# No place like home: New theory for how salmon, sea turtles find their birthplace

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How marine animals find their way back to their birthplace to reproduce after migrating across thousands of miles of open ocean has mystified scientists for more than a century. But marine biologists at the University of North Carolina at Chapel Hill think they might finally have unraveled the secret.

At the beginning of their lives, salmon and sea turtles may read the magnetic field of their home area and "imprint" on it, according to a new theory in the latest issue of the journal *Proceedings of the National Academy of Sciences*.

The Earth's magnetic field varies predictably across the globe, with every oceanic region having a slightly different magnetic signature. By noting the unique "magnetic address" of their birthplace and remembering it, animals may be able to distinguish this location from all others when they are fully grown and ready to return years later, researchers propose.

Previous studies have shown that young salmon and sea turtles can detect the Earth's magnetic field and use it to sense direction during their first migration away from their birthplace to the far-flung regions where they spend the initial years of their lives.

The new study seeks to explain the more difficult navigational task accomplished by adult animals that return to reproduce in the same area where they themselves began life, a process scientists refer to as natal

homing.

"What we are proposing is that natal homing can be explained in terms of animals learning the unique magnetic signature of their home area early in life and then retaining that information," said Kenneth Lohmann, Ph.D., professor of biology in the UNC College of Arts and Sciences and the first author of the study. "We hope that the paper will inspire discussion among scientists and eventually lead to a way of testing the idea."

The theory builds on previous studies with sea turtles by Lohmann and his team. In 2001, they showed that baby turtles use magnetic information to help guide them during their first migration across the Atlantic Ocean. And in 2004 they discovered that sea turtles several years of age possess a more sophisticated "magnetic map" sense that helps them navigate to specific areas rich in food.

Sea turtles and salmon are among nature's most impressive ocean travelers but, no matter how long or far they journey, both seem to remember where home is. Some populations of sea turtles, for example, cross entire oceans and are absent from their home beach for more than a decade before returning to reproduce. Salmon hatch in rivers, then migrate hundreds of miles out into the ocean before returning to their home river several years later to spawn.

Just why marine animals migrate such vast distances to return to their own birthplace, sometimes bypassing other suitable locations along the way, is not known. Scientists speculate that natal homing evolved because individuals that returned to their home areas to reproduce left more offspring than those that tried to reproduce elsewhere.

"For animals that require highly specific environmental conditions to reproduce, assessing the suitability of an unfamiliar area can be difficult

and risky," Lohmann said. "In effect, these animals seem to have hit on a strategy that if a natal site was good enough for them, then it will be good enough for their offspring."

The study notes that the Earth's magnetic field changes slightly over time and thus probably only helps animals arrive in the general region of their birthplace. Once an animal is close to the target, other senses, such as vision or smell, may be used to pinpoint specific reproductive sites. Salmon, for example, are known to use smell to locate spawning grounds once they have drawn near.

Lohmann said one problem making it difficult to test the new theory is the low survival rate of sea turtles. Only one out of about 4,000 baby sea turtles survives to adulthood and returns to its natal site to breed. A similarly small percentage of baby fish survive.

Lohmann also notes that if the theory is correct, it could lead to new ways of helping save sea turtles and salmon. "Ideally, it might be possible to steer turtles to protected areas where we would like them to nest," Lohmann said, noting the animals' endangered status. "It might also be possible to use magnetic imprinting to help re-establish salmon populations in rivers where the original population has been wiped out."

Source: University of North Carolina at Chapel Hill