



BORDER HEALTH NEWSLETTER – July 2015

WELCOME!

Hi everybody!

I hope everybody, who attended the Border Health and Ship Sanitation course, had a nice time in Wellington and a safe trip back.

Sorry for the late newsletter. I am writing from Germany, where it is tropically hot and I have had several encounters with mosquitoes. Since it feels pretty much like Singapore, where I had a stopover, this issue is all about climate change.

SAMPLES

During July 396 samples were collected by staff from 12 DHBs with 49 positive. There were only 2 adults found this month! The numbers of *Aedes notoscriptus* larvae are similar compared to last month and slightly higher than last year, whereas the number of *Culex quinquefasciatus* larvae went down after June but is still much higher than July 2014.

Species	Adults		Larvae	
	July 2015	July 2014	July 2015	July 2014
New Zealand Mozzies				
<i>Aedes antipodeus</i> (winter mosquito)	Nil	Nil	Nil	1
<i>Ae. australis</i> (saltwater mosquito)	Nil	Nil	1	Nil
<i>Ae. notoscriptus</i> (striped mosquito)	1	Nil	949	773
<i>Culex astilae</i>	Nil	Nil	9	Nil
<i>Cx pervigilans</i> (vigilant mosquito)	Nil	19	30	83
<i>Cx. quinquefasciatus</i> (southern house mosquito)	1	55	70	17
<i>Opifex fuscus</i> (rockpool mosquito)	Nil	Nil	12	21
Total	2	74	1071	894

INCURSIONS/INTERCEPTIONS

We have had a single interception in July:

7.7.2015 4 specimens of a non-mosquito were found in an air can (with sealed corn cobs) off an Australian plane coming from Brisbane. Three females sent to NZB could be identified as the chironomid *Polypedilum nubiferum* (the fourth specimen was identified byASUREQuality Pest Laboratory with the same result).



PICTURE OF THE MONTH

Where to move if you hate mosquitoes



You can escape the annoying bloodsuckers, but you'll need to pack a serious parka. No mosquitoes anywhere in sight on this iceberg in Antarctica. (Photo: Victor/flickr)

There are only two places in the world that are completely and utterly mosquito-free: Antarctica and Iceland. Unfortunately, no one really lives in Antarctica, considered on average the coldest, driest and windiest continent on Earth.



But we hear Iceland is nice! And no mosquitoes ... yet. (Photo: Moyan Brenn/flickr).

It is very strange, Ólafsson said it's likely a chemical composition of water and ground that keeps the bugs at bay. Mosquitoes could be carried to the country with airplanes or the wind and learn how to adapt to the climate.

NEWS OF THE MONTH

#ISeeChange: Is climate change responsible for SoCal's mosquito problems?

SUSANICA TAM FOR KPCC

Over the last several months, KPCC has been asking you to share observations about your environment for a project called #ISeeChange. The goal? To have you-our audience-help us look for possible signs of change, climate and otherwise, in your backyard. We collect your observations, look for patterns and then share them with scientists to get their take. In these dog days of summer, we're following up on some of your favourite summer complaints: bugs and heat.

The observation

Learka Bosnak, a resident of Los Angeles, likes to spend time in her backyard during the summer. When she does, she says, she now finds herself using a blanket to cover her entire body — a novel effort to prevent bug bites — and one she didn't need to worry about not too long ago.

"I've had welt-sized bug bites," she said. "Normally other people are my insect repellent. I don't get bitten. And this past year has been treacherous."

Bosnak is not the only one who wrote in to us with observations that the number of bug bites they receive seem to be increasing.

The questions sound a lot alike: "Why have the mosquitoes gotten worse?"

Mosquitoes are hard to count, easy to find

Levy Sun, a spokesman for the Greater Los Angeles Basin Vector Control, says it's hard to know if mosquito numbers are growing. County mosquito technicians set traps every year, but there's no historical census or population estimate.



NEW ZEALAND BIOSECURE



But according to Sun, California has seen increasing variety in its mosquito population. “The mosquitoes that we’ve had here, have always been here,” Sun said. “Now we have more, new ones in our cities.”

Invasive *Aedes aegypti* and *Aedes albopictus* mosquitos may have come here through global trade or travel. They could spread yellow fever, dengue fever, and chikungunya.



So vector control has tailed them into the L.A. area — to communities including Whittier, Pico Rivera and Commerce — where technicians say they’ll find the mosquitos at one out of every three houses.

Asian and Australian mosquitoes only need a capful of water to breed in, so the drought isn’t slowing them down, according to Vector Control officials.

“We used to say a season is summer, but because of these mild winters, mosquito season is yearlong practically. We don’t rest,” said Sun. So controlling the mosquitoes becomes harder because their peak season is growing.

Mild winters are associated with climate change in California.

Warming predicted for Los Angeles region

Like most urban centers, greater Los Angeles temperatures have risen in the last century — by about 5 degrees. During that time, cities’ populations swelled and became more dense. Forests and fields were paved over and covered with concrete, which helped fuel the rise in temperatures.

“We really have two factors,” said Alex Hall, UCLA atmospheric scientist. “One is the urban heat island effect. The other is global warming. And both of those are contributing to this warming we’ve seen over the last century.”

Hall’s team is predicting that climate change will warm the L.A. region another 4 to 7 degrees by 2100, and some places will get hotter than others.

“We know that in the future, oceans will warm much more slowly than land areas,” Hall said. “These areas that are influenced by the marine environment experience less warming than areas that are not.” So, not only are there more kinds of mosquitoes here, but warmer temperatures will enable them to thrive. Climate may be changing behaviors

Learka Bosnak knows her outdoor blanket strategy only goes so far. “I just put screens on my whole house,” she said. She’s not the only one adapting to warm weather and the bugs they bring.

Kenny Tashman runs a hardware store in West Hollywood. His screen business has been booming as Southern Californians — who like to open windows to cool their homes — respond to breeze and bug problems.

“I can tell — by the amount of people crying to me about when their screens are going to be ready — when it gets hot,” he said.

Demand for Tashman’s services depends on the time of year. “Earlier in the year, spring, you’ll get more calls from the valley. Cause it’s a little warmer earlier there,” he says. “To the end of summer, it’s more West L.A.-type of customers because the valley gets too hot and everybody’s turning on their air conditioner.”

Tashman’s business is likely to keep booming as the number of days of extreme heat rises. UCLA scientists are predicting climate change will give the L.A. region 3 or 4 times as many of them as we have now.

But Tashman says he’s ready: energy efficient windows can keep out the heat and, of course, the dreaded mosquitos.



NEW ZEALAND BIOSECURE

VECTOR-BORNE DISEASES

Recent Local News

Samoa fears dengue spreading beyond Apia



27 July 2015

Samoa's Apia has been hit with an outbreak of dengue fever type 3 with fifty five confirmed cases which will be sent to New Zealand for further medical testing.

The acting Director General of Health, Robert Thomsen, says the latest number of cases have also to be tested because some patients either have dengue or a combination with the chikungunya virus.

Four people have been admitted to hospital with severe symptoms, but there have been no deaths. Dr Thomsen says while the impact has been mostly in the Apia urban area, officials fear it could spread more widely.

"And if the numbers warrant, like happened last year with the chikungunya when advices were taken out for schools to be closed, then we will go to that stage."

The Ministry of Health is continuing preventive measures such as spraying incoming flights from American Samoa, and in the hospitals and schools.

The public is advised to use mosquito repellants and mosquito nets as well as long sleeve shirts and trousers to protect them from mosquitoes.



Pacific syndromic surveillance report Week 31, ending 2 August, 2015

Chikungunya: Cook Islands have reported a total of 763 cases since October 2014, including 5 new cases in the week ending on 2 August 2015.

Dengue: Outbreaks are occurring in American Samoa (dengue serotype-3) and Samoa (dengue serotype-3).

American Samoa has reported a total of 238 suspected cases, including 75 hospitalizations and 4 deaths, as of 6 August. The outbreak enters its tenth week

Samoa has reported a total of 220 cases of Dengue Like Illness (DLI) including 15 hospitalizations as of 2 August. Most cases were under 25 years of age. No deaths have been reported.

ESR - MONTHLY NOTIFIABLE DISEASE SURVEILLANCE REPORT - June 2015

Chikungunya fever: Three chikungunya cases were notified in June 2015 (1 confirmed and 2 probable) compared to six cases notified during the same month of the previous year. The cases were reported from Waitemata (2 cases) and Southern (1 case) DHBs. The cases were overseas during the incubation period and had travelled to Cook Islands (2 cases) and Samoa (1 case).

Zika virus: One case still under investigation was notified in June 2015. The case was a male from Nelson Marlborough DHB, who reported overseas travel to the Cook Islands during the incubation period.



USA

Climate Change and Mosquitoes: A Deadly Combination for Hawaii's Rare Birds

Researchers say that the invasive insect could wipe out the islands' unique avian life as temperatures climb.

JUL 21, 2015 by John R. Platt



The 'i'iwi. (Photo: Facebook)



Hawaii's 'amakihi. (Photo: Facebook)

For you and me, a single mosquito bite probably isn't much more than an annoyance.

The colorful Hawaiian birds known as 'i'iwi aren't so lucky. For these increasingly rare birds, one mosquito nibble means almost certain death.

Mosquitoes are not native to Hawaii. The insects arrived on the islands about two centuries ago, and with them came the parasite that causes avian malaria (a different form of the disease that can affect humans). Hawaii's birds evolved far away from either mosquitoes or avian malaria, and as a result many of them have little to no resistance to the disease.

So, Why Should You Care? The mosquito and malaria invasion of Hawaii is so bad that it has driven dozens of native birds—which exist nowhere else on Earth—into extinction. Of the 51 native “honeycreeper” bird species of Hawaii, many of which have great importance to Hawaiian culture, fewer than half remain. Many of those are endangered, some critically so.

Things are about to get worse. According to a paper published this week in the journal *Global Change Biology*, most of Hawaii's cold elevations where mosquitoes can't survive.

remaining native birds have retreated to high, That sanctuary is about to disappear. Climate change will warm those mountain habitats and make them more hospitable to mosquitoes and the deadly diseases that they carry.

According to calculations by researchers from the United States Geological Survey and the University of Wisconsin–Madison, the effect will be devastating. The 'i'wi population could plummet by up to 90 percent by the end of the century.

RELATED: Climate Change Could Imperil Half of North America's Birds by the End of the Century

Other species will also suffer. The researchers looked at infection and survival rates for other honeycreepers and found that the 'apapane will lose about 10 to 20 percent of its population, while the common 'amakihi will decline between 40 and 80 percent. They say the effects will be similar in other species.

Other problems will compound the effect of the mosquitoes. Hawaii's birds have already fled to high, mountainous habitats, which themselves are at risk. “They cannot move to higher elevations because the climatologists predict that the tree line will decrease responding to the future climate change,” said Wei Liao, a postdoctorate at University of Wisconsin–Madison and lead author of the paper. “That is why we are so concerned. The birds are unique in Hawaii, and there are not many, if



none at all, places to relocate them.”

The researchers calculate that the effects of climate change and mosquito migration won't become a problem until around 2040, giving us some time to look for solutions. One important strategy mentioned in the paper would be to control the feral pigs that infest the Hawaiian Islands as they carry mosquitoes to new areas and root up the vegetation and trees that the birds need to survive. Another step would be long-term efforts to restore Hawaii's degraded forests.

Liao's team is looking at some of these potential solutions and malaria mitigation strategies and will soon organize a workshop to share their results with natural resource managers. Until then, maybe it's time for Hawaii to stock up on Deet.

Europe

Mosquito numbers rising as Germany warms up

Thanks to mild winters and moist air, mosquitoes are thriving in Germany. And not just the native species. Scores of exotic mosquito types are now moving here and the unwanted visitors are bringing dangerous baggage.

More and more species of exotic mosquitoes are arriving in Germany and with them the amount of dangerous infectious agents is rising, such as bacteria or viruses. Many of the mosquitoes hitch a ride on tourists or business travellers around the world before arriving in Germany.

Although they tend to survive for only a limited time and die out during the cold winter, experts say the climate in Germany will get warmer and the winters will shorten, meaning their numbers are set to continue to increase.

"The average temperature in certain regions is relatively high, and it's also getting wetter," says Sven Klimpel from the Senckenberg Gesellschaft für Naturforschung, a group of research institutes and natural history museums in Germany which conduct research into bio- and geosciences. "Those are ideal conditions for mosquitoes."

But it's not only the exotic pests causing scientists to worry. Native mosquitoes find the change in conditions equally appealing and are producing several generations of offspring each year.

Dangerous discoveries

Klimpel and Egbert Tannich, from the Bernhard Nocht Institute for Tropical Medicine in Hamburg, are currently researching infectious diseases being spread by mosquitoes in Germany.

The two scientists have already identified the Asian bush mosquito, the Asian tiger mosquito, and the yellow fever mosquito here in Germany. In an extensive 12-year study, the researchers collected more than 75,000 mosquitoes from 55 locations throughout the country. They discovered about 50 native and exotic mosquito species.

The Asian tiger mosquito, which has now been spotted in Germany, transmits dengue fever

"We have found that in certain regions, there are non-native mosquitoes that have made these regions their home, and there are others that only appear every now and then," Egbert Tannich told DW.

Their research also found larvae from the *Dirofilaria repens*, a parasitic roundworm, in German mosquitoes for the first time. The parasite is native to Africa, Asia and southern Europe. The worm lives in the hearts of dogs and foxes. If a mosquito were to suck the blood of an infected animal, it could transmit the infection onto its next victim.

For humans the resulting infection is relatively harmless, as the worms die off quickly. Nevertheless, it's important to observe these sorts of problems before they become a health issue here, says Sven Klimpel.

After feeding on one host and moving to the next, mosquitoes can transmit viruses, parasites or worms, and worse - diseases such as malaria, sleeping sickness, dengue or chikungunya fever.

Most infectious agents are native to Africa, Asia or Latin America - regions with warm, humid climates. As temperature increases in Germany though, the scientists say that the infectious agents



in mosquitoes here will multiply faster.

"In the next 10 to 50 years, infectious diseases transmitted by blood-sucking insects will increase in Europe - especially in Germany," Klempel told DW.

West Nile found again in Dublin mosquitoes

By Earl Rinehart

The Columbus Dispatch Friday August 7, 2015 10:21 PM

The West Nile virus has been confirmed in two more locations in Dublin this week, two weeks after the city was sprayed following confirmation of the virus in three other locations.

The virus was found in mosquito traps set weekly by Franklin County Public Health in the central and northern sections of the city. As a result, two areas will be sprayed next week:

Wednesday: The central area between Brand and Post roads, from the western border to the Scioto River.

Thursday: The northern area north of Brand from Hyland Croy Road to the Scioto River.

The city was sprayed July 27-28.

Spraying is done after 8:30 p.m., weather permitting. The pesticide poses little risk to humans and pets, Public Health has said. It does not persist in the environment and breaks down quickly in sunlight.

This is the worst year for mosquitoes in Ohio in many years, according to Public Health. The long rainy period contributed to an explosion of flood-water mosquitoes in addition to the other types of mosquitoes. The flood-water mosquitoes are large and are aggressive biters.

"We are seeing West Nile virus throughout the county in mosquitoes," said Mitzi Kline, agency spokeswoman. As of Thursday, 31 traps have tested positive, she said.

On Monday, Columbus Public Health will release its numbers of traps testing positive, department spokesman Jose Rodriguez said. The city will also post the spraying schedule for the city on its website, he said.

"The counts have been much higher than they normally would be this time of year," Rodriguez said. He said two areas of concern are the North Side and the Northwest Side.

Health officials recommend that when outside, people wear insect repellent containing DEET, limit their outdoor activities at dusk and dawn when mosquitoes are most active, and eliminate even small pools of standing water around their homes where mosquitoes can breed.

Those small pools include water left out for dogs, Rodriguez said. "Just freshen it up, change it every couple of days," he recommended.

There have been no cases of humans infected with the virus in central Ohio. There have been two cases statewide — a 34-year-old Cuyahoga County man and a 77-year-old Hamilton County man, the Ohio Department of Health reported. No deaths have been reported.

Statewide last year, there were 11 reported cases of the virus in humans and one death. In 2013, there were 24 human cases and three deaths.

WORLD OF MOSQUITO SCIENCE

Mosquitoes are developing resistance to insecticides

Human Needs - Living on Earth

August 04, 2015 by Elizabeth Shockman

Humans have used everything from screens to chemical repellents to protect themselves from mosquitoes and the diseases they carry. Now, however, scientists say mosquitoes are finding ways to adapt to insecticides and other recent changes in their environments.

A new study on mosquito adaptability has big ramifications for public health workers, and for anyone out on a warm night, trying to avoid both mosquito bites, and the itchiness and disease those bites



might bring.

Hossein Asgharian, a molecular biology Ph.D. candidate at USC, and lead author of a study on mosquito evolution began with a question. He wanted to know if mosquitoes were able to adapt to changes to the environment made by humans, including the use of pesticides.

Asgharian and a group of scientists focused their study on two different strands of mosquitoes found in two different parts of the world: Russia and California. The first strand, *Culex pipiens*, is known as an urban or suburban mosquito. It can be found near puddles at California bus stops, buzzing around Moscow railway stations, or feasting on human blood at backyard suburban parties. The second strand, *Culex torrentium*, is a rural mosquito that would be found in Californian or Russian forests and meadows, and prefers animal hosts to human hosts.

“Our finding was that basically geographical location is the most important factor in determining genetic similarity. In other words, urban and suburban mosquitoes from Moscow are more alike and urban and suburban mosquitoes from Sacramento look more alike,” Asgharian said.

Asgharian and his team estimated that between five and 20 percent of the mosquito genome, depending on the population, had undergone recent adaptive change.

“The interpretation is that these mosquitoes are becoming resistant to insecticides and many of these adaptations are happening locally. In other words, different populations are becoming resistant to different chemicals,” Asgharian says.

For public health officials, and those who develop bug repellants, Asgharian’s findings mean that the strategy for fighting mosquitoes will have to be different in different parts of the world.

“If we want to plan defensive strategies we will have to sample each population separately and plan specifically for that population,” Asgharian says.

Asgharian also has advice for dealing with the diseases mosquitoes carry as climate change modifies the insects’ behavior.

“Each mosquito, each species basically prefers a specific environmental set of conditions,” Asgharian says, “When climate change happens, they shift their range, and when they shift their range, they will carry different diseases. So if you can basically anticipate the response of these mosquitoes to climate change, and we can anticipate the shift in their range, we can expect what will be the profile of the more common infections, diseases in each area that these mosquitoes carry.”

High Tech Hope for Repelling Mosquitoes

WIRED WELL

By JENNIFER JOLLY AUGUST 11, 2015

Personal technology for health and fitness.



In Alaska, where I grew up, mosquitoes outnumber people some 24 million to one. That makes it a great place to test the very latest in mosquito shields.

On a recent trip home, I tried the newest products on the market: kid-safe bands treated with plant oils, fans with the repellent built in, chemically treated clothing and good old bug spray. I also tried a high-tech patch that is not set to be released until next year. What I found was this: All of the current products offered varying levels of protection, but nothing worked as well as traditional chemical repellent. Nothing, that is, until I tested the patch, which could very well remove humans from the mosquito food chain for good.



The stakes are high. So far, 40 states have recorded cases of West Nile virus. According to the World Health Organization, mosquitoes remain the deadliest animal on the planet, carrying diseases like West Nile, chikungunya and malaria that kill more than a million people a year. Any new technology that effectively and consistently repels mosquitoes will not only make summers more comfortable — it will save lives.

My first mosquito test used an array of colorful, kid-safe bands doused in natural plant oils such as citronella, geranium oil, rosemary, lemongrass and mint. I tried a slap-on bracelet called Buglet that comes in a rainbow of colors and with cute animal characters. I also tested a more understated plastic wearable called Bugband and a Velcro version called Parakito. They all smelled great and looked good, but they didn't keep the mosquitoes away for long. While they didn't land directly on the bands, they weren't shy about chowing down just a few inches from them.

My Alaska family swears by the Off Clip On — a cellphone-size fan that attaches to the top of your pants or to a pocket. Flip a switch, and it circulates an odorless repellent made with metofluthrin. The device costs a little less than \$10, batteries included. According to the package, it contains enough repellent to last 12 hours.

It worked better than the natural repellents, but it's best suited when sitting relatively still, such as lounging in a backyard, watching a game or working in a small area of a garden. The device won't do much for hikers or golfers. A promotional video notes, "When you are stationary, you're in the protected zone."

Metofluthrin in vapor form has been deemed safe by the Environmental Protection Agency for use in the device, but it's not to be inhaled or applied to skin. As with all chemical repellents, users have to decide their comfort level with them.

Next, I wore clothing treated in permethrin, a synthetic chemical that acts like the natural extracts from the chrysanthemum flower and kills insects when they puncture it. I wore hoodies and pants from Exofficio for my test. The clothing worked reasonably well and was definitely better than nothing. But while the mosquitoes didn't penetrate the clothing, they were perfectly at home swarming around me and occasionally landing on any patch of bare skin they could find.

The only thing that worked really well is the stuff that worked well 40 years ago, back when I was just a young, fresh mosquito target traipsing across the tundra: bug spray with DEET. The more, the better. Sure, it can melt plastic, comes with a list of warnings to rival those in prescription drug commercials, and ate my nail polish off in a matter of minutes, but when it's me versus mosquitoes in a winner-take-all-my-blood feeding frenzy, I use what works. (Did I mention that mosquito swarms in Alaska can become so bad they've been known to asphyxiate caribou?)

The good news is that another option — a patch that essentially creates a mosquito-repelling force field around your body — may be available as soon as next summer. To learn more, I visited Kite, a large warehouse-like laboratory in Riverside, Calif.

Kite's facilities feel more like a South Florida swamp than the birthplace of humanity's ultimate weapon against mosquitoes and mosquito-borne illnesses. The rooms inside the lab are hot, humid, sticky and smelly, and filled with more than 100,000 mosquitoes in various stages of their life cycles. "That's mosquito birth you're smelling," said Grey Frandsen, a mosquito mercenary of sorts who guided me through Kite.

A team of scientists and tech-savvy entrepreneurs are putting the finishing touches on a stickerlike patch, meant to be worn on clothing, that essentially makes humans invisible to mosquitoes. To find out if it works, I made the ultimate sacrifice, placing my untreated, unprotected arm inside a fish-tank-like test box filled with mosquitoes. What ensued was exactly what you might imagine. They came, they saw, they sucked — around 35 bites in less than a minute. Yes, it was awful.

Next, I tried protecting my arm with the array of products (bands, clothing and DEET spray) that I had sampled. In Alaska, with results similar to what I experienced in the field: mixed reviews and



definitely not game changing.

Then came a test of the Kite compound. The patch, which isn't available yet, smelled an awful lot like cloves, and as I inserted my arm into the glass box again, no mosquitoes landed anywhere near it.

During my time at Kite's facility, I wasn't able to talk anyone into telling me exactly what the highly coveted proprietary blend is made of, only that the first version to be released in 2016 — the one I tried — is made of plant-based fragrances and other compounds that don't require E.P.A. approval. A second version is awaiting regulatory approval for 2017.

The new compound works by confusing a mosquito's senses, hindering its ability to target us based on the carbon dioxide we exhale, and confounding its capacity to locate us up close. The Kite compound was effective in the lab, but the ultimate test will come once it can be worn in all corners of the mosquito-covered planet.

If that happens, it means that in the age-old battle of humans versus mosquitoes, humans may finally have a shot at winning.

MOSQUITO DISCUSSION

DENGUE AND CLIMATE: SCIENTISTS TACKLE THE NUANCES

Climate change is one factor, but there's more to the story

August 4, 2015

For more than a decade, scientists have known that the mosquitoes transmitting dengue fever have been moving from the tropics north into the United States—as far north as New Jersey, with outbreaks in Brownsville, Texas, and heavily touristed Key West, Florida.

Now NCAR scientists and their colleagues are learning more about why certain areas are prone to dengue outbreaks while others aren't, and what factors can best predict the future impact of the disease also known as "breakbone fever."

"Climate change is an important factor in the development of the mosquitoes that carry dengue viruses, but it may not be the primary driver of dengue," said NCAR scientist Mary Hayden, a medical anthropologist.

NCAR scientist Mary Hayden takes samples from a water-filled tire in Brownsville, Texas, to test for the mosquito species that transmits dengue fever. Brownsville has experienced dengue outbreaks in 2005 and 2013. (Photo courtesy Mary Hayden, NCAR.) "Climate change is important at large scales, but as you move to specific locations, it becomes one of many factors that affect disease



and transmission risk," added meteorologist Andrew Monaghan, another member of the NCAR team. He explained that other factors include the areas where mosquitoes breed and develop, local disease prevention efforts, socioeconomic conditions, and human population density. To better understand this complicated issue, NCAR experts in climate, weather, disease, and behavioral science have been examining dengue for nearly a decade, in collaboration with various universities and federal agencies, including the Centers for Disease Control and Prevention. "We've built a multidisciplinary team, which is what's needed to understand how all the factors interact," said Hayden.



A half-century ago, less than 10 countries experienced serious dengue epidemics. Dengue viruses, transmitted by several species of *Aedes* mosquitoes, are now passed from human to mosquito to human at endemic levels in more than 100 countries, according to the World Health Organization. Symptoms typically include a sudden high fever, severe headache, and joint pain.

Estimates of annual infections range from 50 million to 400 million people worldwide, with about 500,000 hospitalized. Young children especially are vulnerable. There are about 12,500 deaths each year from dengue, WHO reports.

An outbreak in Key West in 2009–2010 represented the first dengue cases in the continental United States outside the Texas-Mexico border region since 1945. The number of cases in this country remains small but several recent outbreaks, including one in Brownsville, Texas, in 2013, have health officials concerned. Hayden and others believe dengue is underreported in the United States, in part because of low awareness.

The good news is that research and fieldwork to date indicate that it takes a nearly “perfect storm” of climatic, socioeconomic, and human behavioral factors for the mosquito to thrive in the United States, Hayden said.

For optimal development, the mosquitoes want to be in a “sweet spot” of 77 to 90 degrees Fahrenheit (25 to 32 degrees Celsius) with as few fluctuations as possible, Monaghan said. So even though one would expect dengue fever in Nogales, Mexico—given its prevalence in nearby cities just south—temperatures, especially at night, typically are cool enough to thwart an outbreak.

The mosquito depends on humans for “blood meals,” but also is effective at hitching rides on trucks, cargo ships, and the like. In South America, Hayden and colleagues want to study the surprising emergence of dengue in the Galapagos Islands, off the coast of Ecuador.

Hayden spends much of her time examining how human perceptions and behavior can increase disease risk. She has conducted household surveys in the U.S. dengue hot spots of Brownsville and Key West. That research included hunting for outdoor surfaces favorable to mosquito breeding, such as old tires, tarps, and other objects that capture standing water. In 2012, Hayden and colleague Kacey Ernst (University of Arizona) conducted a survey of 400 Key West households that showed an abundance of potential breeding sites.

Monaghan said scientists increasingly are simulating dengue’s future impact—taking climate change, population trends, and other factors into account. He would like to expand these computer models to include the effectiveness of local interventions such as public awareness education and the use of biological agents to kill larvae and adult mosquitoes.

“We’re interested in learning how we can best intervene to reduce the threat of dengue outbreaks,” he said. “As climate change continues, we’re looking for the drivers we can control at the local level.”

DID YOU KNOW?

Climate change has led to swarms of giant mosquitoes responsible for the death of baby reindeer

CLIMATE change has already been blamed for rising sea levels and droughts, but now it appears it has also led to swarms of giant mosquitoes responsible for the death of baby reindeer.

News.com.au AUGUST 04, 2015

A mosquito begins its life as an egg in a pond before hatching into larvae and ultimately transforming into the flying bloodsucker we hate so much.

The speed with which this process happens is dictated by their sensitivity to temperature. Greenlandic mosquitoes won’t hatch until the water has been frozen and then warmed.

According to an ecologist studying mosquitoes in the dusty town of Kangerlussuaq, Greenland, this is where the problem lies.



NEW ZEALAND BIOSECURE



British Arctic specialist Lauren Culler has discovered climate change has been causing mosquitoes to arrive much earlier in the year than normal.

“In the years when the ponds thaw and they heat up really quickly the mosquitoes go through their development faster which means there are fewer days to be eaten by a predator,” she told Motherboard.

“Lab studies, field studies and population models show that a warming climate means more mosquitoes survive until adulthood.”

As the mosquitoes reach adulthood, they go on the search for the blood meal they need to reproduce, however the location of Greenland means this is often easier said than done.

“My research here has found that only 12-15 per cent of mosquitoes ever get a blood meal,” she said.

This means when a meal does become available, the mosquitoes will swarm their victim hoping for a taste of its precious blood.

“They’re aggressive because they’re desperate,” she said.

While this is bad news for humans, it is even worse for the caribou (reindeer) migrating to the area to birth their calves.

In the past, the caribou would not be at risk from the mosquitoes because they would arrive before the little pests were born, however changes in the climate means this is no longer the case.

In order to escape the heavy presence of mosquitoes, the caribou seek refuge in environments free from the pests such as windy areas on top of glaciers.

However, Ms Culler points out these safe environments often lack many of the food sources the animals require to survive and, as a result, the calves die from malnourishment.

“Every moment that a caribou spends avoiding insects is another minute that they’re not doing what caribou need to do so that they can successfully raise calves,” she said.

While getting rid of the mosquitoes may seem like the easiest solution, Ms Culler said they are an important to the ecosystem and must stay.

So, for now there is no solution to the problem.