



ScienceWatch – Homing in on How Pigeons Navigate

“We have recorded for the first time the brain waves of a free flying navigating animal.” – A. Vyssotski

Since the Egyptians first took advantage of the innate homing ability of pigeons 3,000 years ago, we have been intrigued by their ability to fly hundreds of kilometers (km) and find their way back to their home roost from a place they never have seen before.

The homing pigeon (*Columba livia*), a domesticated form of the rock pigeon, has been an important tool in human communication. The founder of Reuters News used a fleet of pigeons to deliver stock prices. Pigeons told the Romans of the conquest of Gaul. News of the battle of Waterloo was first delivered to England by pigeons. During World War I a pigeon was even given the *Croix de Guerre*, awarded for heroism during combat, for delivering important messages despite having been wounded.

Pigeon navigation appears to rely on several signals at different times; sighting the sun, detecting the smell of the home loft and sensing the earth’s magnetic field all play a role when flying over unfamiliar countryside (see – *The Sixth Sense of Homing Pigeons*, ScienceWatch, September 2007 or at www.HRAS.org). Visual cues such as highways and railroad tracks appear to predominate when birds fly over familiar landmarks.

While scientists agree that this “map and compass” strategy allows pigeons to perform their remarkable navigational feats, it has been impossible to determine what visual cues a bird perceives during flight, and so the nature of the mental map has remained controversial. Now a study of pigeon brain waves during flight reveals exactly what pigeons pay attention to in order to help them navigate.

Writing in the July 28, 2009 issue of *Current Biology*, physiologist and animal behaviorist Alexei Vyssotski and colleagues at the University of Zurich in Switzerland found that pigeons’ brains show distinctive activity as they fly over familiar sites. Such characteristic brain waves indicate that pigeons identify landmarks and therefore develop a local map during homing.

The researchers used a device, the “Neurologger 2”, which consists of a GPS tracker and an electroencephalograph to track the birds' route while also recording brain activity during flight. The team outfitted 26 birds with this instrument, which weighs just two grams (0.07oz), and let them loose over the Mediterranean Sea, 18 km (11.2 miles) from the Italian coast and 30 km (18.6 miles) from their home loft.



Vyssotski *et al.* were able to identify a particular band of brain waves (middle frequency) that diminished as the pigeons flew over the featureless surface of the water, but showed up as the birds neared the coastline and flew over familiar landmarks. Birds flying in flocks produced fewer brain waves than single birds, indicating they paid less attention to where they were and relied more on their fellows for guidance. Birds were also released 5 km (3.1 miles) from the home loft over land, where they had to fly over two familiar landmarks (highways) to reach home. Middle frequency brain waves again peaked as the birds passed over the highways.

However, the team also saw peaks in brain activity when they did not expect them. These peaks occurred at two points close to home as the birds flew over a featureless rural area. Something had caught the birds' attention, and when the team visited the spots, they found feral pigeon colonies at both locations. Clearly the birds had more in mind than just the flight path.

Bird brains, even those of pigeons, are more complicated than we may think.

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