Biology

John Travis reports from Boston at a meeting of the Bioelectromagnetics Society

Internal compass guides sea turtles

When loggerhead sea turtles emerge from their shells on the beaches of Florida's east coast, the tiny hatchlings dive into the surf and swim quickly eastward toward the Gulf Stream to avoid coastal predators. Funneled into the North Atlantic gyre, a clockwise circular current, they remain at sea for years as they mature. When finally ready to nest, adult turtles leave the gyre and swim home to the same Florida beaches where they hatched.

Light from the sun and stars, water temperature, and chemical odors may all help to guide these reptiles. In addition, an internal magnetic compass provides a crucial directional aid, says Kenneth J. Lohmann of the University of North Carolina at Chapel Hill. For a number of years, he and Catherine M. F. Lohmann have studied how that compass helps loggerheads navigate by Earth's magnetic field.

The two take just-hatched sea turtles and fit them into Lycra harnesses. They then place the animals in a tub of water and attach the harnesses by means of a leash to an arm at the center of the container. Since the arm can rotate, the turtles are free to swim in any direction. A system of magnetic coils surrounds the tank, enabling the researchers to change the magnetic field the turtles encounter.

In early work, the Lohmanns found that the loggerheads probably use their internal compass to find the Gulf Stream. If initially exposed to light from the east, as they might be on their home beaches, the turtles in the tank swam toward magnetic east, even in darkness. But by flipping the magnetic field 180°, the Lohmanns tricked the turtles into swimming west. The first light the turtles see appears to determine their initial direction. If that light comes from the west, they'll swim toward magnetic west.

More recently, the Lohmanns have found that a sea turtle may use its compass to discern its latitude and thus stay safely within the gyre. At the northern boundary of the gyre, a current forks off and sometimes sweeps turtles farther north, into the fatally cold water off the coast of England.

At that point in the gyre, the terrestrial magnetic field inclines at an angle of 60° relative to the surface. Turtles exposed in the Lohmanns' tank to a magnetic field with that inclination swam south-southwest, a reaction that would help them avoid the northern fork.

The Lohmanns are still monitoring how turtles react to other inclination angles they would encounter in the gyre. The researchers plan to study the importance of the magnetic field's intensity, which also varies with latitude.

Fishing out magnetoreception's secrets

Turtles are not the only animals that can read magnetic fields. Fish, birds, and bees can too, and researchers are struggling to work out the details of this unusual sense they call magnetoreception.

The rainbow trout, for instance, has a nerve that can be triggered by the application of a magnetic field, says Carol Diebel of the University of Auckland in New Zealand. In addition, she and her colleagues have discovered that an area above the trout's nose contains iron-rich particles. "What we needed to do was link up the two items," says Diebel, who believes the particles are crystals of magnetite, an iron mineral found in other animals that sense magnetic fields.

Diebel's group injected a blue dye into the nerve around its midpoint. In time, the dye diffused to the origin of the nerve in the brain and to its other end, a region near the trout's nose suspiciously close to where the researchers had found the crystals. In future dye experiments, she and her colleagues hope to isolate the magnetite-containing cells that sense magnetic fields and presumably transfer the information to the nerve.

Biomedicine

Lisa Seachrist reports from Snowbird, Utah, at a meeting of the International Genetic Epidemiology Society

Reproductive history and *BRCA1*

Women who carry the recently identified mutant *BRCA1* gene face an 85 percent chance of developing breast or ovarian cancer sometime during their lives. As alarming as those odds sound, a new study adds to the misery: German researchers have found that early onset of menstruation and postponed first childbirth could spur the disease to strike earlier in a woman's life.

Jenny Chang-Claude and her colleagues at the German Cancer Research Center in Heidelberg collected information on 43 families in which at least two members developed breast or ovarian cancer before age 60. Using DNA analysis, the team identified 59 women from 10 families who carried the flawed *BRCA1* gene. Forty-two of these women had already developed breast cancer—by their early twenties, in some cases.

The researchers then combed the women's reproductive histories for factors suspected of increasing the risk of breast cancer among the general population. "These women are at very high risk of getting breast cancer," says Chang-Claude. "We wanted to know if factors other than genetics could determine the age of onset of the disease."

Among women with a mutant *BRCA1,* those who began to menstruate before age 14 developed breast cancer earlier than those who first menstruated after 14. Women who had their first child before the age of 25 got the disease later than those who delayed childbirth. Abortion history had no effect, but women born after 1940 developed breast cancer earlier than those born before 1940.

Chang-Claude stresses that this study is so small that she cannot tell the true importance of these factors for age of onset of breast cancer in women with a flawed *BRCA1.* But she points out that "reproductive factors could play a role in delaying the onset of disease for these women."

Smoking and colon cancer

Studies designed to find out whether smoking increases the incidence of colon cancer have yielded equivocal results, at best. Now, using the knowledge that mutations in the *p53* gene result in almost 50 percent of all colon cancers, researchers may have untangled smoking's role in certain types of these cancers.

Mutations in *p53* cause cells to produce copious amounts of the flawed protein for which the gene codes. Moreover, this protein can't perform its normal functions. Andrew Freedman and his colleagues at the Roswell Park Cancer Institute in Buffalo, N.Y., collected tissue samples and smoking information from 163 people with colorectal cancer. The researchers then used antibodies against the mutant protein to identify which tumors resulted from mutations in *p53.* The 326 healthy people who served as controls provided information about their smoking.

When the researchers compared the smoking habits of all colon cancer patients to those of the controls, they found a very small increase in the rate of colon cancer among smokers. But dividing the cancer patients into groups with and without mutations in *p53* led to significantly different results.

For the 50 percent of patients with mutated *p53,* smoking played no role in the incidence of colon cancer. But smoking greatly increased the rate of colon cancer in those with a normal *p53* gene, with the heaviest smokers suffering the most. Overall, smokers who lack the *p53* mutation are twice as likely to get colon cancers as nonsmokers.

"Now we have a model of the relationship between smoking and colon cancer," says Freedman. "Traditional studies simply looked at all colorectal cancer. By separating *p53* mutations from the other colorectal cancers, we are looking at two different pathways that cause cancer."