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INVADING SPECIES: A CHALLENGE FOR PEST MANAGEMENT

REINER POSPISCHIL
PMP-Biosolutions, Im Tiergarten 9, 50129 Bergheim-Erft, Germany

Abstract Global warming together with global trade and tourism gives foreign organisms a lot of opportunities to enter Europe and to find suitable habitats to establish. Many of these species already have a status as pests in their native countries and now start to be of major concern in Europe. A survey is presented on the species which were sent for identification from 2010 to 2014. Of these 128 species 4.0% arrived from the Mediterranean area and 23.4% have their origin on other continents. Invasive species readily accept the conditions of their new habitat. Examples are ants like *Technomyrmex vitiensis* and *Lasius neglectus* but also different cockroach species. The strategies of some species, to find ecological niches where they survive or even expand and the challenge for pest control are discussed. Most alien arthropods have a different way of life than native species and require special control strategies. Detailed descriptions of economically important species are often found in their countries of origin or in the American and Australian literature. Modern pest management requires global knowledge of pest control strategies and pest control literature. Some control advice may also be found in the internet, when the respective alien species has been identified.
Key words Aliens, exotic Formicidae, climate change

INTRODUCTION

Pest organisms accompany man, since he began to settle down (Robinson 1996). In the past centuries a lot of pests arrived from tropical and subtropical areas in Central European harbours with commercial trade of foreign goods. However, since the middle of last century, the pest fauna has changed dramatically in Central Europe, which is mainly caused by the increasing introduction of goods from overseas without having a sufficient pest management or quarantine of goods in the harbours. Sensitive foods are transported by aircraft and reach Central Europe within 24 hours from their overseas origins. Large livestock farms, industrial food processing and modern heating systems, provide constant high temperature conditions even in the winter months and allow tropical insect species to establish in Central Europe (Pospischil, 2001).

This development is accompanied by an increasing number of organisms which arrive in Europe (Klotz et al., 2008). South European species benefit from the rising temperatures caused by climate change and move north to Central Europe (Rabitsch and Essl 2010; Nentwig, 2011). These changes in the abundance of pest organisms are shown by the specimens sent by pest management professionals for identification.

MATERIAL AND METHODS

Several 100 specimens were submitted for identification since 2010 from many places in Germany and from neighboring countries belonging to 128 species from 14 Orders and 56 Arthropod families. Mostly adult arthropods were sent, but egg-batches, larvae, pupae, faecal pellets and gnawing particles and pieces of wood with signs of attack arrived also. In urgent cases or when larger specimens were found, pictures were sent per e-mail. The samples came from pest management professionals, museums,

scientific institutes, botanical and zoological gardens etc. Development stages which could not be identified were cultured until hatching of adults. Identified specimens (particularly Siphonaptera, Coleoptera, Formicidae, and Heteroptera) were pinned or embedded on a slide after identification and included in the collection. Photos were taken of the samples (specimens, signs of infestation) to save the entries for further studies.

This survey refers to specimens which were sent by pest management professionals, institutes, veterinarians, physicians or private clients. Only species which arrived in Europe after 1492 are identified as exotic species or aliens in this survey.

RESULTS AND DISCUSSION

Pests were introduced into Europe with trade since hundreds of years. However, due to quarantine regulations and pest control during unloading in the harbours exotic pests could hardly spread further. With the use of containers and short loading and unloading times often without inspections infested goods came directly into the domestic areas. The pest fauna has changed dramatically in Central Europe since the middle of last century, and the increasing standard of living and world trade also allowed tropical species to establish (Pospischil, 2001). Climate change has an additional effect on the naturalization of exotic species (Rabitsch and Essl, 2010; Nentwig, 2011).

One hundred twenty eight species were identified, of which 72.6% are native Central European inhabitants. 4.0% come from the Mediterranean region and 23.4% are exotic species (Table 1). Most submitted specimens were Coleoptera with 43 species and 17 families (Table 2). 74.4% are part of the Central European fauna, and 4.0% of the Mediterranean fauna, respectively. Exotic species are present in the Families Dermestidae, Bostrychidae, Anobiidae, Coccinellidae, Silvanidae, and Bruchidae. Some specimens sent as pictures are protected species: the leather beetle *Carabus coriaceus* (Carabidae), and the musk beetle *Aromia moschata* (Cerambycidae).

Table 1. Number of submitted species of different orders and areas of origin

Area of origin	**Central Europe**		**Mediterranean**		**Other continents**		**Total submitted**
Order	**No. of species**	**%**	**No. of species**	**%**	**No. of species**	**%**	
Coleoptera	32	74.4	2	4,7	9	20.9	43
Hymenoptera*	13	52.0	1	4.0	11	44.0	25
Diptera	10	90.9	1	9.1	0	0	11
Blattaria	2	25.0	1	12.5	5	62.5	8
Heteroptera	4	80.0	0	0	1	20.0	5
Siphonaptera	5	100	0	0	0	0	5
Acari	6	100	0	0	0	0	6
Araneae	5	62.5	0	0	3	37.5	8
Others	16	92.9	0	0	1	7.1	17
Total	93	72.6	5	4.0	30	23.4	128

Table 2. Families of the Order Coleoptera and areas of origin.*[1] Number of Central European species;*[2] Names of introduced species in brackets

Area of origin	Family (Species)	No. of species	%
Central Europe*[1]	Carabidae (4 species), Staphylinidae (2 Species), Histeridae (1), Dermestidae (3) Anobiidae (5 species), Ptinidae (3 species), Tenebrionidae (2 species), Lamellicornia (1) Lathridiidae (2), Throscidae (1), Malachiidae (1), Cerambycidae (5), Bruchidae (1), Curculionidae (1)	32	52
Mediterranean area*[2]	Bostrychidae (*Amphicerus bimaculatus),* Anobiidae (*Nicobium castaneum*)	2	4
Other continents*[2]	Dermestidae (*Trogoderma angustum, Attagenus smirnovi, Anthrenocerus australis, Dermestes peruvianus),* Bostrychidae (*Lyctus brunneus*, *Sinoxylon anale*), Coccinellidae (*Harmonia axyridis*), Silvanidae (*Oryzaephilus surinamensis*), Bruchidae (1)	9	44
Total		43	100

Ants

In 1999, 147 species of ants have been recorded living in non native habitats (McGlynn, 1999). As social insects ants have developed an impressive diversity of species and occupy many ecological niches. Most species are beneficial in natural ecosystems, a few are detrimental in urban areas (Holway et al., 2002; Klotz et al. 2008). Surveys on exotic ant species in Central European tropical houses of botanical and zoological gardens were published by Boer and Vierbergen (2008) and Pospischil (2011). 25 ant species were identified in this survey belonging to the subfamilies Formicinae (11 species), Dolichoderinae (1 species), Myrmicinae (12 species) and Ponerinae (1 species) (Table 3). 44% are from overseas and one (*Crematogaster scutellaris*) comes from the Mediterranean coast (caravan from Croatia with insulation material from Italy). *C. scutellaris* colonies survive several years in unheated structures under the Central European climate and allates were found outside a building in February at 10°C.

Technomyrmex vitiensis, *Plagiolepis* sp., *Tetramorium insolens*, *T. bicarinatum* and *Solenopsis molesta* were submitted from tropical green houses. An established colony of *S. molesta* was additionally found in a private house in North Rhine-Westphalia 2012. *Technomyrmex vitiensis*, which was submitted 8 fold during the last 2 years, and *Plagiolepis* sp. are now the most common species in Central European tropical buildings and can survive indoors in private homes at least for a month. In a restaurant attached to a greenhouse, workers of *T. vitiensis* were found in 2013. The colonies are decentralized over large territories with regular exchange of workers. Inseminated queens are only found in new colonies and then replaced by intercastes which can hardly be differentiated from workers. The transfer of nutrients occurs through trophic eggs rather than trophallaxis (Yamauchi et al., 1991).

The small exotic species *Cardiocondyla obscurior* which is already known from some tropical greenhouses was sent from Munich, where a nest was found in cavities of a potted plant.

These ants are night active and their colonies are hidden in small cavities of plants and can easily be transported (Heinze et al., 2006; Pospischil, 2011). Several workers of the red imported fire ant were identified on a sticky trap which was submitted from an international German airport 2012. The establishment of this species in urban areas of Central Europe seems to be possible according to a small colony which was kept under Central European indoor temperature conditions for one year in 2000.

Lasius brunneus was submitted 15 fold during the last 2 years. *L. brunneus* establishes new colonies often in buildings with a moisture damage which has not been repaired correctly. This species is therefore an important indicator of structural damage. *Lasius neglectus* was sent twice: one from a location in Baden Wurttemberg in 2011, and a second from a market garden near Ludwigshafen in 2012. Both places are in the distribution area of *L. neglectus* which is already described by Ugelvig et al. (2008).

Cockroaches

The cockroach samples consist of two native Central European species (*Ectobius lapponicus* and *E. sylvestris*), one species from the Mediterranean region (*Ectobius vittiventris*) and 5 exotic species from overseas which are already established in Central Europe (*Blattella germanica*, *Supella longipalpa*, *Periplaneta americana*, *Pycnoscelus surinamensis* and *Blaptica dubia*). Many cockroach species have the typical attributes of invasive species. They live in human environment and have a broad food spectrum and a hidden mode of life. It is therefore not surprising that most of the submitted cockroaches are exotic species (Pospischil 2010). The migration of the South European *Ectobius vittiventris* from Italy to Switzerland is well documented (Landau et al., 2000). The species followed in the past 6 years the Rhine valley north to the lower Rhine district and was submitted 2013 twice from Bonn and Dusseldorf, respectively.

Heteroptera

The submitted Heteroptera (5 species) are native European species with the exception of *Leptoglossus occidentalis*. This species was first found 1999 in northern Italy and spread rapidly over most of Europe (Rabitsch 2010). The species reached the South of Germany 2006 and is now widespread along the Rhine valley north to the lower Rhine district. Specimens are frequently found in homes when they invade structures to hibernate. The specimens which were included in this study, were submitted from Bochum and Wuppertal (North Rhine-Westphalia).

Flies

The order Diptera is presented with 11 species. 10 species belong to the Central European fauna and one species has its original distribution in the Mediterranean region (*Clogmia albipunctata*, Psychodidae) (Table 1). Other orders are Isopoda, Collembola, Dermaptera, Saltatoria, Psocoptera and Thysanoptera which are represented with only a few Central European species in this study.

Other Arthropods

8 species of spiders were collected from fruit display in supermarkets (mainly bananas) or plant departments and submitted for identification (Table 1). A Brazilian wandering spider (*Phoneutria* sp.) was found in one banana box. Central European house spiders (*Tegenaria atrica*) were submitted from another four supermarkets und one Wolf spider (*Trochosa terricola)*. The tropical species *Achaearanea tepidariorum* was found in a fruit display. The feather-legged lace weaver *Uloborus plumipes* was introduced about 20 years ago to Europe with plant and is now present in most garden centers. The 6 mite species belong to the Central European fauna (Table 1), and 2 of them are parasitic (*Dermanyssus gallinae* and *Ornithonyssus bacoti*)

Table 3. Ant species sent for identification from 2010 to 2013 and area of origin.

Area of origin	Species	No. of species	%
Central Europe	*Lasius brunneus , L. emarginatus , L. flavus , L. niger , L. fuliginosus , L. alienus, Camponotus ligniperdus , C. herculeanus , Messor structor, Tetramorium cf caespitum Temnothorax unifasciatus, Myrmica rubra, Hypoponera punctatissima*	13	52
Mediterranean area	*Crematogaster scutellaris*	1	4
Other continents	*Lasius neglectus, Camponotus maculatus, Plagiolepis.* sp.*, Technomyrmex vitiensis, Solenopsis invicta, S. molesta, Monomorium pharaonis, Cardiocondyla obscurior, Pheidole* sp. *, Tetramorium insolens, T. bicarinatum,*	11	44
Total		25	100

It is conspicuous that not only exotic species started in the last years to be a concern for pest management in Central Germany but also native species which were not mentioned in pest management before. Examples are *Anthocomus fasciatus* (Malachiidae, Coleoptera) and *Eilema complana* (Arctiidae, Lepidoptera). *E. complana* started 2 years ago to be a concern for pest management professionals. The larvae feed on algae, lichens and mosses on the roof of large buildings and enter the interior of the building to pupate.

CONCLUSIONS

The introduction of exotic species including pathogens which is favoured by the global trade and short transport times is strongly increasing. Urbanization proceeds and the mean temperatures in larger cities offer tropical species adequate life conditions.

Climate change has an influence on the further spread and establishment of these exotic species outside buildings. The prerequisites for the pest management to master these challenges are a profound knowledge of the species and their ecological competence. The pest management will further need interdisciplinary cooperation with international teams of specialists with different emphasis including veterinary and human medicine, natural conservation organizations, transportation, agriculture and food production.

REFERENCES CITED

Boer, R. and B. Vierbergen. 2008. Exotic ants in the Netherlands (Hymenoptera: Formicidae). Entomologische Berichten 68: 121-129.

Heinze, J. S. Cremer, N. Eckl and A. Schrempf. 2006. Stealthy invaders: The biology of *Cardiocondyla* tramp ants. Insectes Sociaux 53: 1-7.

Holway, D.A., L. Lach, A.V. Suarez, N.D. Tsutsui, and T.J. Case. 2002. The causes and consequences of ant invasions. Annual Review of Entomology 33: 181-233.

Klotz, J.H., L.D. Hansen, R. Pospischil, and M. Rust. 2008. Ants and their Management in Urban Environments. Cornell University Press Ithaca, London, 196pp

Landau I., H. Baur, G. Müller, and M. Schmidt. 2000. Zur Verbreitung und Taxonomie von *Ectobius vittiventris* (Costa) (Blattoptera: Ectobiidae) in der Schweiz. Mitteilungen der Schweizerischen Entomologischen Gesellschaft 73: 179.

McGlynn, T.P. 1999. The worldwide transfer of ants: Geographical distribution and ecological invasions. Journal of Biogeography 26: 535-548.

Nentwig, W. 2011. Unheimliche Eroberer – Invasive Pflanzen und Tiere in Europa. Haupt Verlag, Bern, Stuttgart, Wien, 251pp

Pospischil, R. 2001. Veränderungen der Schädlingsfauna im menschlichen Umfeld seit 1950 - Verh. Westd. Entom. Tag 2000, Löbbecke Mus. Düsseldorf, 319 – 324.

Pospischil, R. 2010. Schaben (Dictypotera, Blattodea) – Ihre Bedeutung als Überträger von Krankheitserregern und als Verursacher von Allergien. *In:* Aspöck, H. Ed. Krank durch Arthropoden. Denisia, Wien, 30: 171-190.

Pospischil, R. 2011. The role of tropical greenhouses for introduction and establishment of foreign ant species (Hymenoptera: Formicidae) in Central Europe. W.H. Robinson and A. E. C. Campos, eds., Proc. Internat. Conf. Urban Pests, Ouro Preto-MG, Brazil: 59-66.

Rabitsch, W. 2010. True Bugs (Hemiptera, Heteroptera). Chapter 9.1. *In:* Roques A. et al. Eds. Alien terrestrial arthropods of Europe, BioRisk 4(1): 407–403.

Rabitsch, W. and F. Essl (eds). 2010. Aliens unter uns? Wer sind sie wirklich? Sind sie die Gewinner des Klimawandels? pp 11-17. *In:* Aliens, Neobiota und Klimawandel – Eine verhängnisvolle Affäre? Verlag Bibliothek der Provinz, Weitra, Austria, 158pp

Robinson, W.H. 1996. Urban Entomology – Insect and Mite Pests in the Human Environment. Chapman & Hall, London, Weinheim, New York, Tokyo, 430pp

Ugelvig, L.V., F.P. Drijfhout, D.J.C. Kronauer, J.J. Boomsma, J.S. Pedersen, and S. Cremer. 2008. The introduction history of invasive garden ants in Europe: Integrating genetic, chemical and behavioural approaches. BMC Biology 6:11.

Yamauchi K., T. Furukawa, K. Kinomura, H. Takamine, and K. Tsuji. 1991. Secondary polygyny by inbred wingless sexuals in the dolichoderine ant *Technomyrmex albipes*. Behavioral Ecology and Sociobiology 29: 313-319.