You're being followed: Scientists track movement of living things

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Almost 24 centuries after the Greek philosopher Aristotle wrote his book, "On the Movement of Animals," modern scientists are still struggling to understand how, why, when and where living creatures move.

Whether an organism drifts in the sea, swims, wriggles, crawls, walks, runs, jumps, flies or casts its seeds upon the wind, movement is essential to life, they say. No matter how big or little it is, it's got to get away from its birthplace to find food, escape predators and reproduce.

"From microbes to trees to elephants ... the movement of individual organisms is one of the most fundamental features of life on Earth," Ran Nathan, an ecologist at Hebrew University of Jerusalem, wrote in the *Proceedings of the National Academy of Sciences*. "The rich variety of movement modes among microorganisms, plants and animals has fascinated mankind since time immemorial."

Nathan is combining work in biology, ecology, environmental science, physics and mathematics into a theory of Movement Ecology to help study how and why living things move from place to place in order to survive and thrive. He edited a 76-page special section on the topic in the Dec. 9, 2008, Proceedings of the National Academy of Sciences.

Even the movements of humans present unsolved puzzles. Scientists still can't explain exactly how the brain processes signals from the eyes and ears to control the motions of the arms and legs.

Movement studies aren't just theoretical. Researchers map the spread of viruses and diseases. They track invasive weeds, crop-destroying insects and other pests. They watch threatened species try to adapt to human depredations and climate change.

For example, Martin Wikelski, an evolutionary biologist at Princeton University, studied enormous swarms of locusts -- as many as 100 billion insects weighing a total of 200,000 tons -- that ravage parts of Africa, Asia and the Middle East.

"These large-scale movements of insects have enormous implications for human welfare, including catastrophic losses of crops, the spread of diseases to people and livestock, and provisioning of essential ecosystem services such as crop pollination," Wikelski observed in the journal Science. "These spectacular and ubiquitous movements remain mysterious."

Movement research is accelerating. Nearly 26,000 scientific papers on the subject have been published in the last 10 years, said Marcel Holyoak, an environmental scientist at the University of California, Davis.

New technologies such Global Positioning Satellites, as well as tiny radio transmitters that can be attached to crabs, birds and butterflies, are providing an unprecedented ability to observe their movements.

For example, Wikelski used Krazy Glue to fasten tiny radio transmitters to the bodies of dragonflies to track them as they migrated up and down the East Coast. Jason Chapman, an ecologist at Rothamsted Research, an agricultural research park in Hertfordshire, England, used radar to track moths, locusts and other flying insects.

"The ability to map movements has increased dramatically over the last

few years," Christian Rutz, an Oxford University zoologist, wrote in the Biology Letters of the British Royal Society. "These novel, fast-tracking GPS technologies are opening up exciting possibilities to track marine animals for extended time periods."

Barbara Block, a marine scientist at Stanford University in California, uses global positioning satellite tags to track large ocean predators in the Pacific. She reported for the first time last week that at least five great white sharks recently passed under the Golden Gate Bridge and into San Francisco Bay. Diane Cowan, an expert at the Lobster Conservancy in Friendship, Maine, put sonar tags on lobsters to observe their travels under the North Atlantic.

"Even in the past year, things that were not possible a year ago have become possible," Nathan said. "We have very good transmitters and new devices that enable us to track movement more precisely."

Joseph Wright, a forest ecologist at the Smithsonian Tropical Research Institute in Panama, studied the various ways that trees use the wind to scatter their seeds in different seasonal conditions.

George Wittemyer, an environmental scientist at the University of California, Berkeley, plotted the travels of African elephants in dry weather and wet, and in protected and unprotected areas.

Movement is essential even for one-celled organisms such as viruses and bacteria that invade healthy cells. Microbes "gain nutrients by moving, avoid inbreeding and benefit from being in an environment with less competition," Holyoak explained.

The movements of our human ancestors are also a subject of vigorous study and dispute.

Anthropologists still don't know for sure when our species, Homo sapiens, left Africa, or what route they took through the Middle East and Asia to Europe, Siberia, Alaska, North America and eventually down to the tip of South America.

"It's a topic of lively debate," said Paul Mellars, an archaeologist at Cambridge University in England.

After they left Africa, Mellars said, early humans spent 10,000 to 15,000 years inching along "the so-called coastal express" -- the southern coast of the Middle East, Asia, Malaysia and Indonesia. Their overall progress was about one kilometer (0.6 miles) a year, he said.

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