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Leaf and Seed Beetles (Coleoptera, Chrysomelidae) Chapter 8.3

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Abstract

The inventory of the leaf and seed beetles alien to Europe revealed a total of 25 species of which 14 seed beetles (bruchids) and 11 leaf beetles mostly belonging to the subfamilies Alticinae and Chrysomelinae. At present, aliens account for 9.4% of the total fauna of seed beetles in Europe whereas this percentage is less than 1% for leaf beetles. Whilst seed beetles dominated the introductions in Europe until 1950, there has been an exponential increase in the rate of arrival of leaf beetles since then. New leaf beetles arrived at an average rate of 0.6 species per year during the period 2000–2009. Most alien species originated from Asia but this pattern is mainly due to seed beetles of which a half are of Asian origin whereas leaf beetles predominantly originated from North America (36.4%). Unlike other insect groups, a large number of alien species have colonized most of Europe. All but one species have been introduced accidentally with either the trade of beans or as contaminants of vegetal crops or stowaway. Most aliens presently concentrate in man-made habitats but little affect natural habitats (<6%). Highly negative economic impacts have been recorded on stored pulses of legumes and crops but very little is known about possible ecological impact.

Keywords

Coleoptera, Chrysomelidae, Bruchidae, seed beetle, leaf beetle, bioinvasion, alien, Europe, translocation, introduction

8.3.1 Introduction

The family Chrysomelidae is one of the largest Coleopteran families, including ca. 37 000 described species in the world and perhaps the same number as yet undescribed (Jolivet and Verma 2002). Bruchidae, or seed beetles, is a relatively small family. Kingsolver (2004), referring to the most recent world catalogue, mentions 1,346 valid bruchid species. Although there are good arguments to treat Bruchidae as a subfamily of Chrysomelidae and raise some leaf beetle subfamilies to family rank (Reid 1995), this is still not common practice among leaf beetle researchers. We treat Bruchidae and Chrysomelidae in this contribution as families, merely for practical reasons. According to *Fauna Europaea*, the fauna presently observed in Europe includes 1532 leaf beetles and 145 seed beetles.

Except for important agricultural pests such as the Colorado potato beetle, *Leptinotarsa decemlineata*, and more recently, the western corn rootworm, *Diabrotica virgifera virgifera*, little was known about introductions of alien leaf beetles until Beenen (2006) revealed that 126 species have been translocated at least once from one continent to another. More information on alien seed beetles has been available in the literature mainly because of their potential impact on stored products (Southgate 1979). In the present work, we will show that 25 non-native species of leaf and seed beetles of which one is of unknown origin (cryptogenic) have already established in Europe (Table 8.3.1). Thus, aliens still represent only a very small proportion (1.5%) of the total fauna of leaf and seed beetles in Europe. By comparison, approximately 71 alien leaf beetle species have been recorded from North America (Beenen 2006, Beenen, unpubl.).

Within Europe, changes in the distribution of native leaf beetles have also been noticed which can be partly associated either to human activity or to natural trends such as delayed post-glacial expansion and global warming. For example, the recent northwards expansion of a flea beetle, *Longitarsus dorsalis,* seems to result from both the introduction of a rapidly expanding invasive plant originating from South Africa, *Senecio inaequidens* DC., on which *L. dorsalis* thrives (Beenen 1992), and from increasing temperatures during the past years. However, the role of human activity is often difficult to ascertain in such observed range expansions of native species. We will essentially consider the species alien *to* Europe, a summary of the species alien *in* Europe (Table 8.3.2) and will present their characteristics at the end of the chapter.

8.3.2 Taxonomy

A total of 25 alien species of which 14 seed beetles and 11 leaf beetles have been recorded as established in Europe (Table 8.3.1). Thus, bruchids represent more than a half (56.0%) of the alien species whereas they account for only 8.1% of the native fauna of seed and leaf beetles (Figure 8.3.1). This arrival of alien seed beetles has

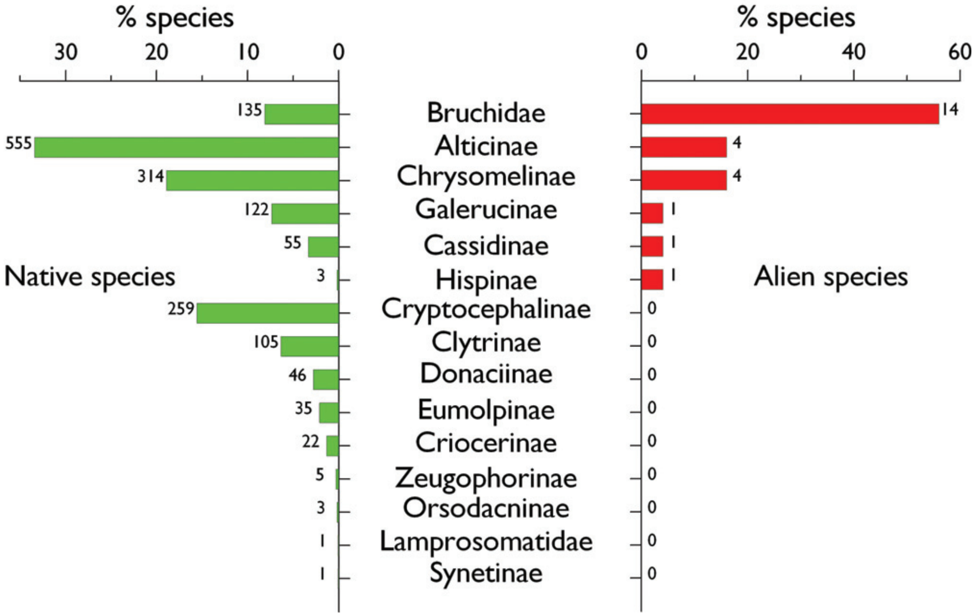

Figure 8.3.1. Comparison of the relative importance of the subfamilies of Chrysomelidae and Bruchidae in the alien and native entomofauna in Europe. Subfamilies are presented in a decreasing order based on the number of alien species. The number right to the bar indicates the number of species per family.

significantly modified the composition of the total fauna of seed beetles observed in Europe, where aliens account for 9.4% at present. The pattern is rather different for Chrysomelidae. Although this family includes 13 subfamilies in Europe the alien entomofauna is only distributed among five of these subfamilies. Large differences are observed in the contribution of each subfamily without any apparent correlation to its numerical importance in the native fauna. The recent arrival in France of an alien palm hispine beetle, *Pistosia dactylifera* (Drescher and Martinez 2005), largely modified the composition of the Hispinae subfamily which includes only three native species (Fauna Europaea 2009). However, aliens represent much less so for the two major subfamilies of leaf beetles, Alticinae flea beetles (four species- 0.7% of the total) and Chrysomelinae (four species- 1.3% of the total). Other alien species include one skeletonizing leaf beetle (Galerucinae) and one tortoise leaf beetle (Cassidinae). The same subfamily pattern is observed for translocations of leaf beetles at world level but Beenen (2006) also noticed other species belonging to Hispinae (e.g. *Brontispa* palm leaf beetles) and Criocerinae. It is noticeable that representatives from some important subfamilies such as Cryptocephalinae and Donaciinae have never been introduced, or never established at least.

Leaf beetles and seed beetles largely differ in biological traits that may be involved in the relative success of seed beetle invaders compared to other groups. Seed beetles have several ways of egg-laying. Most species deposit their eggs on mature pods of legumes (Fabaceae), the eggs being cemented to the pod or dropped in a self- made hole in the pod wall. Other species lay eggs on mature seeds that are still attached to the inside of a partly opened pod. A third group of species oviposit on mature seeds that have fallen to the ground from a fully dehisced pod. However, some species such as *Acantoscelides obtectus* use different life history strategies. Early in the season in this species, oviposition occurs on green pods of *Phaseolus*, while later in the season, the eggs are deposited on mature seeds that have fallen to the ground. These biological features make *A. obtectus* fully capable of completing cycle after cycle on naked seeds in storage (Kingsolver 2004). The larvae of seed beetles entirely develop within the seeds until pupation and their presence cannot be recognized before adult emergence, unless the seed is X-rayed.

In contrast, leaf beetles show a large variety of reproductive traits. Many Galerucinae (e.g., *Diabrotica* species) and Alticinae larvae (e.g., *Epitrix* species) develop in or at the roots of plants and adults feed from leaves of a specific host plant or a wide variety of plant species. Other Chrysomelidae feed both as larva and adult externally on leaves of their host plants. Although practically no plant species is free of leaf beetles, most leaf beetles need fresh plant products in all or at least in the adult stage. Stored dry plant products are not suitable for leaf beetles to complete their life cycle.

8.3.3 Temporal trends

Chrysomelids probably began to be introduced thousands of years ago. It is likely that leaf beetles associated with crops have taken the same route as herbs associated with cereals which are supposed to have entered Europe from the Near East (Pinhasi et al. 2005). Beenen (2006) argued that the combination of *Buglossoides arvensis* (L.) Johnston and *Longitarsus fuscoaeneus* Redtenbacher 1849 might have taken the route from southwest Asia where they spread with agriculture to large parts of the temperate parts of the Northern hemisphere. Thus, a number of species which are at present considered as native may indeed be originally alien. Bruchidae must have infested pulses grown by man since the dawn of agriculture. Southgate (1979) also mentioned infestations of lentils from the Egyptian Ptolemaic period (305 BC – 30 BC). Relatively little is known of these ancient introductions. More recent ones are much better documented as in the case of the potato Colorado beetle (*Leptinotarsa decemlineata*) (see factsheet 14.10).

From a global point of view, new records of alien species in Europe were relatively important during the 2nd half of the 19th century, due to seed beetle species. The most important being *Acanthoscelides obtectus*, *Callosobruchus chinensis* and *C. maculatus*. However, these species may have been introduced well before their first record. Since ca. 1900, the rate of seed and leaf beetle introductions severely decreased until 1975 when it began to increase again with globalization, essentially through the arrival of leaf beetles. The last seven years since 2000 corresponded to an acceleration of introductions, with an average of 0.8 new species of Chrysomelidae per year, again mostly leaf beetles (Figure 8.3.2)

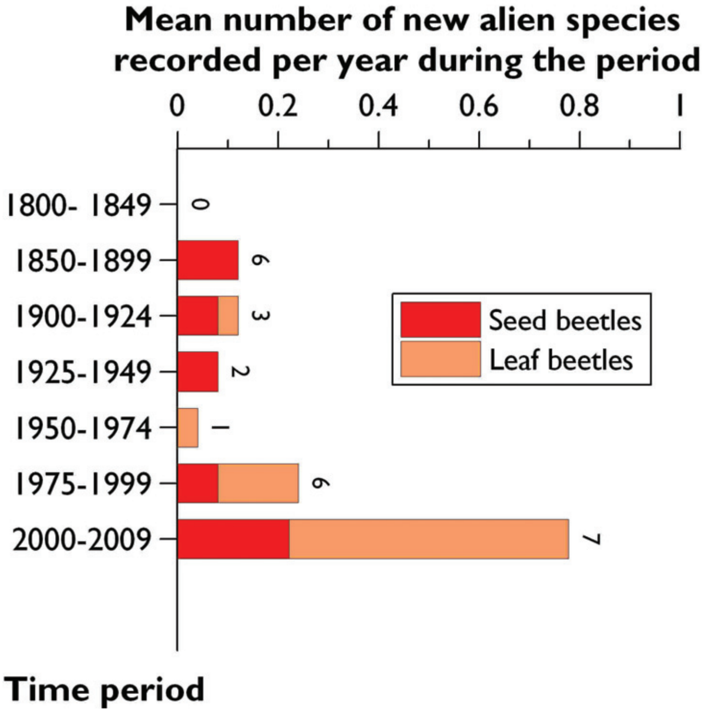

Figure 8.3.2. Temporal changes in the mean number of new records per year of seed and leaf beetle species alien *to* Europe from 1800 to 2009. The number right to the bar indicates the total number of seed and leaf beetle species recorded per time period.

8.3.4 Biogeographic patterns

Asia supplied the major proportion of the alien seed and leaf beetles that have established in Europe (Figure 8.3.3). However, this pattern is mainly due to seed beetles of which a half are of Asian origin whereas leaf beetles predominantly originated from North America (36.4%). No seed and leaf beetle species of Australasian origin have yet established in Europe.

Alien species are not evenly distributed in Europe, and leaf and seed beetles do not show the same pattern of expansion. Half of the alien seed beetles have colonized more than ten countries with four of them present in more than 50 countries and the main islands of Europe. In contrast, 63.6% of the alien leaf beetles have not yet spread out of the country where they have been initially introduced. Only two species, *Leptinotarsa decemlineata* and *Diabrotica virgifera*, are presently encountered in 38 and 20 countries respectively (EPPO 2009, Gödöllo University 2004, Grapputo et al. 2005, Purdue University 2008) (see maps in the spreadsheets 8 and 10). Owing to climate change, *L. decemlineata* may extend its range to Finland (Valosaari et al. 2008).

Alien seed and leaf beetles appear to be concentrated in southern Europe with 18 species observed in mainland Italy and more than 10 species in continental France

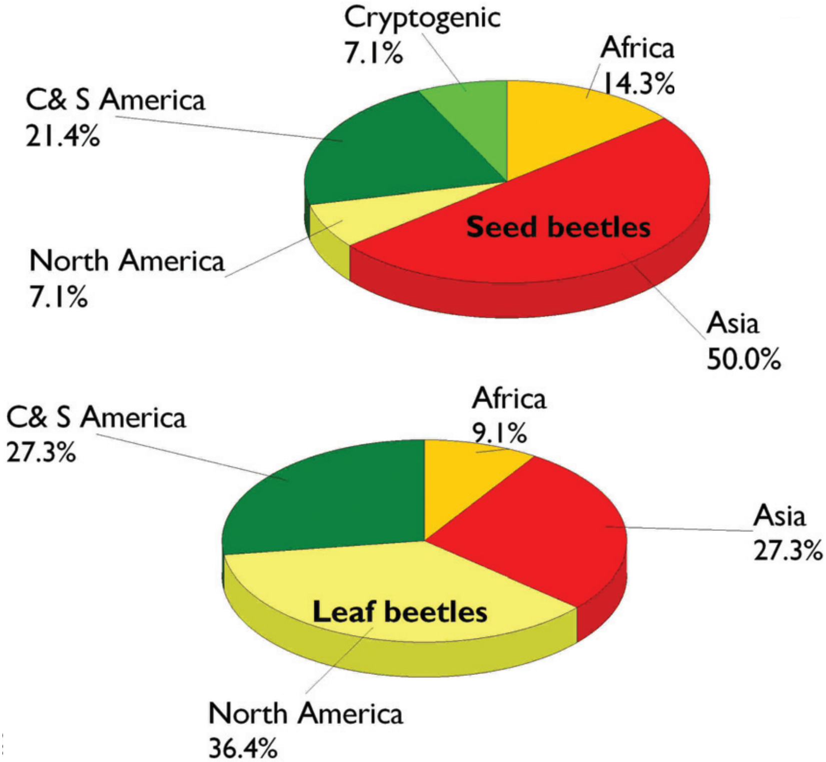

Figure 8.3.3. Comparative origin of seed and leaf beetle species alien *to* Europe

and mainland Greece. Central Europe usually hosts less than 10 species except Czech Republic (11 species), whereas aliens have been little recorded in Northern Europe (Figure 8.3.4).

8.3.5 Main pathways and vectors to Europe

All alien species of seed and leaf beetle except one (i.e., 95.7%) have been introduced accidentally to Europe. Unlike North America and South Africa, where a number of alien species were released for biological control of weeds (Beenen 2006), only the ragweed leaf beetle, *Zygogramma suturalis*, has been intentionally introduced from North America for the biological control of common ragweed, *Ambrosia artemisifolia* L., since 1978 in Russia (Reznik et al. 2004) and several countries of southeastern Europe, and subsequently established in the wild especially in the Caucasus (Kovalev 2004). A flea beetle native of Continental Europe, *Altica carduorum* (Guérin- Méneville), has also been introduced in Britain and Wales in 1969–1970 to control creeping thistles, *Cirsium arvense* (L.) Scop. but none apparently established (Baker et al. 1972, Cox 2007). Although it is difficult to ascertain the exact pathway of introduction for most of the

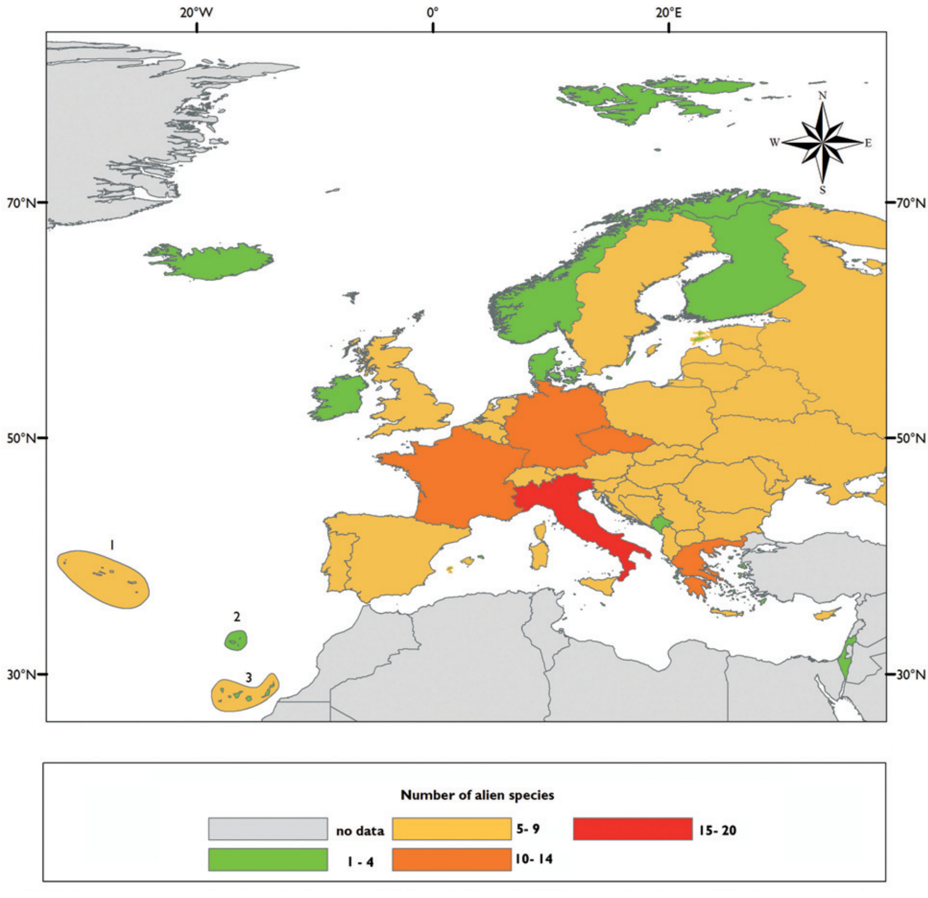

Figure 8.3.4. Colonization of continental European countries and main European islands by seed and leaf beetle species alien *to* Europe.

other species introduced accidentally, the general behaviour of chrysomelids suggests that most introductions are related to trade of plants and stored products, although some may have arrived as stowaways in all forms of packaging and transport, or even as wind-borne organisms.

The world trade of beans for agricultural purposes is probably responsible for the nowadays wide distribution in Europe of most alien species of seed beetles, such as *Acanthoscelides obtectus*, *Bruchus* species *Callosobruchus* species and *Zabrotes subfasciatus* (Figure 8.3.8) which develop in legume seeds of the subfamily Papilionoideae (*Phaseolus, Lathyrus, Pisum, Vicia)* (Böhme 2001, Kingsolver 2004). However, the arrival of other seed beetles of the genera *Bruchidius*, *Caryedon*, *Megabruchidius* and *Mimosestes* seems to be more related to the trade in legume tree seeds of Mimosoideae (*Albizzia, Acacia*) and Caesalpinoideae (*Cassia, Cercis, Tamarindus*) used as ornamentals in parks and gardens. *Megabruchidius tonkineus* was at first suspected to have been introduced from Vietnam to Germany with white beans (Wendt 1980) but it was later found to be associated with pods of honey locust trees, *Gleditsia triacanthos* L. (Papilionoideae), and not capable of complete development in beans (Guillemaud et al. 2010). Similarly, *Acanthoscelides pallidipennis* was probably introduced with seeds of false indigo bush (*Amorpha fructicosa* L., Papilionoideae) (Tuda et al. 2006) and *Bruchidius siliquastri* with these of redbuds (*Cercis*; Caesalpinoideae) from China (Kergoat et al. 2007). Seeds imported for ornamental purposes may also serve as the vector of seed beetles. *Specularius impressithorax* (Pic) sustained several generations indoors in the Netherlands after having been introduced from South Africa along with seeds of *Erythrina* (Papilionoideae) used for decoration, but did not eventually establish (Heetman and Beenen 2008) (Figure 8.3.7).

Most alien leaf beetles are associated with vegetable crops (Solanaceae, Brassicaceae, Gramineae including maize). With both larvae and adults feeding on foliage, these species probably entered Europe as plant contaminants (eggs, larvae) or crop contaminants (adults). The Colorado potato beetle has frequently been intercepted with potato plants and tubers, but also in all forms of packaging and transport. For example, it usually arrived to Great Britain with commercial freight among vegetable crops such as lettuce, *Lactuca sativa* L., or on ships, aircraft or private cars traveling from the continent (Cox 2007). Indeed, fresh vegetables grown on land harbouring overwintering beetles are common means of beetle transport in international trade (Bartlett 1980). The African tortoise beetle *Aspidimorpha fabricii* (= *A. cincta* Fabricius) was believed to be imported in Italy as a contaminant of bananas in the late 1950s but it became a problem in cultures of *Beta vulgaris* L. (Zangheri 1960). A hispine palm leaf beetle, *Pistosia dactyliferae* was also probably introduced as a contaminant of palms imported for ornamental purposes (Drescher and Martinez 2005).

The means of introduction appears different when larvae are root-feeding as in *Diabrotica* and *Epitrix* species. Unless soil infested with larvae has been imported with host plants, which is usually prohibited, these species probably travel as stowaways. The western corn rootworm, *Diabrotica virgifera virgifera*, proved to have been translocated from North America to Europe at least three times in aircraft laden with goods and materials, but probably not with maize plants (Ciosi et al. 2008, Miller et al. 2005). The outbreaks in Northwestern Italy and Central Europe probably resulted from introductions of individuals originating in northern USA (Delaware) (Guillemaud et al. 2010).

However, another pest species related to tobacco, *Epitrix hirtipennis*, is assumed to have arrived in Europe as aerial plankton with easterly trade winds blowing from the New World to Europe (Döberl 1994b). Similarly, Jolivet (2001) reported the translocation of the Sweet potato flea beetle, *Chaetocnema confinis* Crotch, from the USA to several tropical destinations by hurricanes. Adults of Colorado potato beetle are also assumed to be capable of migrating across the Channel although this beetle does not fly strongly (Cox 2007) or from Russia (the St Petersburg region) to Finland (Grapputo et al. 2005).

The collection and trade of orchids for greenhouses has also resulted in the arrival of several species which caused severe damage without persisting such as a flea beetle, *Acrocrypta purpurea* Baly, a species from Southeast Asia which was accidentally introduced with plant collections into a greenhouse of Leiden University in the Netherlands (Döberl 1994a). Likewise, larvae of a criocerine species, the yellow orchid beetle *Lema pectoralis* Baly, were imported to the Netherlands with an orchid collected in 1988 in Thailand (Beenen, unpubl.). Originating of the Peninsula Malaysia and Singapore (Mohamedsaid 2004), *L. pectoralis* is a major pest ('orchid lema') of orchid cultures, particularly *Vanda* and *Dendrobium*, in the Philippines (de la Cruz 2003).

Pathways within Europe are a source of particular concern because of the waiver of formerly routine phytosanitary inspections on goods transported within the European Union. Thus, alien species once introduced into one European country along with alien plants or seeds, can freely move to other European countries. Spread may combine long-distance, human-mediated dispersal and natural dispersal by adult flight, as it is the case for *Leptinotarsa decemlineata* (Grapputo et al. 2005). Another significant example is the present northwards expansion of a species alien in Europe, *Chrysolina americana*. This leaf beetle originates from the Mediterranean Basin where it is associated to *Rosmarinus* and *Lavendula.* Because both plants are popular garden plants throughout Europe, *C. americana* has been translocated outside its native range along with its host plants, e.g. to the Netherlands along with potted *Lavendula* plants imported from Italy (Beenen, unpubl.). Once introduced, this species, which has good flight capacities, disperses naturally by flight.

8.3.6 Most invaded ecosystems and habitats

All alien Chrysomelidae are phytophagous. As expected from the numerical importance of Bruchidae within aliens, seeds constitute the most important larval feeding niche (56.0%), far more important than leaves (24.0%) and roots (20.0%). Almost all these species are only present in man-made habitats which represent 94.1% of the colonized habitats, essentially agricultural lands, parks and gardens, glasshouses, and warehouses for seed beetles (Figure 8.3.5). Natural and semi-natural habitats have been very little colonized yet.

In addition to these strong habitat trends, about 40% of the alien chrysomelid species remain strictly related to their original, alien plants. This is especially true for leaf beetles, where only *Epitrix hirtipennis* out of the 11 alien species has been observed to shift onto native Solanaceae in Italy (Beenen 2006). In contrast, most alien seed beetles found outdoors have already switched to seeds of native plants, for example *Bruchidius siliquastri* on the native redbud, *Cercis siliquastrum,* in France (Kergoat et al. 2007), and *Acanthoscelides obtectus* and *Callosobruchus chinensis* on wild legumes (Tuda et al. 2001). Under outdoor conditions, a strict dependency to the original alien host was only observed for two *Megabruchidius* species, *M. tonkineus* and *M. dorsalis*, associated with seeds of honey locust tree, *Gleditsia triacanthos,* in parks and gardens. However, a number of seed beetle species still confined to greenhouses and warehouses only develop on alien hosts of tropical origin, such as *Caryedon serratus* associated with

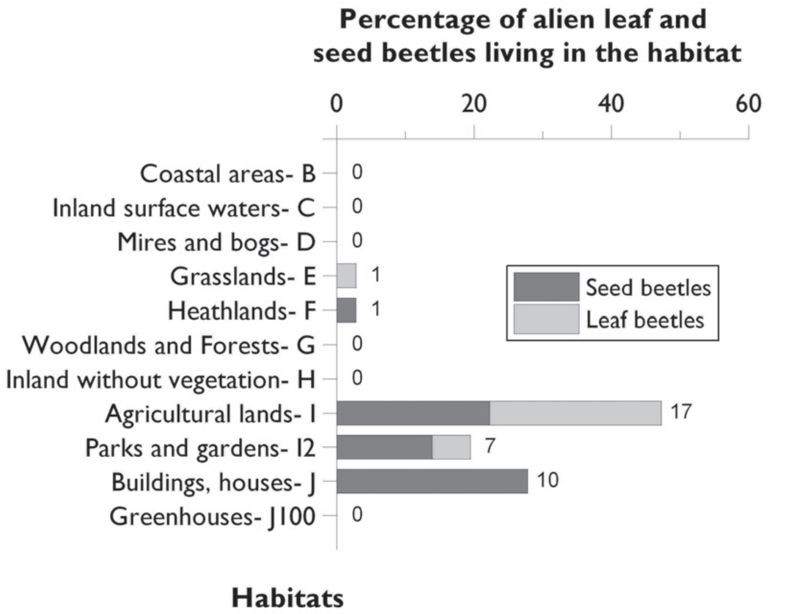

Figure 8.3 5. Main European habitats colonized by the established alien species of Chrysomelidae and Bruchidae. The number over each bar indicates the absolute number of alien species recorded per habitat. Note that a species may have colonized several habitats.

groundnuts (*Arachis hypogaea* L.), tamarind (*Tamarindus indica* L.) and other seeds of alien Caesalpinioideae (Kingsolver 2004). Such species still cannot establish outdoors because none of their alien hosts can survive in the wild at the present time.

8.3.7 Ecological and economic impact

Threats due to alien chrysomelid species were first pointed out by Linnaeus in a lecture in 1752, referring to his observation of asparagus plants (*Asparagus officinalis* L.) that were heavily infested in the vicinity of Hamburg by *Crioceris asparagi,* a species introduced from Russia at this time (Aurivillius 1909).

Alien chrysomelid species are better known for their economic impact than for their ecological impact. Indeed, possible ecological impacts on native flora and fauna are very little documented. Positive impact can be appreciated for only one alien species, *Zygogramma suturalis*, a strict monophagous species deliberately introduced to Europe for the control of the invasive ragweed (cf above).

Negative economic impacts have been recorded in seven of the alien seed beetle species which may severely affect stored pulses of economically-important legumes (*Acanthoscelides obtectus, A. pallidipennis, Bruchus pisorum, B. rufimanus, Callosobruchus chinensis, C. maculatus, C. phaseoli*, and *Zabrotes subfasciatus*; see (Borowiec 1987, Hoffmann et al. 1962)). Most of them are capable of re-infesting stored legumes until the food reserves are exhausted. In leaf beetles, large economic impacts have been shown for the Colorado potato beetle, *L. decemlineata*, affecting potato crops (see factsheet 14.10) and the western corn rootworm, *D. virgifera virgifera* affecting maize roots and foliage (see factsheet 14.8). However, It must be stressed that economic damage has only been seen on maize in Serbia, and in some bordering areas in Croatia, Hungary, Romania, and small areas in Bosnia-Herzegovina and Bulgaria (EPPO 2009). In the United Kingdom, yield losses to be expected from the arrival and spread of *D. virgifera virgifera* have been estimated to range from 0.9 to 4.1 million € over 20 years in absence of obligatory campaign to prevent spread of western corn rootworm but the costs of such a campaign could also range from 3.7 to 10.5 million € (Central Science Laboratory 2007). *Epitrix hirtipennis* may also impact tobacco crops (Sannino et al. 1984, Sannino et al. 1985) as well as *E. cucumeris* these of potato and tomato (Borges and Serrano 1989), and *Phaedon brassicae* the cabbage crops (Limonta and Colombo 2004). Alien foliage-feeding chrysomelids may also act as vectors for plant diseases, for example *D. virgifera* which transmits several cowpea virus strains in North America (Lammers 2006). However, little is yet known in this field (Jolivet and Verma 2002). Besides such economic damage, aesthetic impacts are recorded on ornamental plants, such as these of the leaf beetle *Pistosia dactylifera* on palm trees in southern France (Drescher and Martinez 2005).

8.3.8 Expected trends

Introduction of alien chrysomelids is still an ongoing process, especially through the trade of ornamentals via garden centers. For example, an alien species of the genus *Luperomorpha* was recently imported to Europe. *L. xanthodera*, originating from China, was first found in Great Britain feeding in flowers of several plant species in garden centers (Johnson and Booth 2004). Later it was observed in Switzerland (F. Köhler, personal communication), Germany (Döberl and Sprick 2009) and the Netherlands (Beenen et al. 2009), and also in garden centers, especially on rose flowers (Figure 8.3.6). Other alien specimens of *Luperomorpha* observed in Italy (Conti and Raspi 2007) and France (Doguet 2008) were first identified as *L. nigripennis*, from India and Nepal, but finally identified as *L. xanthodera* (Döberl and Sprick 2009). Plants cultivated in the Mediterranean area, then transported without severe pest control and sold in Central, Western and Northern Europe also constitute a serious threat for the expansion of species alien *in* Europe. The risks associated to this pathway were estimated for Norway (Staverløkk and Saethre 2007).

Species originating from subtropical and tropical regions have also been translocated such as *Aspidimorpha nigropunctata* (Klug) from tropical Africa to The Netherlands and *Macrima pallida* (Laboissière) from the Himalayan region to Cyprus. These introductions usually have not led to establishment (Beenen 2006). However, they do indicate a potential risk, especially in the context of global warming which may facilitate establishments of such species in the near future. The arrival in southern Europe of additional species associated with ornamental palms such as the hispine leaf beetle, *Brontispa longis-*

Figure 8.3.6. Adult of alien flea beetle, *Luperomorpha xanthodera* (Credit: Urs Rindlisbacher- Foto: www.insektenwelt.ch)

Figure 8.3.7. Adult of alien seed beetle, *Specularius impressithorax*; a- dorsal view; b- lateral view (credit: C. van Achterberg; photo taken using Olympus stereomicroscope SZX12 with AnalySIS Extended Focal Imaging software).

Figure 8.3.8. Adult of Mexican bean weevil, *Zabrotes subfasciatus*. a- dorsal view; b- lateral view (credit: C. van Achterberg; photo taken using Olympus stereomicroscope SZX12 with AnalySIS Extended Focal Imaging software)

sima (Gestro), already invasive in other parts of the world (Nakamura et al. 2006), is thus probable, considering the current increase in alien pests related to palms (see Chapter X).

Finally, it is difficult to make serious predictions about the results of future translocations because the species may react differently to the new habitats and hosts when compared with the situation in their native environment. Furthermore, translocations may enhance evolutionary changes partly because of founder effects and genetic bottlenecks and partly because of the triggering of evolution by new environmental factors (Whitney and Gabler 2008). *Zygogramma suturalis* when introduced to the Northern Caucasus for biological control of ragweed, showed rapid evolutionary changes in flight capacity (development of flight ability and morphological changes) within only five generations (Kovalev 2004).

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Table 8.3.1. List and characteristics of the established Chrysomelidae species alien to Europe. Status: **A** Alien to Europe **C** cryptogenic species. Country codes abbreviations refer to ISO 3166 (see appendix I). Habitat abbreviations refer to EUNIS (see appendix II). Last update 1 February 2010.

Family or subfamily *Species*	**Status**	**Regime**	**Native range**	**1st record in Europe**	**Invaded countries**	**Habitat***	**Hosts**	**References**
Alticinae- flea beetles								
Epitrix cucumeris (Harris, 1851)	A	Phyto-phagous	Central and South America	1987, PT-AZO	PT-AZO	I1	*Nicotiana* and other Solanaceae	Borges and Serrano (1989)
Epitrix hirtipennis (Melsheimer, 1847)	A	Phyto-phagous	Southern USA, Central and South America.	1984, IT	BG, GR, IT, MK, PT-AZO	I1	*Nicotiana* and other Solanaceae	Döberl (1994b), Döberl (2000), Sannino et al. (1984), Sannino et al. (1985)
Epitrix similaris Gentner, 1944	A	Phyto-phagous	USA	2008, PT	PT	I1	*Solanum tuberosum*	Doguet (2009), Oliviera et al. (2008)
Luperomorpha xanthodera (Fairmaire, 1888)	A	Phyto-phagous	China, Korea	2003, GB	CH, DE, FR, GB, IT, NL	I2	*Iris* and *Euonymus* roots (larva); adult polyphagous	Beenen, unpubl., Conti and Raspi (2007), Del Bene and Conti (2009), Delobel and Delobel (2003), Doguet (2008), Johnson and Booth (2004)
Bruchidae – seed beetles								
Acanthoscelides obtectus Say, 1831	A	Phyto-phagous	C & S America	1889, IT	AL, AD, AT, BA, BE, BG, BY, CH, CY, CZ, DE, DK, EE, ES, ES-BAL, ES-CAN, FR, FR-COR, GB, GR, GR-CRE, GR-NEG, GR-SEG, HR, HU, IE, IL, IS, IT, IT-SAR, IT-SIC, LI, LT, LU, LV, MD, MK, MT, NL, NO, NO-SVL, PT, PT-AZO, PT-MAD, RO, RS, RU, SE, SI, SK, UA	J1, I	*Phaseolus* seeds, wild and cultivated legumes outdoors	Borges et al. (2005), Delobel and Delobel (2003), Hoffmann et al. (1962), Tomov et al. (2007)

Family or subfamily *Species*	**Status**	**Regime**	**Native range**	**1st record in Europe**	**Invaded countries**	**Habitat***	**Hosts**	**References**
Acanthoscelides pallidipennis (Motschulsky, 1874)	A	Phyto-phagous	North America	1980, BG	AT, BA, BG, CH, CZ, DE, HR, HU, IT, LU, MK,PL, RO, RS	I, J	*Amorpha fruticosa* (indigobush) and other legumes	Borowiec (1983), Borowiec (1988), Migliaccio and Zampetti (1989), Szentesi (1999), Wendt (1981)
Bruchidius siliquastri Delobel 2007	C	Phyto-phagous	Crypto-genic	2003, FR	FR	I2	*Cercis* seeds	Kergoat et al. (2007)
Bruchus pisorum (Linnaeus, 1758)	A	Phyto-phagous	Asia-Temperate	1850, CZ	AD, AL, AT, BA, BE, BG, BY, CH, CY, CZ, DE, DK, EE, ES, ES-BAL, ES-CAN, FI, FR, FR-COR, GB, GR, GR-CRE, GR-NEG, GR-SEG, HR, HU, IE, IS, IT, IT-SAR, IT-SIC, LI, LT, LU, LV, MD, MK, MO, MT, NL, NO, NO-SVL, PL, PT, PT-AZO, PT-MAD, PT, RO, RS, RU, SE, SI, SK, UA	I, J1	Dried peas; *Lathyrus, Pisum, Vicia*	Delobel and Delobel (2003), Fauna Europaea (2009), Gobierno de Canarias (2010), Hoffmann (1945), Sainte-Claire Deville (1938)
Bruchus rufimanus Bohemann, 1833	A	Phyto-phagous	Africa	1894, PT	AD, AL, AT, BA, BE, BG, BY, CH, CY, CZ, DE, DK, EE, ES, ES-BAL, ES-CAN, FI, FR, FR-COR, GB, GR, GR-CRE, GR-NEG, GR-SEG, HR, HU, IE, IS, IT, IT-SAR, IT-SIC, LI, LT, LU, LV, MD, MK, MT, NL, NO, NO-SVL, PL, PT, PT-AZO, PT-MAD, RO, RS, RU, SE, SI, SK, UA	I, J1	Stored beans; *Phaseolus, Vicia, Lathyrus, Lupinus, Pisum, Lens, Cicer* (wild and cultivated)	Delobel and Delobel (2003), Fauna Europaea (2009), Gobierno de Canarias (2010), Hoffmann (1945), Sainte-Claire Deville (1938)

Family or subfamily *Species*	Status	Regime	Native range	1st record in Europe	Invaded countries	Habitat*	Hosts	References
Callosobruchus chinensis (Linnaeus, 1758)	A	Phytophagous	Asia-Temperate	1878, FR	AD, AL, AT, BA, BE, BG, BY, CH, CY, CZ, DE, DK, EE, ES, ES-BAL, ES-CAN, FI, FR, FR-COR, GB, GR, GR-CRE, GR-NEG, GR-SEG, HR, HU, IE, IL, IS, IT, IT-SAR, IT-SIC, LI, LT, LU, LV, MD, MK, MT, NL, NO, NO-SVL, PT, PT-AZO, PT-MAD, RO, RS, RU, SE, SI, SK, UA	I, J1	Stored legumes (capable of re-infesting)	Biondi et al. (1994), Essl and Rabitsch (Eds) (2002), Fauna Europaea (2009), Gobierno de Canarias (2010), Hoffmann (1945), Sainte-Claire Deville (1938), Tomov et al. (2007)
Callosobruchus maculatus (Fabricius, 1775)	A	Phytophagous	Africa	1878, FR	AL, BG, CZ, ES, FR, GR, GR-CRE, IL, IT, IT-SIC, IT, PT, PT-AZO	I, J1	*Phaseolus* and other stored legumes (capable of re-infesting)	Binaghi (1947), Delobel and Delobel (2003), Fauna Europaea (2009), Gu et al. (2009), Hoffmann (1945), Tomov et al. (2007)
Callosobruchus phaseoli (Gyllenhal, 1833)	A	Phytophagous	Asia-Temperate	1945, FR	AL, CZ, ES, FR, GR, GR-CRE, IL, IT, IT-SIC	I, J1	*Phaseolus, Lupinus* and other stored legumes (capable of re-infesting)	Delobel and Delobel (2003), Hoffmann (1945), Tomov et al. (2007)
Caryedon serratus (Olivier, 1790)	A	Phytophagous	Africa	1900, CZ	CY, CZ, DE, GR, GR-CRE	I1, I2, F, J1	*Acacia, Cassia, Prosopis* seeds	Delobel and Delobel (2003)
Megabruchidius dorsalis (Fahreus, 1839)	A	Phytophagous	Asia (Japan)	1989, IT	IT	I2	*Gleditsia* seeds	Migliaccio and Zampetti (1989)
Megabruchidius tonkineus György 2007	A	Phytophagous	Asia-tropical (Vietnam)	2001, HU	HU	I2	*Gleditsia* seeds	György (2007), Jermy et al. (2002)

Family or subfamily *Species*	Status	Regime	Native range	1st record in Europe	Invaded countries	Habitat*	Hosts	References
Mimosestes mimose (Fabricius, 1781)	A	Phyto-phagous	Asia-Temperate	1945, FR	DE, DK, FR, IT	J1	*Acacia, Phaseolus, Vicia, Ciser* (chickpea) seeds	Hansen (1996), Hoffmann (1945)
Pseudopachymerina spinipes (Erichson, 1833)	A	Phyto-phagous	C & S America	1919, ES	ES, FR, GR, GR-CRE, IT, IT-SIC	I2	*Acacia farnesiana* seeds	Bouchelos and Chalkia (2003), Fauna Europaea (2009), Ramos et al. (2007)
Zabrotes subfasciatus (Bohemann, 1833)	A	Phyto-phagous	C & S America	1858, FR	AL, CZ, ES, ES-CAN, FR, GR, GR-CRE, IT, IT-SIC, NL, PT, PT-AZO	J1	*Phaseolus* and other stored legumes (capable of re-infesting)	Delobel and Delobel (2003), Hoffmann (1945)
Cassidinae – Tortoise leaf beetles								
Aspidomorpha fabricii Sekerka, 2008	A	Phyto-phagous	Africa	1957, IT	IT	I1	*Beta vulgaris*	Zangheri (1960)
Chrysomelinae – leaf beetles								
Leptinotarsa decemlineata (Say, 1824)	A	Phyto-phagous	North and Central America	1922, FR	AD, AL, AT, BA, BE, BG, BY, CH, CZ, DE, EE, ES, ES-BAL, FR, FR-COR, GR, HR, HU?, IT, IT-SAR, IT-SIC, LI, LT, LU, LV, MD, MK, MO, NL, PL, PT, RO, RS, RU, SE, SI, SK, UA	I1	*Solanum tuberosum* and other Solanaceae	CABI/EPPO (2003), EPPO (2006), Fauna Europaea, Grapputo et al. (2005), Tomov et al. (2007)
Phaedon brassicae Baly, 1874	A	Phyto-phagous	China, Japan, Taiwan, Vietnam.	2000, IT	IT	I1	Brassicaceae	Limonta and Colombo (2004)
Calligrapha polyspila (Germar, 1821)	C	Phyto-phagous	North America	> 2001, PT-AZO	PT-AZO		*Sida rhombifolia*	Jolivet (2001)

Family or subfamily *Species*	Status	Regime	Native range	1st record in Europe	Invaded countries	Habitat*	Hosts	References
Zygogramma suturalis (Fabricius, 1775)	A	Phyto-phagous	North America	1985, HR	HR		*Ambrosia artemisiifolia*	Igrc et al. (1995)
Galerucinae – Skeletonizing leaf beetles								
Diabrotica virgifera virgifera LeConte, 1868	A	Phyto-phagous	Central America	1992, RS	AT, BA, BE, BG, CH, CZ, DE, FR, GB, HR, HU, IT, MO, NL, PL, RO, RS, SI, SK, UA.	I1	*Zea mays.*	Baca (1994), Ciosi et al. (2007), EPPO (2009), Gödöllo University (2009), Guillemaud et al. (2010), Purdue University (2009)
Hispinae – Hispine leaf beetles								
Pistosia dactyliferae (Maulik, 1919)	A	Phyto-phagous	India	2004, FR	FR	I2	Palms	Drescher and Martinez (2005)

Table 8.3.2. List and characteristics of the Chrysomelidae species alien *in* Europe. Country codes abbreviations refer to ISO 3166 (see appendix I). Habitat abbreviations refer to EUNIS (see appendix II). Last update 1 February 2010.

Family or subfamily *Species*	**Regime**	**Native range**	**Invaded countries**	**Habitat***	**Hosts**	**References**
Alticinae- flea beetles						
Altica ampelophaga Guérin-Méneville, 1858	Phyto-phagous	Western, Southern and Central Europe	PT-AZO	I	*Vitis*	Borges and Serrano (1989)
Altica carinthiaca Weise, 1888	Phyto-phagous	Continental Europe	GB	I2	*Lathyrus pratensis* (meadow vetchling)	Cox (2007)
Chaetocnema hortensis (Geoffroy, 1785)	Phyto-phagous	Continental Europe	PT-AZO	I	Graminae	Borges and Serrano (1989)
Epitrix pubescens (Koch, 1803)	Phyto-phagous	Continental Europe	PT-AZO	I	*Solanum*	Borges and Serrano (1989)
Longitarsus kutscherae (Rye, 1872)	Phyto-phagous	Continental Europe	PT-AZO	I	*Plantago*	Borges and Serrano (1989)
Longitarsus lateripunctatus lateripunctatus (Rosenhauer, 1856)	Phyto-phagous	Mediterranean region	PT-AZO	I	*Borago officinalis* and other Boraginaceae	Borges and Serrano (1989)
Longitarsus obliteratoides Gruev, 1973	Phyto-phagous	Continental Europe	GB	I2	*Thymus, Rosmarinus*	Cox (2007)
Neocrepidodera brevicollis (J. Daniel, 1904)	Phyto-phagous	Alps	DK	G3, G4	*Cirsium*	Hansen (1964)
Neocrepidodera ferruginea (Scopoli, 1763)	Phyto-phagous	Continental Europe, Caucasus	PT-AZO	I	Asteraceae and Poaceae	Borges and Serrano (1989)
Psylliodes chrysocephalus (Linnaeus, 1758)	Phyto-phagous	Continental Europe	PT-AZO	I	Brassicaceae	Borges and Serrano (1989)
Psylliodes cucullata (Illiger, 1807)	Phyto-phagous	Continental Europe	GB	I2	*Spergula arvensis* (Corn spurrey)	Cox (1995), Cox (2007)
Bruchidae – seed beetles						
Bruchidius foveolatus (Gyllenhal, 1833)	Phyto-phagous	Continental Europe	PT-AZO	I1	*Sarothamnus scoparius* seeds	Borges et al. (2005)

Family or subfamily *Species*	**Regime**	**Native range**	**Invaded countries**	**Habitat***	**Hosts**	**References**
Bruchidius lividimanus (Gyllenhal, 1833)	Phyto-phagous	Mediterranean region	PT-AZO	I1	*Genistea, Ononis, Cytisus* seeds	Borges et al. (2005)
Bruchidius varius (Olivier)	Phyto-phagous	Continental Europe	GB	E, G	*Trifolium pratens* (red clover), *T. medium* (zig-zag clover), *Ulex europaeus* (gorse), *Bolboschoenus maritimus* (sea club-rush) seeds	Cox (2007), Hodge (1997)
Bruchus ervi Frölich, 1799	Phyto-phagous	Mediterranean region	BE, CH, CZ, DE, DK, ES-CAN, FI, GB, HU, IE, LI, LU, LV, NL, NO, PT-AZO, PT-MAD, RO, SE, SK, UA	I, J1	*Lens* seeds	Fauna Europaea (2009), Gobierno de Canarias (2010), Strejček (1990)
Bruchus lentis Fröhlich, 1799	Phyto-phagous	Southern Europe	ES-CAN	I, J1	*Lens, Vicia* seeds	Gobierno de Canarias (2010), Igrc et al. (1995)
Bruchus rufipes Herbst, 1783	Phyto-phagous	West Palaearctic	PT-AZO, ES- CAN	I	*Lathyrus, Pisum, Vicia* seeds	Borges et al. (2005), Gobierno de Canarias (2010)
Bruchus signaticornis Gyllenhal, 1833	Phyto-phagous	Mediterranean region	BE, CH, CZ, DE, DK, EE, FI, GB, HU, IE, LI, LT, LU, LV, MD, NL, NO, RU, SE, SK, UA	I, J1	*Lathyrus, Lens, Vicia* seeds	Strejček (1990)
Criocerinae- leaf beetles						
Crioceris asparagi (Linnaeus, 1758)	Phyto-phagous	Continental Europe, Central Asia	GB	I, J	*Asparagus officinalis officinalis* (garden asparagus), *A. officinalis prostratus* (wild asparagus)	Cox (2007), Hill et al. (2005)

Family or subfamily *Species*	**Regime**	**Native range**	**Invaded countries**	**Habitat***	**Hosts**	**References**
Lilioceris lilii (Scopoli, 1763)	Phyto-phagous	Continental Europe	GB, IE	I2, I1	*Lilium, Fritillaria* and other Liliaceae; *Arum maculatum*	Cox (2007), Stephens (1839)
Cryptocephalinae – casebearers						
Cryptocephalus sulphureus G. A. Olivier, 1808	Phyto-phagous	Western Mediterranean	PT- AZO	I2	*Pulmonaria*	Borges and Serrano (1989)
Chrysomelinae – leaf beetles						
Chrysolina americana Linnaeus, 1758	Phyto-phagous	Mediterranean region	BE, GB, NL	I1, I2	*Rosmarinus, Lavandula, Salvia, Thymus*	Beenen and Winkleman (2001), Cox (2007), Johnson (1963), Lays (1988)
Chrysolina bankii (Fabricius, 1775)	Phyto-phagous	Mediterranean region	GB	I2	*Plantago lanceolata* (ribwort plantain), *Ballota nigra* (black horehound), *Mentha* spp., and other Lamiaceae	Cox (2007)
Gonioctena fornicata (Bruggemann, 1873)	Phyto-phagous	Eastern Europe	IT	I	*Medicago*	Michieli (1957)
Galerucinae- Skeletonizing leaf beetles						
Xanthogaleruca luteola (Müller, 1766)	Phyto-phagous	Europe	GB	I2	*Ulmus*	Buckland and Skidmore (1999)