

THE TIMES Alien pests threaten even the fittest as stowaway insects invade Darwin's islands

Hannah Devlin

Mosquitoes introduced to the Galapagos on chartered flights and tourist boats could put the islands' unique species at risk of extinction, scientists warn today.

According to a study published in the Royal Society journal *Proceedings B*, several are readily introducing mosquitoes into the island's ecosystem. Many of them will carry diseases such as avian malaria or West Nile fever, with potentially devastating consequences for the native species, including Galapagos tortoises, marine iguanas, sea lions and Darwin's finches.

"The animals have evolved in the absence of these diseases so they have virtually no resistance," Simon Goodman, a geneticist from the University of Leeds who led the research, said.

One infectious mosquito was enough to trigger an outbreak of disease, he added. If the mosquito infected a bird or animal that was then killed by other mosquitoes, these would also become carriers of the disease. Once a small proportion of the mosquito population became carriers, a disease outbreak was almost inevitable.

The scientists found that live insects were being introduced regularly to the islands in aircraft holds. All flights to the Galapagos from Ecuador, Europe, the Americas and elsewhere have mosquitoes found in 126 flights leaving the coastal city in 2006-07.

Although most of those were infected with avian malaria or West Nile fever, commonly carried by mosquitoes in Ecuador, the scientists predicted that if insects continued to be introduced it would be only a matter of time before this happened. "It's a numbers game," Dr Goodman said. "The more times you fly the more likely it is to happen."

In the second part of the study the scientists analysed how the mosquitoes were surviving and mating with native insects. Their research revealed that the higher rate of migration was from the Ecuador mainland towards the two islands to which chartered flights fly, Bolívar and San Cristóbal. Mosquitoes were then transferred to other islands such as Isabela

the guardian

Unique species of Galapagos threatened by mosquitoes

Caroline Davies

Unique species on the Galapagos islands are under threat from mosquitoes introduced by air traffic, scientists warn today. The researchers say that the high rate of migration from the Ecuador mainland towards the two islands to which chartered flights fly, Bolívar and San Cristóbal, means mosquitoes are being transferred to other islands such as Isabela

The Galapagos giant tortoise and marine iguana, which are unique to the islands, are particularly vulnerable. The researchers say that the high rate of migration from the Ecuador mainland towards the two islands to which chartered flights fly, Bolívar and San Cristóbal, means mosquitoes are being transferred to other islands such as Isabela



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Mosquito evolves into threat to Galapagos wildlife

Fears that insect could spread disease to islands' rare indigenous animals

By Steve Connor, Science Editor

Tuesday, 2 June 2009

A mosquito that has lived on the Galapagos Islands for thousands of years is emerging as a potential threat to the archipelago's wildlife, because of an increase in tourism.

Scientists fear the endemic insect could pick up diseases from other mainland mosquitoes brought to the islands as stowaways on tourist ships and planes and then transmit the infections to the rare collection of indigenous animals on the islands.

The black salt marsh mosquito distributed throughout the Galapagos is highly unusual because it can feed on the blood of reptiles as well as mammals and birds. But its diverse diet means it could transmit introduced diseases such as West Nile fever to the islands' rare birds and reptiles which include the giant tortoise, the marine iguana and the flightless cormorant.



The black salt marsh mosquito is able to feed on the blood of reptiles, posing the threat of infection to rare Galapagos species such as iguanas.

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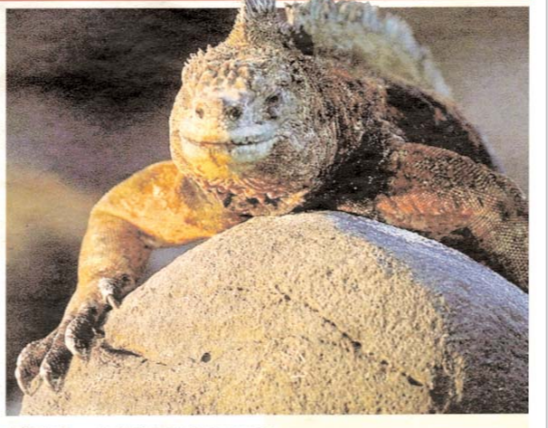
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"When we started the work we thought that this species was also introduced by humans (about 200 years ago), so it was a surprise that it turned out to be so ancient," Dr Bataille said.

"The genetic differences of the Galapagos mosquitoes from their mainland relatives are as large as those between different species, suggesting that the mosquito in Galapagos may be in the process of evolving into a new species."

The scientists also found that the mosquito, unlike its mainland counterparts which is normally confined to swamps and coastal salt marshes, has also become adapted to living and breeding in inland areas and at relatively high altitudes, making it widespread throughout the archipelago.

Two other species of mosquito are found in the Galapagos but both are recent introductions and do not seem to be outside of the main centres, suggesting that they are less of a threat to wildlife, Dr Bataille said.

"They are limited to where you find humans and they don't move much away from humans, so they won't have as big an impact on spreading disease to wildlife," he said.

The study, which is published in the journal *Proceedings of the National Academy of Sciences*, concluded that growth in the number of people vi-

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Page last updated at 08:49 GMT, Tuesday, 2 June 2009 09:49 UK

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Mosquito threat to Galapagos icons

A tiny mosquito is threatening giant tortoises and other iconic reptiles living on the Galapagos Islands.

The mosquito has acquired a particular taste for reptilian blood, scientists have discovered.

They fear it could act as a vector, transmitting new infectious diseases such as West Nile virus to the reptiles.

The scientists have published their findings in the *Proceedings of the National Academy of Sciences*.

The black salt-marsh mosquito (*Aedes taeniorhynchus*) is the only mosquito that is widely distributed across the Galapagos archipelago. It was first recorded on the islands in the late 1800s, but it was not known whether human explorers carried it there, or whether it naturally colonised the Galapagos.

Previous studies have shown that the mosquito regularly spreads the dog heartworm parasite across Central and South America and is capable of spreading other diseases, including St Louis encephalitis virus and West Nile virus.

So Arnaud Bataille of the University of Leeds, UK and colleagues from the Zoological Society of London and the Galapagos National Park studied the mitochondrial DNA of the mosquito to determine where it had come from.

The mosquito actually colonised the archipelago around 200,000 years ago, they found.

Since then, the mosquito has adapted to its new environment, being able to breed up to 20km inshore and at an altitude of up to 700m. On the mainland, the same species of mosquito is normally confined to mangroves and salt marshes along the coast, never moving more than 5km inland.

More alarmingly, while mainland salt-marsh mosquitoes feed on the blood of mammals and the odd species of bird, the Galapagos salt-marsh mosquito has developed a taste for reptile blood.

Studies of the mitochondrial DNA found in the mosquito's guts showed that 58% of mosquitoes sampled had fed on reptile blood, with 47% biting marine iguanas and 11% biting Galapagos tortoises.

It is the first time that the salt-marsh mosquito has been shown to feed on reptiles.

No mammals were present on the Galapagos until brought there by people around 500 years ago. So the mosquito had to adapt to feeding on reptiles when it arrived, say the researchers.

They now fear it could pose a significant threat to the future of the tortoise and iguana, species that are found nowhere else.

The salt-marsh mosquito is already widespread and known to carry pathogens such as West Nile virus, which if nothing is done to prevent it, is predicted to reach the Galapagos in a few years time, says the team.

"With tourism growing so rapidly, the chance of a disease-carrying mosquito hitching a ride from the mainland on a plane is increasing," says Andrew Cunningham of the Zoological Society of London, one of the research team.

"If a new disease arrives via this route, the fear is that the Galapagos' own mosquitoes would pick it up and spread it throughout the archipelago."

Other remote islands such as Hawaii have mountainous regions, which are too high and cold for mosquitoes to colonise. These provide a refuge of sorts for animals susceptible to mosquito-borne diseases.

The Galapagos archipelago has no such refuge, say the researchers, increasing the risk to its native animals.



Marine iguanas have become an acquired taste for mosquitoes.

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Mosquito threat to giant tortoise



Galapagos mosquito now has a taste for the marine iguana.

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FOUNTAIN June 1, 2009

Giant tortoises on the Galapagos Islands could be at risk from mosquitoes that have developed a taste for reptile blood.

Scientists are worried people visiting the islands in the Pacific Ocean could bring mosquitoes carrying diseases like malaria with them by mistake.

Local mosquitoes, which feed on the reptiles, could then pick up the diseases and pass them on.

The tortoises are not immune to malaria because the islands are very isolated.

Try our tortoise quiz

Planes flying into the Galapagos Islands have to be sprayed with insecticide to try to prevent infected mosquitoes being transported to the islands.

Rare species

The Galapagos Islands are home to some of our rarest species of plants and animals, including giant tortoises, marine iguanas and rare sea lions.

The giant tortoises have grown so big because they have no natural predators.

The islands are 1,000km off the coast of Ecuador in South America and they were the first place on the planet to become a protected World Heritage site more than 30 years ago.

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Galapagos mosquito now has a taste for the marine iguana.

Galapagos mosquito now has a taste for the marine iguana.

FOUNTAIN June 1, 2009

Animals of the Galapagos have been studied extensively since Darwin and his finches. But there's been less scrutiny of the archipelago's insects, including mosquitoes.

Now, a paper in *The Proceedings of the National Academy of Sciences*, by scientists from the University of Leeds, the Zoological Society of London and Galapagos National Park, sheds light on the black salt marsh mosquito, *Aedes taeniorhynchus*.

Since it is the only mosquito found throughout the archipelago, the findings raise concerns about the impact of mosquito-borne diseases.

Arnaud Bataille and colleagues conducted a genetic analysis that showed that the mosquito, one of three species found in the Galapagos, was not introduced recently by humans but instead arrived about 200,000 years ago.

Since then the insect has evolved so much it is practically a distinct species from mainland variety.

thing, the insect has adapted to be able to feast on the blood of lizards, tortoises and reptiles and not solely on mammals, as it does on the mainland. The mosquito has a wider range than on the mainland.

Scientists find a new species of mosquito in the Galapagos

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Galapagos giant tortoises face mosquito threat

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All of that could spell trouble, the researchers say, if West Nile virus or a similar pathogen were to reach the island. A. taeniorhynchus would appear to be poised to rapidly spread such a virus, with potentially devastating consequences. The researchers suggest that all planes and boats arriving in the Galapagos be treated with pesticides.

Creating a buzz

Some stories really capture the media's imagination and this one pushed all the right buttons, achieving global news coverage. As the research team was in the Galapagos, we worked across time zones to ensure that everything was co-ordinated with the publication of the research paper. We also liaised closely with the funding body, the Zoological Society of London, to secure maximum coverage for the story and all the partners involved.

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Galapagos giant tortoises face mosquito threat

Press Association guardian.co.uk, Monday 1 June 2009 22:05 BST

Article history

Galapagos's giant tortoises are under threat from diseases such as avian malaria because local mosquitoes have developed a taste for reptile blood, it was claimed today.

Scientist fear this, combined with a rise in tourism, could have a devastating effect on the island's wildlife. Dr Andrew Cunningham, from the Zoological Society of London, said: "The chance of a disease-carrying mosquito hitching a ride from the mainland on a plane is increasing ... If a new disease arrives via this route, the fear is that Galapagos's own mosquitoes would pick it up and spread it throughout the archipelago."