The colonisation of the Great Spotted Woodpecker (*Picoides major* L.) in Eucalypt woods and Popular Cultivations in Sicily[1]

La colonisation des plantations d'eucalyptus et de peupliers en Sicile par le pic épeiche (Picoides major *L.)*

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Summary

Thank to the forestry activity, in the last half of the century the wood surface in Sicily has increased. The species planted were Mediterranean pine and Eucalyptus spp., *the latter were used because considered more adapted to marginal soils. In comparison with some natural formations,* Eucalyptus *plantations appear quite poor either from floristic and faunistic point of view. Nevertheless, in the last years, some Australian species of insects, linked to* Eucalyptus, *colonised the European continent, contributing to increase the biodiversity of Eucalypt afforestations. The recent diffusion of the Great Spotted Woodpecker (*Picoides major *L.) in these woods is part of this process, which involved also other types of wood plantations, like poplar cultivation. In the Eucalypt afforestations, the Great Spotted Woodpecker exploits* Eucalyptus, *both extracting from them larvae of the Cerambycidae beetle* Phoracantha semipunctata *and drinking the sap oozing out through holes made along the trunk. This bird species is actually spreading in* Pinus, Eucalytpus *and* Populus *woods close to natural and semi-natural formations, as well as in isolated woods, using almond and olive orchards as biocorridors.*

Key-words

Eucalyptus, Populus, Picoides major, Phoracantha semipunctata, Sicily

Résumé

*Du fait d'une importante activité de reboisement durant la dernière moitié du siècle passé, la superficie des forêts en Sicile a considérablement augmenté. Les espèces utilisées pour le reboisement ont surtout été des pins méditerranéens et différentes espèces d'eucalyptus ; ces dernières ayant souvent été préférées car considérées comme mieux adaptées à des conditions de sol difficiles. Comparées aux formations forestières naturelles, les plantations d'eucalyptus sont généralement plus pauvres tant d'un point de vue floristique que faunistique. Néanmoins, quelques espèces d'insectes australiens inféodés aux eucalyptus ont également colonisé le continent européen, contribuant ainsi à l'augmentation de la biodiversité de ces boisements. La colonisation récente de ces boisements d'eucalyptus ainsi que des plantations de peupliers par le pic épeiche (*Picoides major *L.) fait partie du même processus. Les facteurs qui ont favorisé cette colonisation du pic sont d'une part, la présence du coléoptère cérambycide* Phoracantha semipunctata, *dont les larves vivant dans les troncs des eucalyptus sont particulièrement recherchées par le Pic et, d'autre part, la consommation de la sève d'eucalyptus qui suinte au travers des trous creusés par l'oiseau le long du tronc. Cette espèce est actuellement en expansion dans les boisements de* Pinus, Eucalyptus *et* Populus, *à proximité de formations naturelles ainsi qu'au niveau de bosquets isolés où les vergers d'amandiers et d'oliviers servent de corridors biologiques.*

Mots-clés

Eucalyptus, Populus, Picoides major, Phoracantha semipunctata, Sicile

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Riassunto

Nell'ultima metà del secolo scorso, la superficie forestale in Sicilia ha avuto un discreto incremento determinato dall'opera di rimboschimento. Le specie utilizzate sono state soprattutto pini mediterranei ed eucalitti. Questi ultimi sono stati utilizzati per la presunta elevata produttività e della effettiva capacità di adattamento alle situazioni pedologiche più difficili. I nuovi boschi di eucalitto hanno mostrato tutti i loro limiti in termini ecologici, non consentendo un'elevata diversità floro-faunistica. In questi ultimi anni, grazie anche alla colonizzazione da parte di specie di insetti proprie dell'eucalitto, è in atto un processo di naturalizzazione, che precorre una probabile diversificazione dell'habitat. La diffusione del Picchio rosso maggiore negli eucalitteti si inserisce in questo processo; esso è stato osservato anche in altri tipi di rimboschimenti, come i pioppeti, la cui finalità è del tutto differente. Negli eucalitteti, il Picchio si nutre delle larve della Phoracantha semipunctata *e della linfa ottenuta effettuando numerosi fori nel tronco di alcune piante. La specie si è diffusa in boschi di pini ed eucalitti, contigui a formazioni naturali e seminaturali ma anche in boschi isolati dimostrando una capacità dispersiva inattesa. Le osservazioni hanno accertato il ruolo di corridoi ecologici svolto dagli arboreti come mandorleti ed oliveti nel consentire questa espansione.*

Photos 1 and 1bis. During the winter some Eucalyptus camaldulensis *show a series of regularly spaced holes from which the Great Spotted Woodpecker obtain the sugary sap.*

Photo 2. Holes made by woodpeckers on a telephone pole, probably with the aim to excavate a nesting hole.

INTRODUCTION

One of the main causes of the massive use of *Eucalyptus* species in the past decades has been the total absence of specific pests interfering significantly with the production processes. Nevertheless, in the last years, as international woody exotic species trade became more and more intense, the increasing import of entire trees and vegetative propagules enhanced the dispersal opportunities for a high number of insects linked to *Eucalyptus* species in their original country. As matter of the fact, the australian beetle *Phoracantha semipunctata* Fabricius became almost cosmopolite. In Europe it was recorded firstly in Sardinia (Tassi 1969; Piras *et al.*, 1970) where, according to Cavalcaselle and Contini (1973) about 100,000 trees were already attacked in 1971; in the following years it was also reported from Sicily (Romano & Carapezza, 1975) and Central-South Italy (Parenzan, 1976; Longo *et al.*, 1993; Rastelli *et al.*, 2001).

Additionally, due to hazelnut economical crisis (Clerici & Asciuto, 1991), many poplars took the place of hazel orchards, or, in some pedologically favourable territories, previously uncultivated, a productive poplar cultivation started. Actually the surface of poplar in this area is about 300 ha.

Generally, Eucalypt plantations are very poor in bird species, but in the last ten years in Sicily they were colonised by the Great Spotted Woodpecker (*Picoides major* L.). Aims of this research were to ascertain the actual diffusion of this species into Sicilian Eucalypt and poplar plantations and its behavioural relationships with these trees.

MATERIALS AND METHODS

Between 1995 and 2001 all *Eucalyptus* woods of Sicily were visited to record: a) the possible presence of the Australian xylophagous *Phoracantha semipunctata* by its typical emerging holes or the presence of adults or larvae under the bark; b) the possible presence of the Great Spotted Woodpecker (*Picoides major* L.) by its calls, its typical druming (mechanical sound made by resonance of dead branches under rapid blows from bill) or other evidences of its activity on tree bark. Abundance of some woodpecker populations was estimated by the IKA method (Ferry & Frochot, 1958), which gives linear values of abundance referred to a measure unit (number of individuals per km). Holes were inspected to ascertain if used by woodpeckers to nest, drum or feed. Some data on its feeding habits were obtained through observations in the field with the aid of a 10 x 40 binocular.

In the years 1999-2000 in five eucalypt forests seven sample areas (0.5 ha) were established, where the diameter of all trees (n = 1119) was measured by a calliper, and evidences of the woodpecker presence (nests, druming and feeding holes) were recorded.

The main features of the studied *Eucalyptus* plantations are reported in table 1. Mustigarufi is the largest one, with three species of *Eucalyptus* (*E. camaldulensis, E. occidentalis* and *E. globulus*) mixed at patch. The plots have been selected within two homogeneous areas but the observations were carried out in the entire wood. Reina, Torretta and Cannatello woods are homogeneous and similar according to species, surface and age on the contrary Spagnolo wood shows some differences in species utilisation and plant size.

Additionally, in the years 1999-2000, in the poplar cultivation of Piazza Armerina (Enna) some observations were carried out to ascertain which clones are preferred by woodpeckers for feeding and nesting; three sample areas 40 x 40 m were established to gather some biometrical parameters and to evaluate the percentage of trees (n = 206) exploited by woodpeckers.

RESULTS AND DISCUSSION

Spreading of the Great Spotted Woodpecker in eucalypt wood: toward a new association woodpecker-eucalypt?

Woodpeckers are a bird group clearly defined and homogeneous, highly specialized for the arboreal life, widespread all over the world, with the exception of Australia, New Zealand and Madagascar. The Great Spotted Woodpecker (*Picoides major*) constitutes a superspecies with *P. leucopterus*, *P. assimilis*, *P. himalayensis* and *P. syriacus* and is well diffused in the Palearctic Region, in woodland, plantations and some urban parks (Del Hoyo *et al.*, 2002). In Sicily it was known as uncommon and local resident breeder (Iapichino & Massa, 1989), living in all the naturally wooded areas. Lo Valvo *et al.* (1993) recorded it on 19.9 % of UTM 10 x 10 km sicilian squares; more recently, presumably from nearby natural woods, it colonized some woods, including *Eucalyptus* woods, poplar afforestations and riparian woods, with an

Wood, Municipality (Province)	Area (in ha)	Plants/ha	Occurrence (%) of different species in the sample area	Mean Ø (± s.d.) in cm	Plants with holes made by woodpeckers for drinking sap				Plants with holes for nests		
					n/ha	%	Mean Ø (± s.d.) in cm	% of *Eucalyptus* species with woodpecker holes	nests/ha	Mean Ø	% of *Eucalyptus* species with woodpecker holes
Mustigarufi, San Cataldo (CL)	3,252	289	100 *E. camaldulensis*	24.3 ± 5.5	11	3.8	19.3 ± 4.3	100 *E. camaldulensis**	2	29.2	100 *E.camaldulensis**
Reina, Mussomeli (CL)	210	350	95 *E. camaldulensis* 5 *E. occidentalis*	16.4 ± 4.4	13	3.7	15.6 ± 3.5	100 *E. camaldulensis*	3	24.7	100 *E.camaldulensis*
Torretta, Mussomeli (CL)	76	750	95 *E. camaldulensis* 5 *E. occidentalis*	15.8 ± 4.4	10	1.5	17.0 ± 2.4	100 *E. camaldulensis*	2	28.6	100 *E.camaldulensis*
Cannatello, Mussomeli (CL)	137	500	95 *E. camaldulensis* 5 *E. occidentalis*	16.5 ± 4.7 17.0 ± 4.2	8	1.6	16.0 ± 2.2	100 *E. camaldulensis* 25 *E.occidentalis*	2	22.0 32.0	75 *E.camaldulensis*
Spagnolo, Milena (CL)	226	350	56 *E. occidentalis* 44 *E. camaldulensis*	11.1 ± 4.88 10.8 ± 4.2	10	2.9	10.3 ± 2.3	100 *E. camaldulensis*	2	11.0 12.0	75 *E. camaldulensis* 25 *E. occidentalis*

* Outside sample areas some specimens of *E. occidentalis* with presence signs of woodpeckers were observed.

Table 1. Some parameters of Sicilian Eucalyptus *woods where woodpecker activity was observed and characteristics of plants where woodpeckers carried out their activity.*

amount of variation of another 6.4%, totally covering 26.3% of UTM squares (fig. 1 and 2).

This was unexpected, particularly because *Eucalyptus* afforestations are generally considered very poor in fauna and flora (La Mantia & Pasta, 2001); additionally, as reported by some authors (e.g. Hinsley *et al.*, 1995), this woodpecker is usually lacking in small woods, like most Sicilian afforestations.

Censuses of woodpeckers carried out in Sicilian natural woods let us to obtain densities remarkably higher than in afforestations, particularly of *Eucalyptus*. In oakwoods and beechwoods we found as much as 3-5 individuals/10 km, while in *Eucalyptus* afforestations only 0.5-1 individuals/10 km; the difference was significant (Wilcoxon test: $Z_8=1.94$, $P=0.05$). During the winter we found many small holes (mean width 1.5 cm, depth 0,5 cm) on scattered trees; the result of its activity is a very high number of rings of holes around the trunk trees. Following its behaviour, we assumed that the food source was the sap and that the woodpecker used to exploit many times the same tree for this reason.

Many species of woodpeckers, Great Spotted Woodpecker included, cover the bark of living trees with series of regularly spaced holes from which they obtain the sugary sap (Del Hoyo *et al.*, 2002). Typically, the holes, known as "sap wells", are arranged in horizontal rows, which, together with those made in previous years, can extend over rather distinctly large parts of a tree.

Tree sap may be the key resource for survival in arid habitats.

This behaviour indicates that the sap was not randomly searched for, but the same tree was exploited for a long time. Previously, other authors highlighted the importance of sap as food of *P. major* (cf. Cramp, 1985 and references therein); the rings of holes are made by woodpeckers to drink sap oozing out or, possibly, also to eat exposed cambium of tree. Similar situation were observed an individual tree of *Ulmus glabra*, showing over 400 holes for sap extraction, thus certainly used for many years (Gatter, 1972).

As regards the size of trees concerned by woodpecker activity it is variable. Woodpeckers seem to prefer trees characterized by a small trunk diameter (table 1 and fig. 3). The mean diameter of trees where woodpeckers excavated nesting holes resulted a bit larger, and dependent again on the mean size of trees (table 1 and fig. 3), but the scarce number of trees did not allowed a statistic test.

Xylophagous larvae of *P. semipunctata* are also an important prey in winter. In *Eucalyptus* afforestations insects are scarce and uncommon, and larvae of *P. semi-*

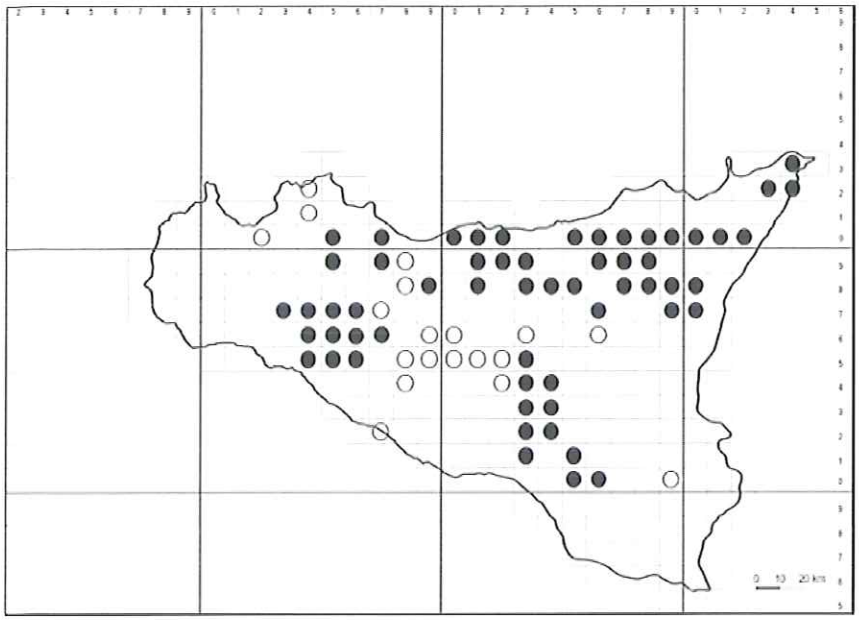

*Fig. 1. Map of distribution of the Great Spotted Woodpecker (*Picoides major *L.) in Sicily. In black the 10 x 10 km UTM squares where the woodpecker was present in 1979-93 (after Lo Valvo* et al., *1993), in white newly colonised areas.*

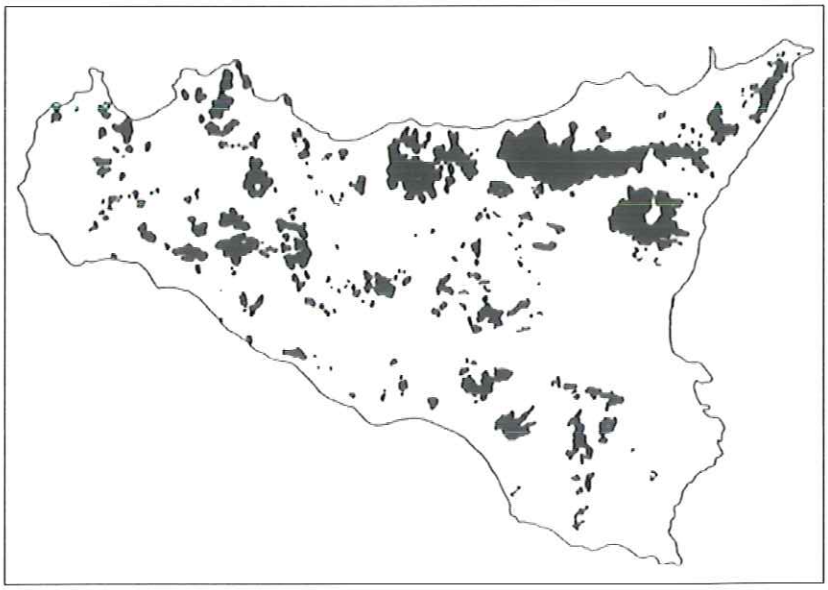

Fig. 2. Map of Sicilian wood in Sicily (after Lo Valvo et al., *1993).*

punctata may provide an important part of the woodpecker's diet (as reported by Mendel *et al.* (1984) for *P. syriacus* in Israel). We observed woodpeckers capturing insects living under bark in dead trees and in dead wood in the ground during the winter, and insects living on the surface of trees and on foliage in spring and summer. There are also consistent data reporting seeds, bird eggs and chicks as food of this woodpecker (Cuisin & Pesson, 1980; Cramp, 1985). Also Amat and Soriguer (1983) and Zenatello (1995) report as food of *P. major* in spring both xylophagous insects and other species collected on the leaves (particularly on the lower surface). Different authors have stressed the importance of xylophagous larvae in the diet of this woodpecker, mostly in winter. Woodpeckers are efficient predators of overwintering moth larvae, frequently reducing the pest population in orchards to a level where other natural control agents were able to prevent the succeeding generation from damaging the fruit to an uneconomical degree (Mac Lellan, 1959).

Adult and larvae of bark beetles form 67-99 % of the winter diet of woodpeckers in infected areas, and their activity results in 45-98 % decrease in beetle survival (Crockett & Hanoley, 1978). Woodpeckers have been recognized for many years as a major factor in the natural reduction of Engelmann spruce beetle populations (Knight, 1958). *P. major* is considered an important pre-

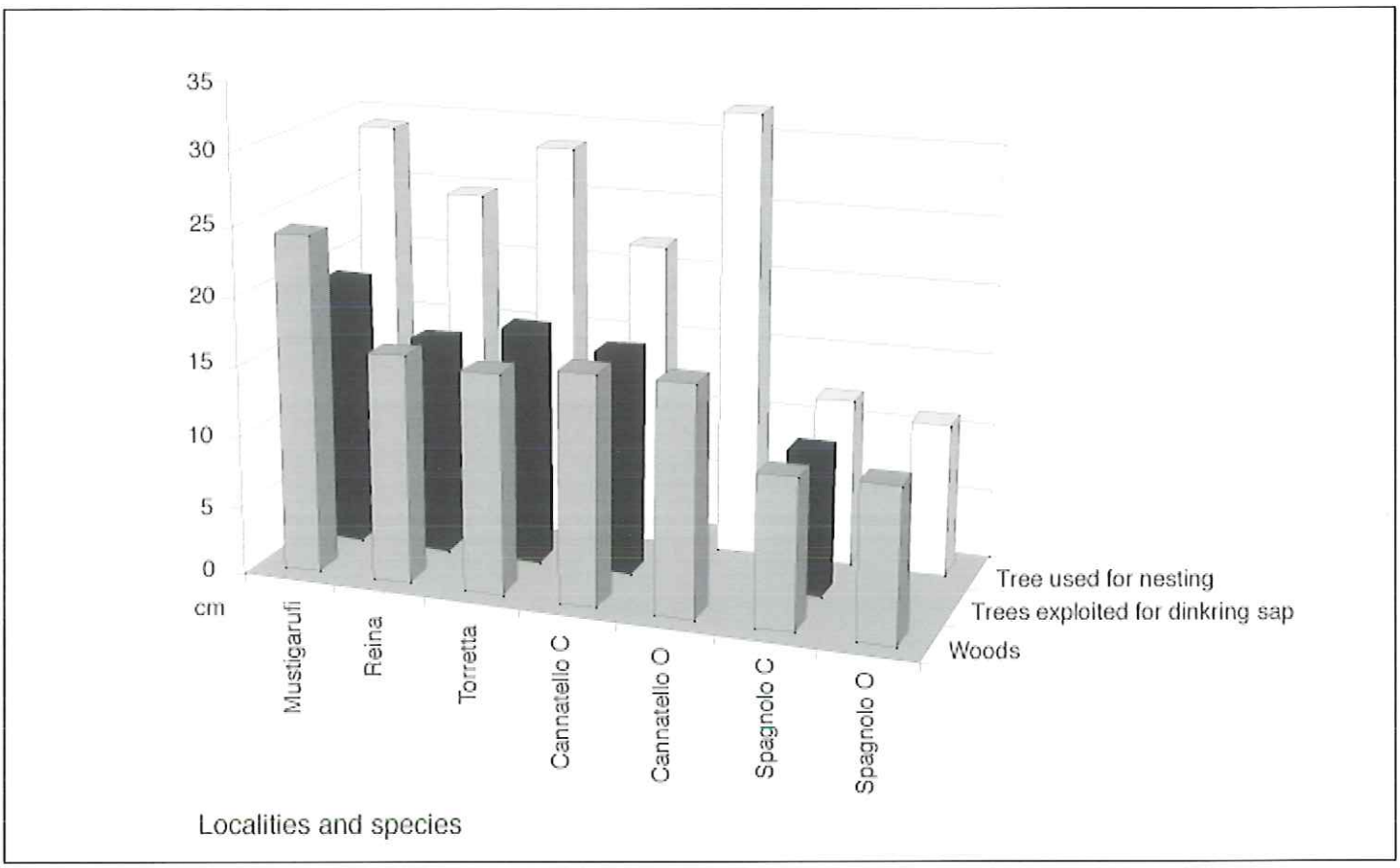

Fig. 3. Mean diameter of trees in different Eucalypt woods (c = Eucalyptus camaldulensis*; o* = Eucalyptus occidentalis*) and mean diameter of trees used by woodpeckers for nesting and for drinking sap.*

dator of overwintering larvae of *Scolytus intricatus*, being responsible of capturing up to 62.6 % of them (Pavlik, 1999). Related species are also considered important predators of xylophagous insects. Mendel *et al.* (1984) observed that hole density of *P. syriacus* on *Eucalyptus* increase during the spring and summer, and that the average larval mortality of *P. semipunctata* due to predation of this woodpecker may reach as much as 29 %. They consider *P. syriacus* an efficient natural enemy of *P. semipunctata*, destroying larvae and consuming the eggs on standing trees.

We dissected some trees bearing a high number of rings of holes (testifying the woodpecker activity for drinking sap), without finding any evidence of the presence of xylophagous insects. Conversely, only removing the bark of trees with wide and irregular woodpecker holes, we found the typical galleries of *P. semipunctata*. Thus, we may assume that woodpeckers excavate on the plant regular and horizontal small holes to drink sap. As a matter of fact, only from parts of trees bearing wide and irregular woodpecker holes, preserved in laboratory, adults of *P. semipunctata* emerged.

As regards eucalypt species, when woodpecker is searching for sap, it prefers *Eucalyptus camaldulensis* and *E. globulus*, probably because these species have a gum type deciduous bark (Moggi, 1964); species, with persistent bark, like *E. occidentalis* which present Stringybark type (Moggi, 1964), are not interested by woodpecker drinking activity. Conversely, the woodpecker activity for extracting larvae of *P. semipunctata* is independent from the eucalypt species and the bark type.

During our research, we found rings of holes made by woodpeckers also on some Aleppo Pine (*Pinus halepensis*), Cypress (*Cupressus sempervirens*) and Elm (*Ulmus minor*) and, exceptionally, also on a telephone pole, probably with the aim to excavate the nesting hole. Several

Clones	plants/ha %	plants/ha n	Mean diameter (cm)	Height (m)	Plants bearing woodpecker feeding holes	Nesting or resting holes: Plants with holes (%)	Nesting or resting holes: Mean N. of holes per plant	Nesting or resting holes: Height range of holes (m)
I 614	12	50	41	30.0	25*	63**	3.5	5-7
Armerino	88	381	24	25.7	–	–	–	–

* feeding holes and nesting or resting holes were found in different plants
** % is referred to the total number of plants of the clone

Table 2. Characteristics of poplar cultivations and woodpecker activity at Piazza Armerina (Enna).

authors have reported damages caused by woodpeckers. Evers (1982) noticed in Germany and Norway some cases of Norway Spruce power line poles (preserved with carbolineum), exploited as sites for the excavation of nesting holes by *P. major*, while Moran (1977) reported cases of attack to polyethylene irrigation pipes in Israel orchards by *P. syriacus*. According to Allegro (1993), the benefits of *P. major* (which feeds on a wide range of insect pests) outweigh any damage to the tree bark and stems which may be caused. As regards eucalypt woods, probably trees injured by woodpecker activity are more easily submitted to pathogen and *P. semipunctata* attacks, but certainly the woodpecker results to be an important natural enemy of the xylophagous insect. Indeed, we found many trees killed by the attacks of *P. semipunctata*, while we did not find dead trees, bearing typical rings of holes caused by woodpecker searching for sap.

In the wood of Mustigarufi we observed the highest activity of the woodpecker against larvae of *P. semipunctata* in plots where trees, according to Fierotti *et al.* (1995), grow under very unfavourable conditions. Evidence of its activity was the presence of irregular holes spread on the bark. On the contrary, in plots where trees grow under quite favourable conditions, we mostly observed the typical woodpecker activity for extracting sap, testified by the presence of small regular rings of holes.

Concerning sampled eucalypt woods, they (with the exception of Mustigarufi) are small sized and well isolated from other woods. It seems that *P. major* has colonised these woods through areas with scattered trees, like almond orchards, that it exploits in autumn-winter for feeding reasons (A. Cairone, pers. comm.) and suggests the important role of small woods and biocorridors. At local scale, some studies (La Mantia 1997; Massa & La Mantia, 1997) have already highlighted the key-role played in Sicily by biocorridors and hedgerows-windbreaks in conserving and increasing species richness.

Colonisation of the poplar cultivation of Piazza Armerina by the Great Spotted Woodpecker

Recently, the Great Spotted Woodpecker has colonised the poplar cultivations of Piazza Armerina, in central Sicily (fig. 2). This area has been cultivated with a mosaic distribution of *Eucalyptus*, poplar, *Pinus pinea*, and riparial vegetation which increased the diversity. Nowadays, at Piazza Armerina the following poplar clones are cultivated (Garfì & La Mantia, unpublished data): 1) 'Armerino', now naturalised, which is a hybrid of uncertain origin between *Populus nigra* and euroamerican hybrids introduced to Piazza Armerina. Despite its lower productivity in comparison with other clones, it shows a higher fitness to the environment and very good technological characteristics to produce matches that are the main local product; 2) 'I 214', an euroamerican clone very diffused in the modern poplar cultivation for its high productivity, at Piazza Armerina it has been decreasing because its wood is not suitable for matches production; 3) 'Luisa Avanzo', also introduced for its high productivity, but, for the same reasons of 'I 214', has become rare.

As a consequence of the availability of newly afforested territories (both of eucalypts and poplars), the Great Spotted Woodpecker has recently colonised the above cited poplar plantations, showing evident preferences for some clones. In particular, in poplar stands with mixed clones, it does not excavate holes in trees of 'Armerino', while it does in 'Luisa Avanzo' and 'I 214' clones, both for feeding and nesting. Our observations (table 2) let us to conclude that the presence of few trees of 'I 214' or 'Luisa Avanzo' (preferred by woodpeckers) possibly consents to protect them from xylophagous attacks, without be detrimental to technological characteristics of 'Armerino' trees. Some farmers report negative effects of woodpeckers on poplars, but scattered 'I 214' and 'Luisa

Avanzo' clones may play the same role of dead trees and natural woods bordering poplar cultivations of North Italy (Allegro, 1991). Concerning the positive role of this woodpecker within poplar stands, Camerini & Quadrelli (1991) report the interesting observation of its active predation on *Ostrinia nubilalis* living within stems of corn that area cultivated at the edge of a young poplar, where it regularly preyed the xylophagous *Cossus cossus*, *Saperda carcharias* and *Paranthrene tabaniformis* (cf. also Allegro 1991, 1993). In winter, in riparian forests of poplar this woodpecker may destroy about 10-50% of larvae of *Saperda carcharias* by pecking them out of their galleries (Srot, 1983; Allegro, 1991 and 1996). According to Quadrelli (1984), in poplars of North Italy it removes about 20% of larvae of *Cossus cossus*, showing a higher foraging activity in trees with diameter between 40-50 and 80-90 cm.

Conclusions

The recent diffusion of the Great Spotted Woodpecker suggests the important role of small woods and biocorridors. Their function has been recognised at an international level and led to the realisation of the "*European Ecological Network*" (EECONET) (Benett, 1991, 1994).

The results of this work, focusing on the role of great spotted woodpecker and *Phoracantha semipunctata,* show an increase of ecological interactions within these artificial woods. For this reasons several researches are now involved in the identification of the best approach to increase their naturalisation process (La Mantia *et al.*, 2000). In particular, the adoption of more adequate selvicultural techniques should enhance the diffusion of many autochthonous trees and berry-producing shrubs. The so-called "re-naturalisation actions" (La Mantia & Pasta, 2001) could be applied in different ways, depending on the wood-type; besides, they should allow an increase and a maintainance of species-richness (Ciancio, 2000). Thus, it is necessary to fit wood implantation and management techniques to the new role that wood itself plays in the western countries.

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