not been included in the EPPO database (2017) and was published in
47 Russian only.

48 **Materials and methods**

49 The collecting site, the city of Sochi, is located in the south of European Russia near the Black Sea Coast. This large
50 Russian holiday resort occupies a long narrow band (145 km) between the mountains and the sea. The climate is
51 humid subtropical with a warm rainy winter and a sunny summer. The average annual temperature is +13.6 °C. The
52 average annual precipitation is 1703 mm. The coldest month in the city is February with an average temperature of
53 +6.0° C. The warmest month is August, its average daily temperature is +23.0 °C (Mosiyash and Lugavtsov 1967).
54 Twenty two traps made of plastic bottles and baited with a mixture of commercially available red wine and vinegar
55 were placed in different parts of Sochi and kept from 4 to 19 of June 2017. This bait for *Drosophila suzukii* was
56 recommended by Cini et al. (2012). One more trap baited with grapes harvested by us in Sochi was kept from 18 to
57 30 of September 2017. *Otiorhynchus armadillo* was collected by hand.

58 **First reports of invasive pests found in 2017**

59 *Drosophila suzukii* (Matsumura, 1931) (Diptera, Drosophilidae)

60 Spotted-wing *Drosophila* is one of the most important invasive pests of fruit-production and wine-production (Cini
61 et al. 2012). A special issue of the Journal of Pest Science was devoted to this species (Biondi et al. 2016). Unlike
62 other vinegar flies, it is able to oviposit and develop in healthy ripening soft fruits. This species is native to Eastern
63 Asia and has recently spread to Europe and the Americas. Since 2011 *D. suzukii* has been included in the EPPO A2
64 List (EPPO 2017). It has been recorded in at least 20 European countries. In 2014 *D. suzukii* was firstly recorded for
65 the Ukraine on the Black Sea coast of Crimea (Lavrinenko et al. 2017).

66 We present the first record of this pest in European Russia and the Caucasus. One male *D. suzukii* was
67 found in the trap kept near the railway station Sochi (43°35'N, 39°44'E) from 4 to 19 of June 2017. One mature
68 female and one female from puparium was found in the trap kept in Serafimovicha Street (43°34'N, 39°45'E) from
69 18 to 30 of September 2017. The species was identified by referring to Hauser (2011) and checking the following
70 characters: male: one black spot at the apical part of wings and two black combs at the apex of 1st and 2nd tarsal
71 segments (one comb on each segment), female: ovipositor with many dark sclerotized teeth; ovipositor is much
72 longer (at least 6X) than spermatheca diameter.

73 Since the specimens were captured in different localities and in different months, it indicates, that a
74 breeding population exists. Wine production and fruit production are important branches of economy of the
75 Caucasus region. So the establishment of *D. suzukii* could cause serious negative consequences.

76 *Otiorhynchus armadillo* (Rossi, 1792) (Coleoptera, Curculionidae)

77 We were informed that extensive ornamental plantations of *Viburnum tinus* in Imeretian Resort (Sochi, 43°25'N,
78 39°56'E) had been severely damaged by an unknown pest. During a survey on 8 June 2017 we found that many

79 leaves had feeding damage that was characteristic for Curculionidae (semicircular cuts on edges) and we collected
80 one female of *Otiorhynchus armadillo*. Similar damage has been noted also on *V. tinus*, *Viburnum rhytidophyllum*,
81 *Photinia fraseri* and *Osmanthus heterophyllum* in 2015-2017. Seedlings of *Viburnum tinus* and other damaged plants
82 were imported from Italy in 2012, the pest was obviously introduced with them.

83 The specimen was identified by referring to Heijerman and Hellingman (2008). The distinctive features are:
84 body black; dorsum covered by yellowish hairs, which arranged in small patches on elytra; rostrum with one high
85 medial keel, without medial furrow; antennae thin, 1st and 2nd funicular antennomeres very thin, elongate,
86 antennomeres 3 to 7 distinctly longer than wide; pronotum covered by dense granules; elytra broadly oval, greatly
87 expanded from the base, slightly narrowed to the apex; shoulders more developed than in *O. salicicola*; intervals
88 covered by irregular granules partly fused to each other and forming transverse wrinkles; striae with more or less
89 regular rows of granules, 1st and 2nd striae connected with each other at elytral apex, all intervals evenly convex,
90 without keels in odd intervals, fore tibiae without external apical lobe. Our specimen is 9.8 mm long.

91 *Otiorhynchus armadillo* is a pest of trees and shrubs including *Viburnum*. Adults feed on the leaves of 25
92 families of plants, the larvae feed on roots (Heijerman and Hellingman 2008). Before the 1990s the distribution was
93 restricted to Italy, France, Germany, Croatia, Austria and Belgium (Mazur and Mokrzycki 2011). This flightless
94 weevil has now also been introduced with seedlings to the UK, the Netherlands, Poland, Norway, Czech Republic,
95 Slovakia and Turkey. It is also known from Hungary, Romania, Slovenia, Sweden, Greece, Liechtenstein,
96 Switzerland (Magnano and Alonso-Zarazaga, 2013; Çerçi 2016). In the Netherlands and the UK it has become a
97 serious pest (Heijerman and Hellingman 2008; Halstead 2011).

98 **Invasive pests found in 2011-2016**

99 *Halyomorpha halys* Stål, 1855 (Hemiptera, Pentatomidae) is a very damaging invasive polyphagous pest native to
100 East Asia and established in North America and Europe in the 1990s and 2000s, respectively (Haye and Weber
101 2017). In 2008-2013 *H. halys* was included in EPPO Alert List, and since 2002 it has been included in the NAPPO
102 Alert List (EPPO 2017). It was firstly found in Russia in 2014 in Sochi. Since 2015 a severe outbreak is being
103 observed, which has led to significant losses of harvest of fruits (Gapon 2016; Karpun et al. 2017). Recently this
104 pest was recorded in different parts of Krasnodar Territory, Adygea and Abkhazia.

105 *Paysandisia archon* (Burmeister, 1880) (Lepidoptera, Castniidae) is native to South America. This serious
106 invasive pest of palm trees is included in A2 EPPO list and NAPPO Alert List. It was firstly recorded in Europe
107 (France) in the 1990s and then spread to Belgium, Cyprus, Greece, Italy, Spain and Switzerland (EPPO 2017). It
108 was firstly recorded in Russia in Sochi in 2014 on *Trachycarpus fortunei* and in 2015 spread all over the city and
109 killed a lot of trees: *T. fortunei*, *Washingtonia filifera*, *W. robusta*, *Phoenix canariensis* and *Chamaerops humilis*
110 (Karpun et al. 2015b).

111 *Rhynchophorus ferrugineus* (Olivier, 1791) (Coleoptera, Dryophthoridae) is native to South-East Asia. In
112 the 1980s this began to spread outside its native range and by now has established in the Middle East, North Africa,
113 North America, countries of the Caribbean and South Europe (EPPO 2017). It was added to the EPPO A2 list in
114 2006 and is regarded as a quarantine pest in several countries (EPPO 2017). In 2009 *R. ferrugineus* was found in the
115 Caucasus for the first time in Georgia (Pelikh 2009). In 2012-2013 it was recorded in Sochi, where it mainly
116 damages *Phoenix canariensis* and *Washingtonia robusta* (Karpun et al. 2014).

117 *Epitrix hirtipennis* (Melsheimer, 1847) (Coleoptera, Chrysomelidae) is a pest of tobacco and other plants of
118 the family Solanaceae. It is native to the Americas and established in Europe in the 1980s. It was first recorded for
119 Russia and the Caucasus in Sochi and Tuapse in 2013 (Orlova-Bienkowskaja 2014) and then repeatedly found in

120 Sochi in 2016 (our unpublished data). This pest could be introduced to the Caucasus with seedlings, because its
121 larvae develop on roots. There is no information about the economic importance of this species in the region.

122 *Dinoderus japonicus* Lesné, 1895 (Coleoptera Bostrichidae) is a serious pest of bamboo native to East Asia.
123 It was often intercepted in Europe with imported bamboo products, but did not establish until recently. In 2012-2013
124 established populations were found in France and Italy (Nardi et al. 2015). In 2016 it was recorded in European
125 Russia and the Caucasus for the first time: an established population was found in Sochi in the in the thicket of
126 *Phyllostachys* sp. (Bieńkowski and Orlova-Bienkowskaja 2017).

127 *Luperomorpha xanthodera* (Fairmaire, 1888) (Coleoptera, Chrysomelidae) is a pest of ornamental flowers.
128 Adults feed on flowers, whereas larvae develop on roots. The species is native to China and Korea, established in
129 Europe in 2003, and since then quickly expanded its range (Beenen and Roques 2010). It was recorded for the first
130 time in the Caucasus and Russia in 2016 and severely damages roses and other flowers in Sochi (Bieńkowski and
131 Orlova-Bienkowskaja 2017). Larvae could probably be introduced to the region with seedlings.

132 *Medythia nigrobilineata* (Motschulsky, 1861) (Coleoptera, Chrysomelidae) is serious pest of soybeans in
133 Asia. It is native to China, Far East of Russia, Japan, Nepal, Pakistan and South Korea and had not yet been
134 recorded in Europe before 2016 (Beenen 2010; Toepfer et al. 2014). In 2016 a single female of *M. nigrobilineata*
135 was collected on ruderal plants in Sochi (Bieńkowski and Orlova-Bienkowskaja 2017).

136 *Harmonia axyridis* (Pallas, 1773) (Coleoptera, Coccinelidae) is native to East Asia. It has been used for
137 biological control of aphids all over the world and has become almost cosmopolitan (EPPO 2017). In some regions
138 *H. axyridis* is regarded as a pest of wine production and fruit production, since it can feed on fruits. An established
139 population was first recorded in Sochi in 2012 (Belyakova and Reznik 2013). The species is now common in Sochi
140 (Ukrainsky and Orlova-Bienkowskaja 2014), but it is unknown, if it has an economic impact.

141 *Stelidota geminata* (Say, 1825) (Coleoptera, Nitidulidae) is a pest of strawberry in its native range, in North
142 America (Connell 1980). Since the 1980s it has been spreading in Europe, though only a few cases of damage of
143 strawberry have been recorded (Spasić et al. 2011). In 2013 the species was found for the first time in the Caucasus
144 in Sochi and Abkhazia (Tsinkevich and Solodovnikov 2014). It now is common in Sochi on decaying fruits.

145 *Ophelimus maskelli* (Ashmead, 1900) (Hymenoptera, Eulophidae) damaging leaves of many *Eucalyptus*
146 species, began to spread outside its native range (Australia) at the beginning of the 2000s. It has spread to North
147 America, North Africa, the Middle East, and South Europe (EPPO 2017). The pest was first recorded in Russia and
148 the Caucasus in Sochi in 2011 and became abundant in 2013 (Karpun et al. 2015a). Now it is common in Sochi and
149 damages *Eucalyptus cinerea*, *E. gunii*, *E. globulus* and *E. viminalis*.

150 *Glycaspis brimblecombei* Moore, 1964 (Hemiptera, Psyllidae) is another Australian pest of *Eucalyptus*. In
151 1998 it was firstly recorded outside its native range (in North America) and then appeared also in South America,
152 South and North Africa, Mediterranean countries and South Europe. *Glycaspis brimblecombei* was included in the
153 EPPO Alert List between 2002 and 2006 (EPPO 2017). In 2014 it was first recorded in Russia in Sochi, where it
154 damages leaves of *Eucalyptus viminalis* and *E. globulus* (Karpun et al. 2015a).

155 *Leptocybe invasa* Fisher & La Salle, 2004 (Hymenoptera, Eulophidae) is an invasive gall inducer on
156 *Eucalyptus*. It is supposed that the species is native to Australia, since it is a specialized pest of a plant native to
157 Australia, but it has not yet been found in this continent (EPPO 2017). It was discovered in 2000 in the Middle East
158 and then recorded in the Americas, Africa, Asia and South Europe. The pest was included in EPPO Alert List
159 between 2006 and 2010. In 2014 *L. invasa* was recorded in Sochi (Karpun et al. 2015a). It severely damages
160 *Eucalyptus viminalis* and close species.

161 *Lamprodila festiva* (Linnaeus, 1767) (Coleoptera, Buprestidae) is a serious pest of ornamental
162 Cupressaceae native to Mediterranean region and South Europe and has recently expanded its range in Europe. After
163 the first record in Sochi in 2013 the species has become common in the region and severely damages *Thuja*,
164 *Chamaecyparis*, *Juniperus* and *Cupressus* (Volkovitsh and Karpun 2017).

165 *Cydalima perspectalis* (Walker, 1859) (Lepidoptera, Crambidae) is a pest of boxwood native to Asia. It was
166 first found in Europe in 2006 and then spread to 20 countries (EPPO 2017). Between 2007 and 2011 it was included
167 into the EPPO Alert List. *Cydalima perspectalis* was first intercepted in Russia in 2012, and in 2013 became
168 abundant pest all over the Black Sea coast from the border of Abkhazia to Tuapse (Karpun et al. 2015a) as well as in
169 city parks of the Absheron District of Krasnodar Region and the city of Grozny (Chechnya). In 2014 it was recorded
170 in Abkhazia and Georgia, in 2015 also in Crimea and Adygea. It has completely destroyed *Buxus sempervirens* and
171 other boxwood species in Sochi as well as natural plantations of an endemic protected species *B. colchica* (Karpun
172 et al. 2015a).

173 *Acizzia jamatonica* (Kuwayama, 1908) (Hemiptera, Psyllidae) is a pest of *Albizia* spp. In the 1980s the pest
174 native to Japan began to spread to other countries of Asia. After an accidental introduction to Italy in 2001 it spread
175 to 13 European countries. Since 2006 *A. jamatonica* has been expanding its range in North America. It was included
176 on the EPPO Alert List between 2004 and 2006 (EPPO 2017). In 2014 it was found in Sochi and severely damaged
177 *Albizia* trees (Karpun et al. 2015a).

178 *Cacopsylla pulchella* (Löw, 1877) (Hemiptera, Psyllidae) is a species of Mediterranean origin, a pest of
179 *Cercis*. In the second half of the twentieth century *C. pulchella* spread widely across Europe (Halperin et al. 1982).
180 It was first recorded in Russia in 2014 in Sochi (Karpun et al. 2015a) and in 2016-2017 severely damaged *Cercis* in
181 city parks.

182 *Ceroplastes ceriferus* (Fabricius, 1798) (Hemiptera, Pseudococcidae) is a polyphagous pest of trees and
183 shrubs. It is native to India and has become almost cosmopolitan (EPPO 2017). In Europe it was established only in
184 Italy. Between 2002 and 2005 the species was included in the EPPO Alert List. In 2015 *C. ceriferus* was first
185 recorded in Russia in Sochi and became abundant on many plants (Karpun et al. 2017).

186 *Glyphodes pyloalis* Walker, 1859 (Lepidoptera, Crambidae) (*Daiphania pyloalis*) is a pest of *Morus* native
187 to the USA and Mexico. It is a serious invasive pest of silk-production in Asia. In the 2000s it appeared in Europe in
188 Moldova, Romania, Georgia, Azerbaijan and became an economically significant pest (EPPO 2017). In 2015 *G.*
189 *pyloalis* was recorded in European Russia for the first time in Sochi (Karpun et al. 2017).

190 Discussion

191 Plantations of Sochi consist mainly of exotic plants. Alien insects are often introduced there with imported planting
192 material, and the subtropical climate promotes their establishment (Karpun et al. 2015a). The rate of invasions has
193 never been as high as now. Previously 5-6 new alien pests per decade appeared. Between 2011 and 2017 at least 20
194 new invasive species were recorded.

195 Insects that have recently appeared in the region are native to different continents: Asia (10 species),
196 Australia (3 species), Europe (3 species), North America (3 species) and South America (1 species). Many of them
197 began to spread outside their native ranges 10-20 years ago and spread in different continents or even all over the
198 world. All species except *Medythia nigrobilineata* occur in other European countries. Most of the invasions were
199 probably connected with an import of planting material from European nurseries during the landscaping the city of
200 Sochi in preparation for the Olympic Games in 2011-2013. The exporting countries were mainly Italy, Spain and
201 Montenegro (Karpun et al. 2017). *Drosophila sukii* and *Halyomorpha halys* could have been unintentionally

202 introduced with imported fruits, *Dinoderus japonicus* - with bamboo products, *Medythia nigrobilineata* - with
203 soybeans. *Glyphodes pyloalis* and *Harmonia axyridis* could also be introduced or spread spontaneously from
204 neighboring countries.

205 The information about first records of the quarantine pests *Drosophila suzukii*, *Paysandisia archon* and
206 *Rhynchophorus ferrugineus* in Russia should be included in the EPPO database as well as information about records
207 of other invasive pests. Quarantine measures should be taken to prevent dispersal of pests to other regions of the
208 Caucasus and countries of the Black Sea region. Special attention should be paid to invasion of *Medythia*
209 *nigrobilineata* to the Caucasus, since this pest is new to Europe.

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