Buffalo fly faces Dengue nemesis

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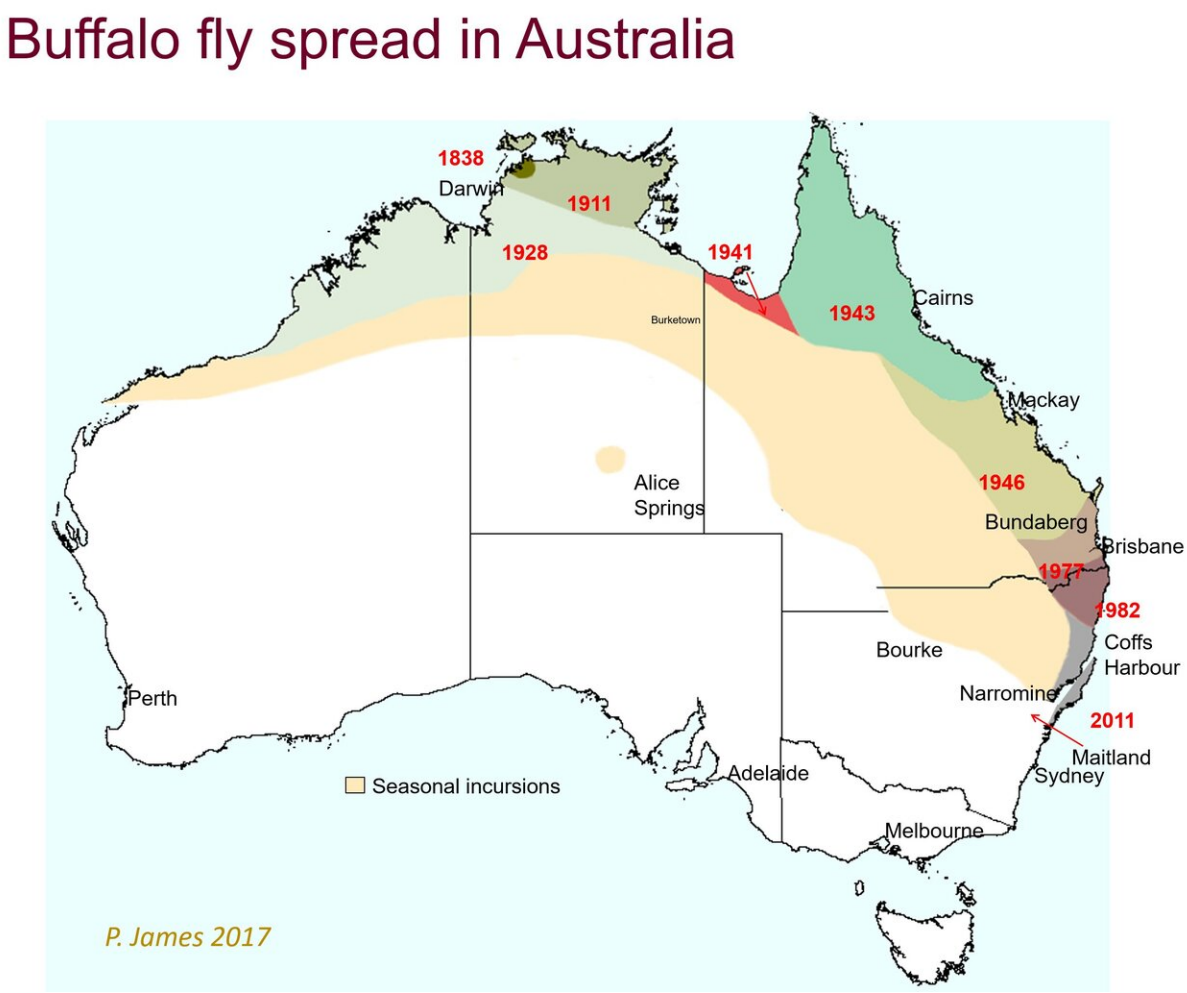

Credit: University of Queensland

Few beef producers in the temperate climate of southern Australia will

have encountered the parasitic buffalo fly (Haematobia irritans exigua), a scourge of the cattle industry in the country's tropical and subtropical north—but maintaining this state of affairs, and also lifting a burden off the northern industry, has become a race against time, and climate.

Buffalo fly is a serious animal health and production challenge, costing the northern Australian cattle industry almost $100 million a year in treatments and lost production. But control of the pest with insecticides is running into increasing resistance, plus there is a need to protect Australian beef's 'clean green' reputation and so minimize the need for pesticides.

Over the past century the buffalo fly has been creeping southwards through Queensland to northern New South Wales and modeling shows that, aided by climate change, it could reach as far south as South Australia and south-west Western Australia by 2030. The blood-sucking fly causes large, painful sores and distressed animals can be distracted from feeding enough to seriously affect growth.

The only obstacle in its path is a joint university, industry and Queensland Government biological control project using the insect-infecting bacterium, Wolbachia—the same agent that has been used so successfully to suppress mosquito-transmitted dengue fever in humans.

The project is led by Dr. Peter James from the Queensland Alliance for Agriculture and Food Innovation (QAAFI) at The University of Queensland, who explains the key is using the Wolbachia bacterium to break the fly's breeding cycle. If this can be sustained it presents an opportunity to both suppress the buffalo fly population in the north and stop its spread southwards.

The buffalo fly is a formidable foe, having been introduced from Asia into the Northern Territory in the late 1830s, but the chink in its armor is

it weakens in cold weather. Its populations tend to shrink into localized pockets. Dr. James says if Wolbachia can be used to further stress the buffalo fly in winter, then a local eradication strategy starts to become a real possibility.

But there are some considerable technical challenges still to overcome. Because the bacterium is spread vertically from mother to offspring, not transferred sideways amongst flies, buffalo flies have to be artificially infected by microinjection. With mosquitoes, this is usually done by microinjection into the eggs. That approach hasn't been able to be used for buffalo fly because the eggs are extremely hard: "When we started micro-injecting eggs, as is done with mosquitoes, we were blunting needles and damaging the eggs like you wouldn't believe. Needles were even breaking," says Dr. James.

"So from there we looked at micro-injecting adult flies or pupae, the idea being the bacterium would still spread through the insect and get into the germinal tissue of the females."

He says the main thing is to establish the bacterium in the population because once flies are infected, three control scenarios open up. While Wolbachia is a maternally transmitted bacterium, through eggs, male flies can still be used to manipulate this.

If a Wolbachia infected male mates with a healthy female the eggs will be infertile and so no offspring. Conversely, if a healthy male mates with an infected female the mating will be successful with eggs and offspring produced, but they will be carrying Wolbachia and help to spread it through the buffalo fly population. Dr. James says the advantage of this is that it saves researchers having to otherwise breed and release millions of infected or sterile flies.

"But Wolbachia also has a whole lot of other impacts on fly population

fitness. We have shown that just the presence of the bacterium can shorten the buffalo flies' lifespan, reduce the number of eggs laid, and the number of pupae that hatch. There are probably also other fitness penalties that we haven't yet identified. If you start to add up all these impacts, that can be a heavy load on survivability.

"And this is where the winter factor comes. In many areas the buffalo fly only just hangs on in low numbers through winter so even Wolbachia's effect on population fitness could be enough to wipe out these populations if the bacterium is deployed strategically."

A second approach is to use Wolbachia to block transmission of the Stephanofilaria nematode transmitted by buffalo flies and associated with the development of buffalo fly lesions on the cattle. Similar to the way that Wolbachia blocks transmission of dengue virus, zika virus and a number of other viruses transmitted by mosquitoes, it has also been shown to block transmission of some nematodes closely related to Stephanofilaria. Spread of Wolbachia through the buffalo fly population could block the nematode and alleviate lesion development

A third option being explored is to breed and release sterile males.

"Again, the idea is to use the sterile males strategically by releasing them into those overwintering areas that are already in a weakened state. This could stop or slow the build-up of buffalo fly in the next season or stop the southerly spread or even provide the basis of local eradication strategies."

Dr. James says the challenge now is to improve the consistency and persistence of Wolbachia infection. Since the Wolbachia project started in 2017 researchers have achieved the first big challenge of taking different Wolbachia strains from mosquitoes and also fruit fly and introducing them into a whole new species, the buffalo fly: "Wolbachia

has been carried across generations in a number of instances, but we have yet to produce a stably infected strain," he explains.

"But we have reached the stage where we can start finessing the approach. For example we have a project looking at ways to immunosuppress the fly to favor Wolbachia infection.

"We've built up a reasonable toolbox so I am confident we are close to providing sustainable biological control that will deliver economic animal welfare relief to the northern cattle industry, and save the southern industry from ever having to endure the same burden."

More information: Mukund Madhav et al, Transinfection of buffalo flies (Haematobia irritans exigua) with Wolbachia and effect on host biology, *Parasites & Vectors* (2020). DOI: 10.1186/s13071-020-04161-8

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