

Characterization of a *Maculinea alcon* population in the Alvão Natural Park (Portugal) by a mark-recapture method

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Abstract

The blue alcon, *Maculinea alcon* located at the Alvão Natural Park was studied by mark-recapture methods in order to estimate population size and flight range of the butterflies. Sampling was made between 2007 and 2009. The results showed that maculinea population size has increased along the studied period with an estimated density at the peak of the flight period of 190 butterflies in 2007, 392 in 2008 and 1653 in 2009. The number of captured males was higher at the beginning of the flight period while females increase gradually over the flight period. The average value of the sex ratio was 0.9 in 2007, 1.4 in 2008 and 1.2 in 2009. The flight range of the butterflies did not show significant differences between sexes and an average value of about 12 m were recorded. Thus the results indicate that this population is in expansion and not threatened by extinction.

Keywords: *Maculinea alcon* L, population estimate, mark-recapture method

1. Introduction

As a result of their extraordinary life cycle, *Maculinea* butterflies are typical representatives of the most threatened species in Europe (Wynhoff 1998; Mungira and Martin 1999; Van Swaay and Warren 1999). Like most other Lepidoptera species, *Maculinea alcon* lays the eggs on a selected host plant, the *Gentiana pneumonanthe*. However, caterpillars do not complete development on the plant. Instead they are voluntarily carried by *Myrmica* ants to their nests. Once in the nest, caterpillars are fed by the ants until complete larval development (Thomas 1995). Thus, protecting the butterfly is protecting the whole complex systems because, both the host plant and the ant nests are essential for the successful development of *Maculinea alcon*. In Portugal, the Alvão Natural Park is the only known place where is it possible to see *Maculinea alcon* flying. In the past, several populations of the blue alcon were reported by local people but with the habitat fragmentation and abandonment of extensive management many of those populations disappeared. However, there still exist some small populations that need to be studied. Therefore, the population density, the probability of survival and the dispersal ability are important study population features that can lead to programmes of conservation. In this study we examined population size, sex ratio and movements that characterize a *Maculinea alcon* population located at the Alvão Natural Park, which is a part of a Site of Community Importance (SCI) for the Mediterranean biogeographical region, listed in 2006 by the European Commission.

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2. Methodology

The method of repeated marking-release-recapture was used during June, July and August between 2007 and 2009 in order to estimate the parameters characterizing the maculinea population. This method consists in the capture of as many individuals as possible. Each captured adult was sexed and marked with a number on the underside of the right hind wing, using a black permanent pen. Immediately after that, the butterfly was released at the same point of capture. After three days, sampling was repeated and the basic parameters of population dynamics were estimated on the basis of the rate marked vs unmarked *M. alcon* captured. Number of sampling days varied along the studied years. Jolly-Seber method was used to estimate population size and survival probability on those years. In 2009, at each point of capture and recapture, GPS coordinates were recorded and used to calculate the flight range of the butterflies.

3. Results

In 2007, the capture took place between 11 to 31 July and a total of 265 butterflies were marked, 154 males and 111 females. Of the marked butterflies, 70 (26.4%) were recaptured only once and 8 (3.0%) were recaptured twice during the sampling period. The recapture rate was 29.4%. In 2008, a total of 263 were marked between 14 July and 7 August, 141 males and 122 females. Only 17 of the total marked butterflies were recaptured (6.5%). In 2009, 566 butterflies were marked between 13 July and 10 August with 318 males and 248 females. Of the marked butterflies, 43 (7.6%) butterflies were recaptured only once and 2 butterflies were recaptured twice. Sex ratio was calculated for each sampling day (see Figure 1). Results showed differences in the way males and females behave during the study years. The total number of captured males was higher than females during the studied years. However, the sex ratio varied across the sampling days. Although in 2007 the sex ratio was always higher than 1, favourable to males, the rate of females increased gradually which could be registered on the last two years with an inversion of the sex ratio at the middle of the flight period with more females after 24 July. The result of the population size indicates that *Maculinea alcon* population has gradually increased along the study period (see Figure 2). In 2009, at the peak of the flight period, the estimated number of the butterflies was four times higher than in 2008 and even higher than in 2007. The flight range of the butterflies measured by using capture and recapture GPS coordinates (see Figure 3) showed that from the 43 recaptured butterflies in 2009 only 14 moved more than 0,05m (5 males and 9 females). On average, distances of about 11.7 ± 3.2 m were recorded with maximum values of about 80 m with no significant differences between males and females flight range ($F=0.13$; $gl=43$; $Sig=0.911$).

4. Discussion

Results showed differences in population characteristics across the studied years. Although the beginning of the flight period were almost the same (second week of July), the end differed between years with a shorter flight period in 2007. This could be due to weather conditions which was very rainy in the beginning of August 2007. Also, differences were obtained for sex ratio and behaviour characteristics of males and females. In the last two years, the rate of females increased gradually and the approximately 1:1 sex ratio was observed in the last third of the flight period. This is important in the balance of the population because at the beginning of the flight period the host plant used by females to lay the eggs is not flowering yet and that can compromise the success of larvae development. Identical results were obtained by Árnýas *et al* (2005) in a *Maculinea rebeli* population in Hungary. The mobility results of the butterflies indicate that their dispersal ability is very low. According to Thomas (1991) this could be a serious problem for their survival in the modern European landscape. The ability of dispersion

is very important in the successional habitats that this species inhabits (Johnson 2000). When the habitat becomes unsuitable it is necessary migration movements and available suitable sites within very short distances are desirable

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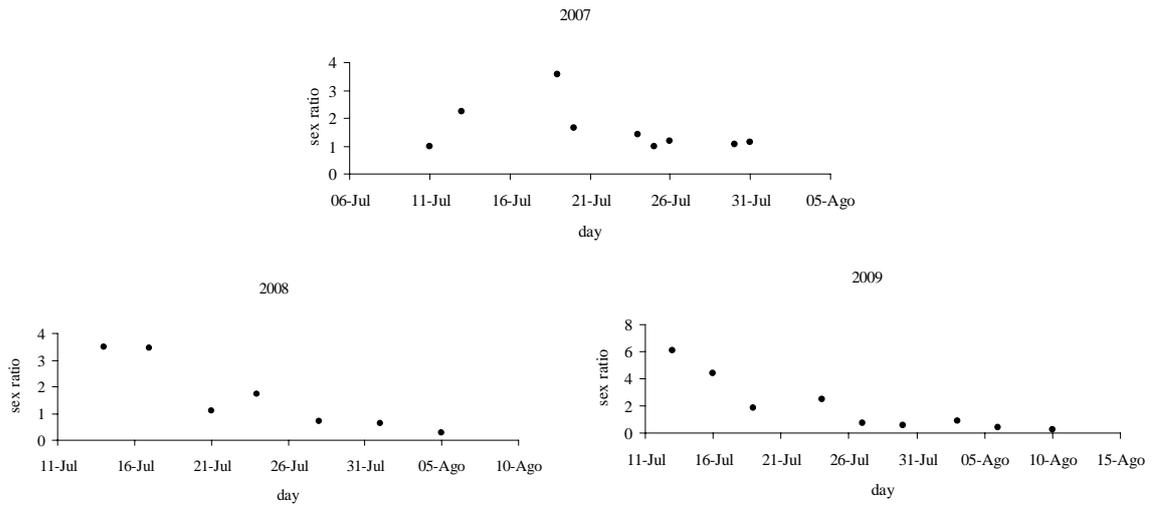


Figure 1: Sex ratio for each sampling day in 2007, 2008 and 2009

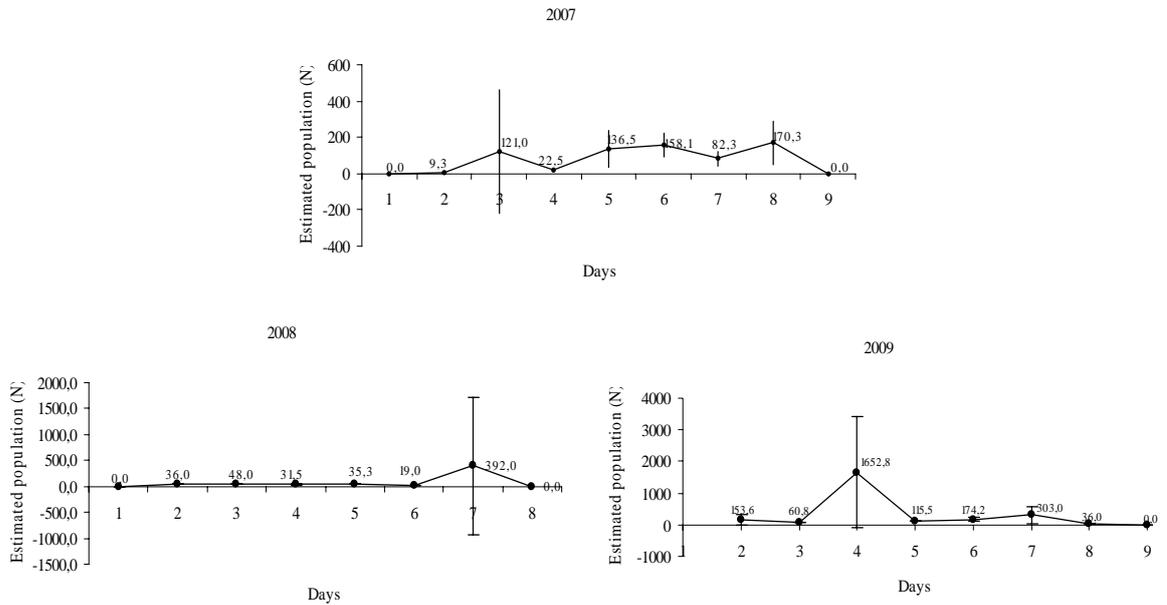


Figure 2: Estimates of the number of individuals and standard error of estimation in 2007, 2008 and 2009 by the Jolly-Seber method.

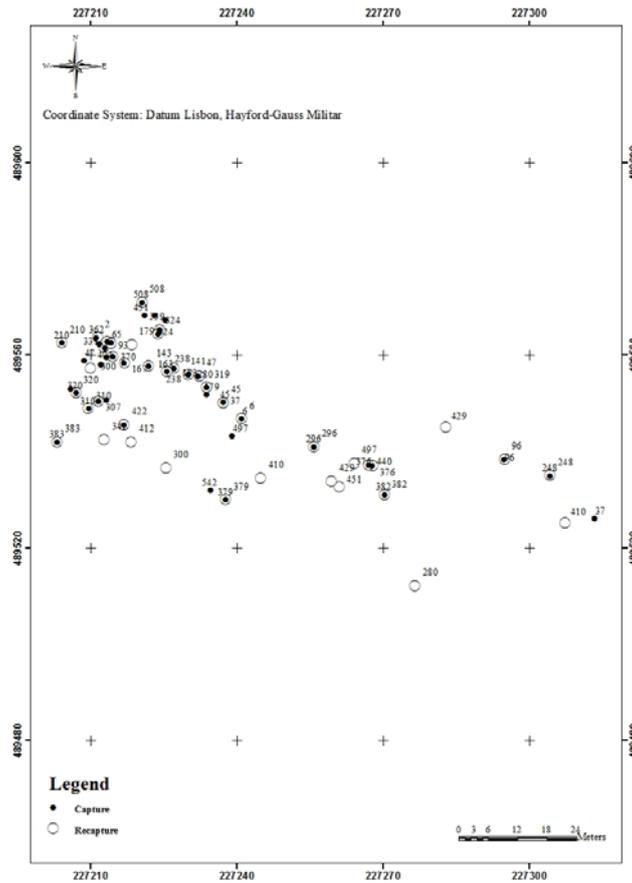


Figure 3: Capture and recapture coordinates used to calculate dispersal ability of *Maculinea alcon* butterflies.