

The mystery of European eels' 5,000-km migration

By HELENA ZHU
Epoch Times Staff

For centuries, little had been known about European eels' (*Anguilla anguilla*) 5,000-kilometre spawning marathon swim from the European coast back to their birthplace in the Sargasso Sea, south of Bermuda in the Atlantic Ocean.

Among all species of eels, European eels make the longest trip to their spawning site—up to 6,500 kilometres. In comparison, American eels move 3,000 to 4,000 kilometres, while Japanese eels move 1,000 kilometres.

"We know what's happening when they are in fresh water. We also know about their larvae. After that they leave the coast of Europe, and from then on we don't know anything. They sort of disappear," said Dr. Kim Aarestrup, a senior researcher at the Technical University of Denmark's National Institute of Aquatic Resources (DTU Aqua).

It takes about two to three years for the larvae to be carried to Europe by the Gulf Stream and North Atlantic Drift. Then in the autumn between their sixth and 30th birthdays, depending on the gender and growth conditions, the eels vanish for their one-way journey across the Atlantic Ocean to mate in their birthplace.

Along with his colleagues, Aarestrup tracked down the first 1,300 kilometres of their journey with recent advances in satellite technology, getting closer to a full understanding of the eels' life cycle.

He said that they set small tags that register and store light, depth, and temperature to pop up to the surface on a specific date,



BIGGEST EEL CONTEST: Dr. Kim Aarestrup and his colleagues searched among more than 100,000 live eels caught by Irish fishermen to find 22 large eels for tagging. KIM AARESTRUP/DTU AQUA

transmitting data to a satellite.

For the last decade, the tags have been used on large ocean-dwelling animals such as sharks and tunas mostly. Even after the tags were miniaturized to 40 grams recently, they are still too heavy for most eels.

Among the 100,000 European eels that the researchers looked at, only 22, each weighing about two kilograms, five times heavier than a typical eel, were selected to bear the mission to carry the tags.

"We took the largest eels we could get," said Aarestrup. "The incentive of getting the larger eels is that the tag nearly has

no effect. ... When we tag eels about this size, we are sure that they are female eels, because male eels barely exceed 40 to 50 centimetres."

After up to 120 days of observation, Aarestrup found that the migrating eels dive deep in the ocean during the day, probably to avoid predators and to delay maturation of their gonad, and then move back near the surface by night, rising and falling over 800 metres every day.

They also discovered that the eels traveled slower and more southward than they expected. The eels moved about five to 25 kilometres daily, much slower

than the expected 35 kilometres per day to reach their destination for spring spawning. The scientists suggested that the southward direction would allow the eels to catch a ride on westward-moving currents.

Aarestrup said that the tagging is now continued in a new European Union-funded project (www.eeliad.com) lasting until 2012. Besides the satellite tags, which they will leave on the fish much longer — for up to a year after tagging, they are using a different technique, implanting much smaller general data storage tags in the large eels.

Aarestrup said that the new tags also record temperature and depth, but with a much lighter weight—about five to six grams.

"The primary advantage is there's absolutely no drag," said Aarestrup.

The new tags do not have a satellite unit; once they detach from the fish, they float ashore. Therefore they are designed in bright colours for human beings to find and return to the researchers for a reward.

According to Aarestrup, the recruitment (amount added to exploitable stock each year) of European eel larvae, a critically endangered species, is down to below 5 per cent, in areas below 1 per cent of the recruitment 40 years ago. The need to completely understand the eel life cycle is more necessary than ever to prevent their extinction.

Aarestrup said that European eels nowadays face being mashed by hydropower plants, fishing, introduced parasites from Japanese eels, drainage that ruins their habitat, blockage of their migration route, and lethal toxicants from pollution.



SAVING ENERGY: *Sternopygus macrurus* regulates the voltage of its electric signals throughout the day. SCOTT SCHULZ/ UNIVERSITY OF TEXAS

Electric fish's sixth sense

By STEPHANIE LAM
Epoch Times Staff

You may have heard of bats and dolphins' ability to echolocate, a means of navigation by vocalizing and receiving the echoes of the sound waves. Electric fish do something similar—they generate an electric field around their bodies to detect the distortions in the field that nearby objects create.

Many fish can detect electric fields, but only electric fish can generate electric fields. They range in the sea and in the fresh waters of Africa and South America. Electric fish include species of rays, knifefish, ray-finned fish, elephant fish, and catfish, but not all members of these taxa (groups of similar species) are electric fish. How about electric eels? They are actually not eels but are a kind of knifefish.

Each electric fish has an electric organ in the tail, which sometimes extends to the rest of the body. The organ consists of modified muscle cells that generate electric signals, known as electrocytes. An electric knifefish, *Sternopygus macrurus*, is known to emit electric signals at a rate of 100 times per second.

The signals form "a uniform field surrounding the fish, kind of like an electric bubble," said Dr. Michael Markham, a professor at the University of Texas.

Electroreceptors on electric fish's skin can detect distortions to the electric field created by nearby objects, and that is how, at night and in murky water, where they often live in, electric fish get to know their world, navigate through it, find their prey, and

be aware of the existence of their predators.

"Nearby electric fish can detect each other's electric fields," Markham said. "Males will modulate the rate or waveform of the electric signal to 'show off' to females or to intimidate rival males."

Since it takes a lot of energy to generate electric signals, Markham and his colleagues started a study investigating how electric fish save energy by varying the voltage of the signals under different circumstances.

They found that at night, or when they are involved in social interactions during the day, *Sternopygus macrurus* generate signals that are 40 percent stronger in voltage than other times.

"They accomplish this by rapidly inserting more ion channels into the electric organ cells," said Markham. Ion channels regulate the movement of ions (and in this case, positively charged sodium ions) into cells following the electrochemical gradient.

"By reducing the signal strength during the day, the fish conserve energy because fewer charged ions have to be moved back and forth across the cell membrane," he said.

However, it remains unclear whether, when various electric fish are within near distances, only one of them would generate the electric field so the others can conserve energy, Markham said.

To read Markham et al.'s research paper, please visit <http://www.plosbiology.org/article/info%3Adoi%2F10.1371%2Fjournal.pbio.1000203>

SCIENCE MATTERS

OCTOBER 6, 2009

Vol. 11, No. 40

Countdown to Copenhagen

By David Suzuki with Faisal Moola

It's amazing what world leaders can do when they come together for a common cause, as they did in Montreal in 1987 to ban CFCs to protect the ozone layer. In December, our leaders will have a tremendous opportunity in Copenhagen to take the world into a new era of innovation and prosperity.

But, as was the case in Montreal, this opportunity is born out of crisis. The threat of climate change is real and imminent. Scientists from around the world have confirmed this through continuous study and observation — despite what the increasingly desperate and nonsensical arguments from deniers would have you believe.

This is no longer a political issue. It's an issue of utmost importance to all of us, no matter where on the political spectrum we feel most comfortable. And we're finally seeing some agreement about confronting this challenge among world leaders from the left, centre, and right. It's especially a conservative issue. After all, as Denmark's Minister of Climate and Energy, Connie Hedegaard, points out, a core conservative belief is "that what you inherit you should pass on to the next generation." And that doesn't mean passing on our mess!

Conservatives also believe that we should live within our means, save some of what we have for tomorrow, and act with care and caution. Conservatives with deep religious conviction know also that we are stewards of the Earth — and good stewardship means protecting the Earth, its resources, and its life.

The December climate summit in Copenhagen is a crossroads. We can continue to delay while the Earth's natural systems reach tipping points beyond which we may not be able to find our way back, or we can move forward in our efforts to slow global warming, reduce pollution, and create new opportunities for healthier lives and stronger economies.

Many world leaders are already committed to negotiating an agreement in Copenhagen that is ambitious, fair, and binding, and many have started implementing solutions in their own countries. Unfortunately, Canada is falling behind. Our national targets for reducing greenhouse gas emissions have been called ineffective, and our performance at a

number of recent climate meetings has been labelled "obstructionist".

Our inaction comes from fear. Because Canada is a major oil producer, politicians and some businesspeople are afraid that reducing our reliance on fossil fuels will harm the economy. But that's short-sighted. If we continue to rely on dwindling non-renewable energy supplies, we'll be left in the dust as the rest of the world moves forward to a green economy, with innovation, jobs, and money from new technologies such as renewable energy infrastructure.

If we were to use our fossil-fuel resources such as oil more wisely, we could make them last longer and derive more national economic benefits from them while we make the transition to a clean-energy economy. The side benefits would include less pollution and environmental damage, a more stable economy, and healthier citizens.

If we continue down the same road, however, we risk catastrophic consequences to our economy and to our very lives. Scientists agree that if average temperatures on Earth rise just another degree, global warming could reach a point of no return, with melting icecaps, rising sea levels, increasing waves of climate refugees, extinction of plants and animals, and floods, droughts, and other severe weather events.

As a northern nation, Canada is particularly vulnerable to climate change. The impact is magnified near the Earth's poles, largely because of the loss of ice and snow coverage. Canada also has the longest marine coastline in the world, so sea-level rise would have a dramatic effect with enormous economic consequences. Many Canadians are already feeling the sting of climate change, especially in the North and in other communities that depend on forestry, fisheries, and agriculture.

Change is never easy, and taking bold steps can come with costs in the short term. But refusing to change means we are condemning ourselves and our children and grandchildren to an uncertain and dangerous future. We can all take individual action to reduce our emissions, but ultimately, we must let our leaders know that we expect them to seize the opportunity in Copenhagen to create a secure and healthy future for our small blue planet and all the people who share it.

Can the mind affect reality?

By LEONARDO VINTIÑI
Epoch Times Staff

"All that we are is the result of what we have thought. The mind is everything. What we think we become." —Attributed to Gautama Siddhartha, the Buddha

According to Dr. Joe Dispenza, every time we learn or experience something new, hundreds of millions of neurons reorganize themselves.

Dr. Dispenza is known throughout the world for his innovative theory concerning the relationship between mind and matter. Perhaps best known as one of the scientists featured in the acclaimed 2004 docudrama "What the Bleep Do We Know," his work has helped reveal the extraordinary properties of the mind and its ability to create synaptic connections by carefully focusing our attention.

Just imagine: In every new experience, a synaptic connection is established in our brain. With every sensation, vision, or emotion never explored before, the formation of a new relationship between two of more than 100 thousand million brain cells is inevitable.

But this phenomenon needs focused reinforcement in order to bring about real change. If the experience repeats itself in a relatively short period of time, the connection becomes stronger. If the experience doesn't happen again for a long period of time, the connection can become weakened or lost.

Science used to believe that our brains were static and hardwired, with little chance for change. However, recent research in neuroscience has discovered that the influence of every corporal experience within our thinking organ (cold, fear, fatigue, happiness) is working to shape our brains.

If a cool breeze is capable of raising all the hairs on one's forearm, is the human mind capable of creating the same sensation with identical results? Perhaps it is capable of much more.

"What if just by thinking, we cause our internal chemistry to be bumped out of normal range so often that the body's self-regulation system eventually redefines these abnormal states as regular states?" asks Dispenza in his 2007 book, "Evolve Your Brain, The Science of Changing Your Mind."

"It's a subtle process, but maybe we just never gave it that much attention until now."

Dispenza holds that the brain is actually incapable of differentiating a real physical sensation from an internal experience. In this way, our gray matter could easily be tricked into reverting itself into a state of poor health when our minds are chronically focused on negative thoughts.

Dispenza illustrates his point by referring to an experiment in which subjects were asked to practice moving their ring finger against a spring-loaded device for an hour a day for four weeks. After repeatedly pulling against the spring, the fingers of these subjects became 30 percent stronger. Meanwhile, another group of subjects was asked to imagine themselves pulling against the spring but never physically touched the device. After four weeks of this exclusively mental exercise, this group experienced a 22 percent increase in finger strength.

For years, scientists have been examining the ways in which mind dominates matter. From the placebo effect (in which a person feels better after taking fake medicine) to the practitioners of Tummo (a practice from Tibetan Buddhism where individuals actually sweat while meditating at below zero temperatures), the influence of a "spiritual" portion of a human being over the undeniable physical self challenges traditional conceptions of thought, where matter is ruled by physical laws and the mind is simply a byproduct of the chemical interactions between neurons.

BEYOND BELIEF

Dr. Dispenza's investigations stemmed from a critical time in his life. After being hit by a car while riding his bike, doctors insisted that Dispenza needed to have some of his vertebrae fused in order to walk again—a procedure that would likely cause him chronic pain for the rest of his life.

However, Dispenza, a chiropractor, decided to challenge science and actually change the state of his disability through the power of his mind—and it worked. After nine months of a focused therapeutic program, Dispenza was walking again. Encouraged by this success, he decided to dedicate his life to studying the connection between

mind and body.

Intent on exploring the power of the mind to heal the body, the "brain doctor" has interviewed dozens of people who had experienced what doctors call "spontaneous remission." These were individuals with serious illnesses who had decided to ignore conventional treatment, but had nevertheless fully recovered. Dispenza found that these subjects all shared an understanding that their thoughts dictated the state of their health. After they focused their attention on changing their thinking, their diseases miraculously resolved.

ADDICTED TO EMOTIONS

Similarly, Dispenza finds that humans actually possess an unconscious addiction to certain emotions, negative and positive. According to his research, emotions condemn a person to repetitive behavior, developing an "addiction" to the combination of specific chemical substances for each emotion that flood the brain with a certain frequency.

The body responds to these emotions with certain chemicals that in turn influence the mind to have the same emotion. In other words, it could be said that a fearful person is "addicted" to the feeling of fear. Dispenza finds that when the brain of such an individual is able to free itself from the chemical combination belonging to fear, the brain's receptors for such substances are correspondingly opened. The same is true with depression, anger, violence, and other passions.

Nevertheless, many are skeptical of Dispenza's findings, despite his ability to demonstrate that thoughts can modify a being's physical conditions. Generally associated as a genre of pseudoscience, the theory of "believe your own reality" doesn't sound scientific.

Science may not be ready to acknowledge that the physical can be changed through the power of the mind, but Dr. Dispenza assures that the process occurs, nevertheless.

"We need not wait for science to give us permission to do the uncommon or go beyond what we have been told is possible. If we do, we make science another form of religion. We should be mavericks; we should practice doing the extraordinary. When we become consistent in our abilities, we are literally creating a new science," writes Dispenza.

Dr. David Suzuki is a scientist, broadcaster, author, and chair of the David Suzuki Foundation and Dr. Faisal Moola is the Director of Science at the David Suzuki Foundation.

Take David Suzuki's Nature Challenge and learn more at www.davidsuzuki.org.