Animal Navigation and Maps

For hundreds of years people have been puzzled about the mechanism behind the extraordinary homing abilities of the domesticated pigeon (*Columba livia domestica*). Many studies have been conducted into finding a possible explanation, such as the famous clock shift experiment of Neuss and Wallraff (2004) which used pigeons subjected to artificial day / night conditions to alter their circadian rhythm in order to prove that 'home orientation' is largely light dependant and that the 'sun compass' is an important tool in avian navigation.

Our experiment involves the use of circular statistics in order to determine whether a significant number of individuals 'vanish' in a homeward bearing out of a sample consisting of ten birds released 25km south of their lofts.

Hypothesis: a statistically significant number of individuals will vanish with a heading comparable to the homeward component

In order to collect the data, 10 pigeons were released at an average rate of one $520s^{-1}$. The individuals were observed with binoculars until out of sight, at which point a compass bearing was recorded. The results are displayed in Figure 1.

From the data, the Mean Vector (φ) was calculated as 12º (see Appendix). The Rayleigh Test to establish the degree of randomness of the sample returned a value of 0.205 suggesting that the sample was significantly non-random. By using the homeward value v (0.380172), u was calculated and found to be greater than its table derived counterpart thereby proving that the null hypothesis can be rejected.

Discussion

From Figure 1. and the subsequent statistical analysis we can see that the proposed hypothesis is validated. The mean vector (φ) is roughly consistent with the home direction and the influence of the prevailing wind. However, the mean is skewed by the arguably anomalous results S33027, S33031 and R06245; these individuals flew in a direction opposite to their home, why this is we do not know. We do know that pigeons have a tendency to gain height and explore their surroundings in a circling path upon release. The recalcitrant individuals may have headed south to take

advantage of the downward gradient to gain height. Another possible explanation could be that the pigeons may have been last released from a location north of their home and headed in a familiar bearing until they orientated (c.f. Perdeck 1958), this could be easily tested by releasing from varying test sites around the compass.

As is true for most experiments, the efficacy of the results may be greatly improved by increasing the sample size in order to lessen the impact of the anomalous results upon the mean vector.

The ultimate aim of experiments of this type is to determine how exactly organisms with homing abilities orientate themselves from known and even unknown release sites. Several theories exist such as the Sun Compass Theory and Magnetoreceptor Theory.

With the constant refinement of experimental techniques and advances in equipment, such as the use of satellite tracking, combined with increasing knowledge the puzzle may well be solved in the near future.