Title: Migration, Orientation and Navigation: Magnetic Compasses in Insects

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Interpretive Summary: The use of magnetic information for orientation and navigation is a widespread phenomenon in animals. In contrast to navigational systems in vertebrates, our understanding of the mechanisms underlying the insect magnetic perception and use of the information is at an early stage. Some insects use magnetic information for simple body alignment or homing. There is also some evidence that insects might use the Earth’s magnetic field to orient during long-distance migrations. In most cases where known, insects use a polarity compass, orienting by the North-South axis of the Earth’s magnetic field. However recent studies have also pointed to a role for magnetic inclination in insect orientation. Also, magnetic information is coupled with other navigation compasses or cues, such as the sun or landmarks. The use of traditional insect models will be critical to increasing our knowledge of the proximal mechanisms. Nevertheless, the study of new species is necessary for the solution of specific questions regarding perception, processing and use of magnetic information in insects. In this article, our current knowledge on the use of magnetic information for orientation and navigation in insects is broadly reviewed from the nature of the magnetic compass to the diversity of its uses. Important directions for future research are also discussed.

Technical Abstract: The use of magnetic information for orientation and navigation is a widespread phenomenon in animals. In contrast to navigational systems in vertebrates, our understanding of the mechanisms underlying the insect magnetic perception and use of the information is at an early stage. Some insects use magnetic information for simple body alignment or homing. There is also some evidence that insects might use the Earth’s magnetic field to orient during long-distance migrations. In most cases where known, insects use a polarity compass, orienting by the North-South axis of the Earth’s magnetic field. However recent studies have also pointed to a role for magnetic inclination in insect orientation. Also, magnetic information is coupled with other navigation compasses or cues, such as the sun or landmarks. The use of traditional insect models will be critical to increasing our knowledge of the proximal mechanisms. Nevertheless, the study of new species is necessary for the solution of specific questions regarding perception, processing and use of magnetic information in insects. In this article, our current knowledge on the use of magnetic information for orientation and navigation in insects is broadly reviewed from the nature of the magnetic compass to the diversity of its uses. Important directions for future research are also discussed.
Magnetic Field Orientation Model Directional Significance Migratory Direction Simple Pattern. These keywords were added by machine and not by the authors. This process is experimental and the keywords may be updated as the learning algorithm improves. Bellrose, F.C.: Possible steps in the evolutionary development of bird navigation. In: Animal orientation and navigation, NASA SP-626 (S.R. Galler et al., eds.), pp. 223–258. Washington D.C.: U.S. Gov. Print. Insect migration is the seasonal movement of insects, particularly those by species of dragonflies, beetles, butterflies and moths. The distance can vary with species and in most cases these movements involve large numbers of individuals. In some cases the individuals that migrate in one direction may not return and the next generation may instead migrate in the opposite direction. This is a significant difference from bird migration.