Population analysis of the insectivorous Sardinian warbler (*Sylvia melanocephala*) in chlorpyrifos treated citrus orchards in Spain

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INTRODUCTION & OBJECTIVES

The Sardinian warbler (*Sylvia melanocephala*) is the smallest predominantly insectivorous bird species inhabiting conventionally treated Spanish citrus orchards where chlorpyrifos is regularly applied. Although the species favours dense shrub, garrigue or maquis it is also commonly found in anthropogenic habitats. Sardinian warblers generally produce two broods per season (Cody & Walter 1976; Shirihai et al. 2001); in our study area from mid-April to end-July .

In order to investigate the importance of commercial citrus orchards during Sardinian warbler's reproduction period, their seasonal occurrence, site fidelity, breeding performance and age structure was analysed. The breeding season coincides with the application of chlorpyrifos in citrus orchards. The species feeds on arthropods from the vegetation and ground (Shirihai et al. 2001) and is very small, which makes it a conservative model species for evaluating potential effect of chlorpyrifos on the local bird community. Chlorpyrifos is applied every year to the almost entire area of commercial citrus in Spain for the control of the red scale (a major insect pest which damages fruit and trees).

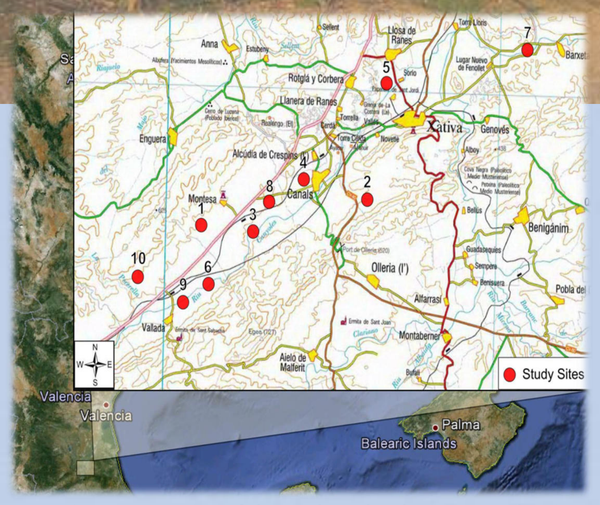

Figure 1: Location of the study orchards near to Valencia

MATERIAL & METHODS

Figure 2: Mist nets for trapping in a study orchard

Repeated trapping by means of standardized mist-netting (Fig.2) and systematic nest search was conducted in ten citrus orchards near Valencia (Fig.1) from April to August in 2011. The orchards ranged in size from 3.5 to 8.3 ha.

An integrated assessment of reproductive performance was achieved by combining counts of adults, nests and juvenile birds.

The study was performed on sites used for earlier studies; one was aimed at assessing potential acute and short term effects on Sardinian warbler (2007), the other one to assess and mark (ring) the population (2010).

Although Sardinian warblers occur regularly in citrus orchards, they do not often nest in citrus itself; on adjacent areas nests are difficult to locate (Fig.5). Therefore adult female birds were supplied with radio-tags (Fig.3) and tracked until the nest was found.

Furthermore the birds were observed systematically to obtain information on their behaviour within the study sites.

The faeces of 23 trapped Sardinian warblers were analysed for ingested food items from mid of May to June in 2007.

Figure 3: Radio-tagged female for nest search

Figure 4: Male Sadinian warbler feeding on ants close to the study orchard

Figure 5: Four-day old chicks, nest located in a citrus tree within the study orchard

Figure 6: Sardinian warblers occacionally feed on fallen fruit

RESULTS AND DISCUSSION

Results of trapping for Sardinian warbler over the study period

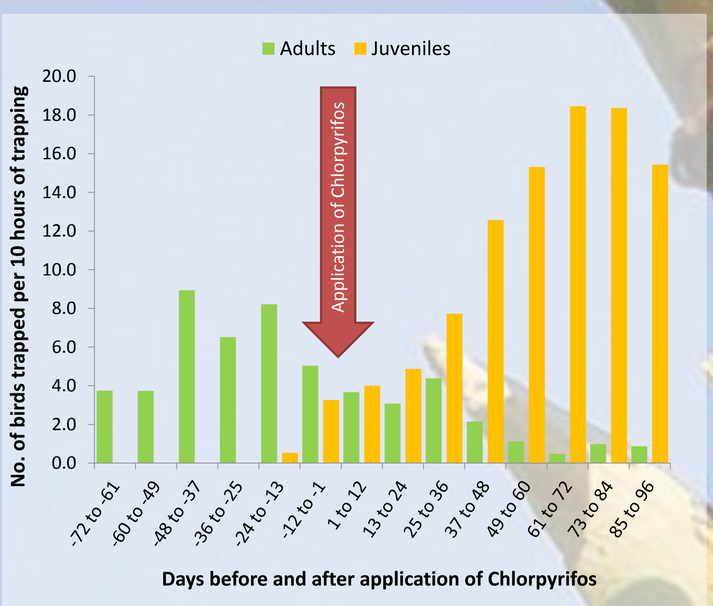

Figure 7: Number of Sardinian warblers trapped during April to August 2011
Application of chlorpyrifos was in May /June, i.e. during breeding

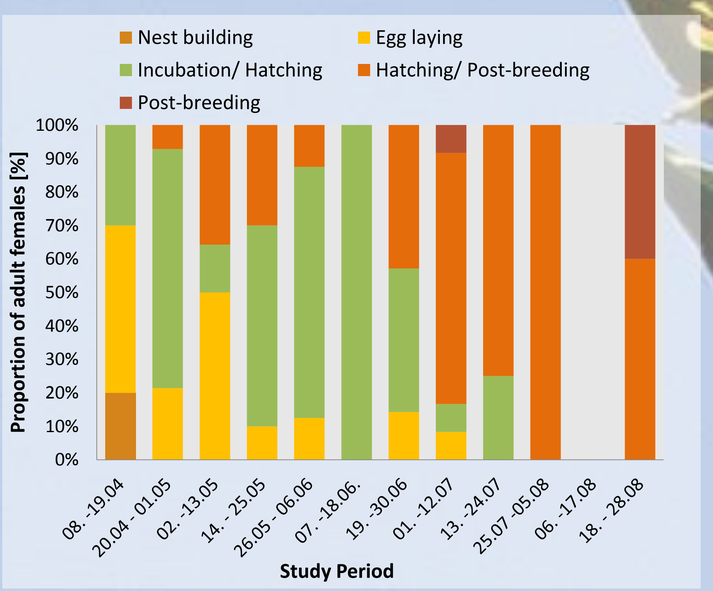

Figure 8: Development of the brood patch of female Sardinian warbler over the trapping period

Chlorpyrifos-treated citrus orchards are widely used by both adults and juvenile Sardinian warblers

Sardinian warblers were present within the study orchard during the entire study period. In total 712 individuals were trapped, of which 154 individuals (21.6%) were captured on at least two different days. Furthermore data gathered during a study in the same citrus orchards in 2010 was related to the 2011 results. 309 Sardinian warblers had been ringed in 2010 and 34 of these birds were recaptured in 2011. Taking into account that the previous study in 2010 had been started later, covering only the last part of the breeding season (July-August) when mainly dispersing juveniles are trapped, these results show that the study sites were widely used by this species in both years.

The number of trapped birds and age structure changed during the study period. Adult birds were captured mainly initially but catches declined continuously , whereas catches of juvenile birds increased towards the end of the study (Fig.7). This pattern follows the general breeding phenology of warblers, i.e. mobility behaviour of adult birds decline after breeding whereas juvenile birds start to disperse. Faeces sample analyses showed that invertebrates and plant material e.g. berries were used at similar rates. As berries are found mainly outside the orchards and ripen later in the season this may also have contributed to the reduction in catches of adult birds over the study period (Fig.5 &6).

With the inspection of the brood patch, the reproductive status of trapped females can be monitored

Control of brood patches for incubation of eggs showed that actively reproducing birds were found in all study sites. From the status of the brood patch it was possible to deduce that most breeding Sardinian warblers were laying at the beginning of the study period. Towards the end of the study, the ratio of birds with the stages of hatching/post-breeding and post-breeding increased strongly (Fig.8).

Scrubland Mediterranean habitats generally make only little bird food available (Pons, 1998), therefore the use of citrus orchards might provide an extra food supply in the most demanding phase of their annual cycle and possibly increase the fitness of individuals.

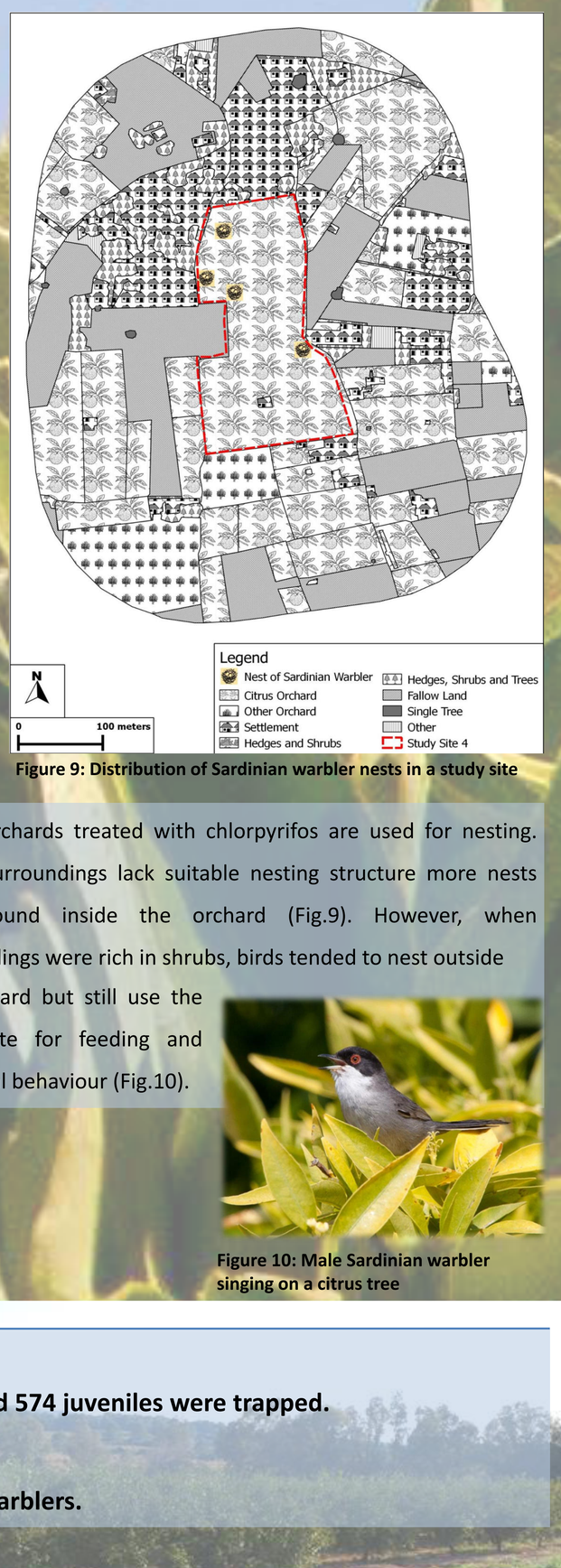

Figure 9: Distribution of Sardinian warbler nests in a study site

Citrus orchards treated with chlorpyrifos are used for nesting. When surroundings lack suitable nesting structure more nests were found inside the orchard (Fig.9). However, when surroundings were rich in shrubs, birds tended to nest outside the orchard but still use the study site for feeding and territorial behaviour (Fig.10).

Figure 10: Male Sardinian warbler singing on a citrus tree

CONCLUSIONS

Sardinian warblers are common residents in citrus orchards treated with chlorpyrifos during the breeding season. In the ten study sites 138 adults and 574 juveniles were trapped.

The high proportion of juvenile birds trapped shows that the local populations are able to successfully reproduce in chlorpyrifos-treated orchards.

The results gives evidence that chlorpyrifos-treated citrus orchards offer habitat conditions which are obviously appropriate for breeding Sardinian warblers.

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