INTRODUCTION

Biological invasions by alien species are a great ecological and economic threat, with a multitude of negative impacts on human and animal health, local biodiversity (flora and fauna) and cultural landscapes. In Europe, insects are one of the taxonomic groups with the most alien species which cause economic impacts (Hulme & Roy, 2010). In fact, the introduction of alien insects is a growing worldwide phenomenon, especially in countries with intensive international movement of goods and people.

Referring in particular to the order Lepidoptera, 74% of alien insects in Europe were established during the 20th century and new arrivals are growing, with an average of 1.9 alien Lepidoptera newly established per year between 1970–2007 (Lopéz-Vaamonde et al., 2010).

Analysis of the 78 alien Lepidoptera species whose origins are known, shows that Asia has contributed most with 28.9%, followed by Africa (including Macaronesian islands, Canaries, Madeira and Azores) with 21.6%, North America with 16.5%, Australasia with 7.2% and the Neotropics with 5.2% (Lopéz-Vaamonde et al., 2010). This largely phytophagous insect group, is particularly affected by the increasing trade in plants and stored plant products.

A recent case is the Box Tree Moth Cydalima perspectalis (Walker, 1859), a species from East Asia, which was recorded for the first time in Europe in 2006 in southwestern Germany, where it most probably arrived with Buxus seedlings (Krüger, 2008).

This species, originally described as Phakellura perspectalis Walker, 1859 has been placed in various spilomeline genera including Palpita Hübnner, 1808, Daiphania Hübnner, 1818 and Glyphodes Gueneé, 1854. Based on phylogenetic analysis, the Box Tree Moth has been transferred to Cydalima Lederer, 1863; since perspectalis is the type-species of Neoglyphodes Streltsov, 2008, this genus name can be synonymised with Cydalima (Mally & Nuss, 2010).

The moth is native to subtropical regions of eastern Asia (India, China, Korea, Japan and the Russian Far East) (Inoue et al., 1982; Leraut, 2012). In Europe, after its first record it spread quickly to many other countries, including United Kingdom, the Netherlands, Denmark, Liechtenstein, France, Belgium, Switzerland, Austria, Italy, Croatia, Romania, Hungary, Slovenia, Slovakia and Turkey (Koren & Črne, 2012; Pastoralis et al., 2013) (for details see Table 1).

Cydalima perspectalis larvae feed on the leaves of different species of Buxus, seriously damaging these ornamental plants in private and public gardens as well as in semi-natural box-tree forests. In addition to the leaves, the larvae can attack the tree-bark, causing the trees to dry out and die. Due to its economic importance in East Asia, this species has been well investigated biologically and ecologically, resulting in its chemical and biological control by nematodes and its pheromones (Zhao et al., 2005; Mally & Nuss, 2010). However, little was known about it in Europe before its arrival, because most of its research was published in Asian languages (EPPO, 2012).

This work provides an update of the Box Tree Moth C. perspectalis distribution in Italy with new records from Tuscany and the first record from Sicily.

IDENTIFICATION OF CYDALIMA PERSPECTALIS

In adults, the most common colour form has white, slightly iridescent wings with a large dark brown band at the outer margin and a characteristic white spot on the forewing, in the discoidal cell (Fig. 1). Hindwings are white with the same band at the outer margin as in the forewings (Mally & Nuss, 2010). In a less common colour variant, the adults are completely brown, but still show a white forewing spot. The moths have a wingspan of around 4

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cm, they are good flyers and can reach a lifespan of up to two weeks.

Eggs are laid on the leaves of the host plant in groups of 5-20, coated with a translucent jelly (LEUTHARDT & BAUR, 2013). When first laid, the eggs are pale yellow, but close to hatching, the black heads of the larvae are visible. The light green larvae are characterized by black stripes with white dots and hairs and a shiny black head; in the last larval stage they can reach a length of up to 4 cm (CABI, 2013).

The pupae are between 1.5 and 2.0 cm long. Initially green with dark stripes on the dorsal surface, towards the end of pupation they turn brown with a dark pattern corresponding to the brown wing borders of the adult. They are concealed in a cocoon of white silk spun among the leaves and twigs (KORYCINSKA & EYRE, 2009).

HOST PLANT

The host plants of *Cydalima perspectalis* are *Buxus* spp.: *B. sempervirens* L., *B. microphylla* Siebold & Zucc., *B. sinica* (Rehder & E. H. Wils.) M. Cheng and *B. colchica* Pojark (Buxaceae). In its origin countries, it has also been reported on *Euonymus japonicus* Thunb., *E. alata* (Thunb.) Siebold (Celastraceae), *Ilex purpurea* Hassk. (Aquifoliaceae), *Pachysandra terminalis* Siebold & Zucc. and *Murraya paniculata* (L.) Jack (Rutaceae) where larvae feed on leaves and are considered serious defoliators (KORYCINSKA & EYRE, 2009; WANG, 2008); there are no current reports of these plant species being attacked in Europe (CABI, 2013).

The genus *Buxus* encompasses about 100 species, distributed in two major centers of diversity (Caribbean-
DISTRIBUTION IN ITALY

In Italy, *Cydalima perspectalis* was first officially reported in the Lombardia region in Como province, in 2011 (Griffio et al., 2012; Tantardini et al., 2012). Very probably, the moth arrived there through Switzerland and is now spreading across the northern part of the region (Lecco and Varese provinces) (APFV, 2012).

Records of this species had already been available for the Veneto region (Padova and Vicenza provinces) since 2010 on national observers’ websites (FEI, 2012a; Strazzabosco, 2013). In 2012, it was also found in Friuli Venezia Giulia (Pordenone province) (Governatori, 2013), in Emilia Romagna (Reggio Emilia and Ravenna provinces) (FEI, 2012b; Uhl & Wulfling, 2013), Tuscany (Pistoia province) (CESPEVI, 2012; Vanarelli et al., 2013) and in Marche (Pesaro Urbino province) (FEI, 2013) (Fig. II).

NEW FINDING SITES

Larvae of *Cydalima perspectalis* were observed on plants of *Buxus sempervirens* ‘Rotundifolia’ in two Eastern Sicily locations: Aci Castello, m 44 a.s.l. (37°32‘44”N; 15°08‘10”E) and Catania, m 33 a.s.l. (37°32‘17”N; 15°07‘12”E), in Catania province. They were registered in nurseries from the beginning of April to the first week of May 2013. Larvae infested the young shoots of plants with damage on leaves and death of parts of the attacked plants.

Mature larvae and coconut were brought to the laboratory to the Department of Agri-food and Environmental Systems Management, University of Catania, for subsequent observation: 19 adults were obtained, respectively 11 females and 8 males. Only one specimen presented the completely brown colour variant.

The attacked Sicilian plants were imported from another nursery in (Pistoia) Tuscany which broadens the moth distribution for this region.

CONCLUSIVE REMARKS

*Buxus* is an economically important ornamental plant grown in nurseries, public gardens, historical parks and private gardens. Data available on the trade of *Buxus* plants provided by the Netherlands, Germany and Italy, show large increases in its importation in recent years, mainly from China (EPPO, 2012).

The newly established *Cydalima perspectalis* in Europe could represent a serious problem for landscaping and nursery production. It has been shown that the moth feeds on all of the most frequently planted box-tree species and varieties in Central Europe, suggesting that its dispersal across Europe is not limited by food resources (Leuthardt & Baur, 2013). A climate model of the potential distribution of *C. perspectalis* in Europe suggests that the species will likely continue its spread across Europe, except for Northern Fenno-Scandinavia and high mountain regions (Nacambio et al., 2013).

The species frequently impacts on the quality of ornamental plants and leads to economic losses. Moreover, it seems to have a potentially important ecological impact: it caused significant damage to large areas (> 100 ha) of naturally growing box tree forests in Switzerland during one single summer (Leuthardt & Ramin, 2011) and could threaten wild *Buxus* in Europe. In Italy, *B. sempervirens* is already suffering from fragmented distribution and population size reduction (Di Domenico et al., 2011) and could be more prone to pest attacks.

The rapid colonization of European countries by the invasive moth is giving rise to a strong need to study its biology, ecology and population dynamics with a view to
better understanding its potential distribution and possible impact on both ornamental and natural box tree populations to assess effective management.

Recently, laboratory experiments have indicated the susceptibility of *C. perspectalis* larvae to baculovirus *Anagrapha falcifera* nucleopolyhedrovirus (AnfaNPV) as a new opportunity to control this pest (Rose et al., 2013).

However, the new finding in Sicily on infested plants imported from a region where the insect was already present, not only confirms once again that the ornamental pathway is the most important for alien arthropods in Europe (Rabitusch, 2010), but also emphasizes the need for controls and inspections of traded goods as a preventive management method.

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THE BOX TREE MOTH CYDALIMA PERSPECTALIS (WALKER, 1859) CONTINUES TO SPREAD IN SOUTHERN EUROPE.


