1. Introduction

Migratory birds, when choosing and maintaining a route, do not make use of only one orientational cue, but instead rely upon various reference systems organised in a hierarchical order (Able, 1980; Wiltshire et al., 1980; Wiltshire & Wiltshire, 1985). However, it seems improbable that the young migrant initially has the entire set of orientational cues at its disposition (Emlen, 1969; Wiltshire et al., 1980; Wiltshire & Wiltshire, 1975). Such a complex integration of several reference systems certainly necessitates a process of biological maturation, or learning, during the first migratory cycle, as has been demonstrated by Perdeck's pioneer work (1958) on starlings. Moreover, in long-distance migrants the hierarchy of orientational cues should be particularly plastic, thereby enabling ecological adaptation to the distance and speed of migration (Wiltshire & Wiltshire, 1975). Hence we can expect differences in orientational behaviour between adults and yearlings at their first migration, in response to a variety of stimuli that either represent directional cues, or factors that can influence these cues.

In order to identify the existence of these supposed differences in behaviour, orientation by adult and young sedge warblers, in Emlen funnel cages, has here been compared. The aforementioned species is particularly suitable for this type of experiment since it is possible, during postnuptial migration, to distinguish the adults from the young birds.
according to their different moult strategies (Ginn & Melville, 1983; Svensson, 1984). Furthermore, adult and yearling birds exhibit temporally separate waves of migration through the study area, situated in an easterly part of the Po Valley; the autumn passage of the adults pre-dates the passage of yearlings. Consequently, reliable data can be obtained for adult and young birds separately. Young and adult sedge warblers were exposed, in the funnel cages, to different sources of light stimuli; i.e., natural (such as the glow of sunset, the sunrise, the moonlight) or artificial (such as the horizon glow present in the study area). The results of these tests are here reported.

2. Materials and methods

2.1. The species.

The sedge warbler Acrocephalus schoenobaenus (L., 1758) is a common, palearctic, long-distance migrant, which seems to migrate exclusively by night. It breeds as far as 70° North, from Atlantic Europe and the Magreb to about 75° East, while its winter quarters are exclusively in central tropical Africa and South Africa (Williamson, 1976; Vaurie, 1959; Moreau, 1972).

According to ringing recoveries (Koskimies & Saurola, 1985; Zink, 1973), birds crossing Italy belong to northeastern Scandinavian populations; specific orientational tests (Bezzi & Baldaccini, 1988) demonstrate that they cross the study area on a southerly course in the autumn.

2.2. Experiments with funnel cages.

The experiments took place between 25th August and 23rd October 1986, and between 31st July and 12th September 1987 in an eastern area of the Po Valley, Northern Italy (Valli di Argenta e Marmorta: 44°36'22"N, 13°5'16"E).

The birds were captured with mist-nets in a reed bed adjacent to the area where funnels had been set up in the open. Each bird was used for the experiments for only one night and then freed according to the following schedule: if the warbler had enough stored fat on capture, then it was kept in a small plastic cage with food and water throughout the remainder of the day, with denied view of the outside; at sunset, as soon as the sun’s disc was below the horizon, the bird was transferred to the funnel, where it was left for one hour, and its behaviour tested. For the rest of the night the bird was kept in a cloth bag, and then put back into the funnel the next morning, one hour before sunrise. As in the evening, the morning test lasted for one hour. All experiments took place in a clear night sky. Nevertheless, during a number of tests some haze was present, low on the horizon, masking the light coming from a town located North-East of the experimental site. The experiments in which the moon was present and visible from the inside of the funnel were considered separately (see 3.3 Moon experiments).

During these tests the moon age ranged between 7 and 16 days in 1986 and between 5 and 15 days in 1987; the moon position was always registered within South-East, South and South-West sectors of the sky. During the experiments, a total of 61 adult birds and 151 young birds were used, in four different experimental situations.

For orientation tests, an Emlen funnel cage was used in its classic shape (Emlen & Emlen, 1966). The funnel was made of plastic and its measurements were those initially indicated by Emlen, and later by Beck & Wiltschko (1982). In order to block out the surrounding features, an opaque cylindrical screen, 8 cm high, was placed on the funnel.