CHAPTER 8
ONLINE CASE
STUDY

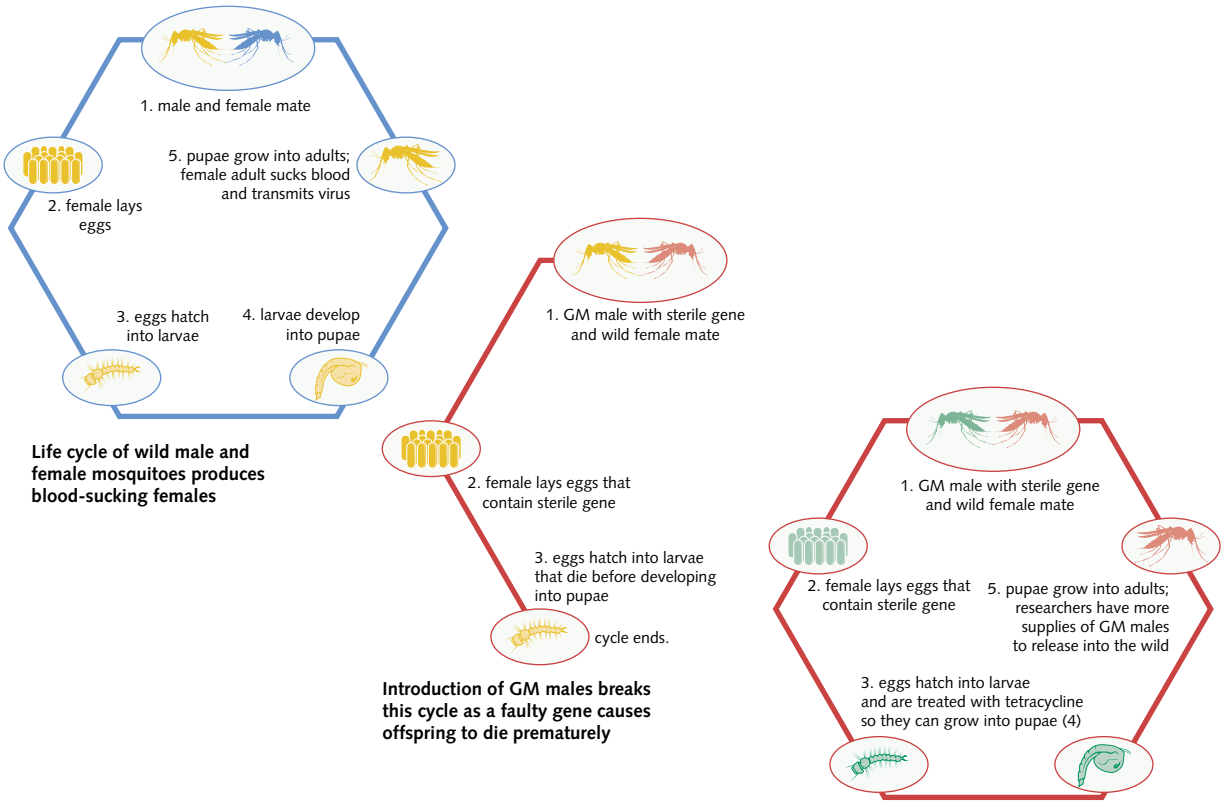
A devastating coincidence: avian malaria in Hawaii

Avian malaria has potentially been present in Hawaii for thousands of years due to annual visits from over a million migratory birds. However, its prevalence has been exacerbated by deliberate introductions of birds in the 1800s by European visitors following the archipelago's first documented contact with European explorers in 1778. Despite the presence of the disease, endemic species such as the Hawaiian honeycreepers (Drepinadiidae) were initially safe as there was no **vector** to transmit it from infected visiting or introduced individuals.

Then, in 1826, the visiting ship Wellington drained its dregs into a river on Maui. This contained the mosquito larvae of *Culex quinquefasciatus*, a vector for the *Plasmodium relictum* parasite. *Culex quinquefasciatus* has a flight range of 14 miles, and can breed in 30% sea water, causing it to spread swiftly to all the major Hawaiian islands. With a vector capable of feeding on infected introduced or migratory birds, avian malaria was transmitted quickly to endemic resident species of honeycreeper (Figure A). Moreover, the introduction of smallpox in the second half of the 19th century aggravated the problem, killing birds that had already been weakened by malarial infection. Avian malaria has subsequently contributed towards the decimation of endemic avian diversity, with 71 of 113 endemic species now extinct and another 32 classified as endangered or threatened.

Online Case Study 8 Figure A The 'i'iwi or scarlet honeycreeper *Vestiaria coccinea* is highly susceptible to disease spread by the mosquito *Culex quinquefasciatas*.

Image of *Vestiaria coccinea* courtesy of Ludovic Hirlimann/ CC BY-SA 2.0.



Online Case Study 8 Figure B Using transgenic mosquitoes to control population size and reduce spread of avian malaria.

Redrawn. Original image © Green Times (http://thegreentimes.co.za/).

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Mosquitoes are found throughout the year at elevations up to 600 m. This restricts species such as honeycreepers, which are extremely susceptible to avian malaria, to forests above this height. However, seasonal temperature and rainfall fluctuations allow mosquitoes to reach heights of 1500 m, periodically causing epidemics of malaria. Climate change may serve to increase disease transmission in mid-elevation habitats.

Several strategies for the control of mosquitoes have been implemented. The formation of conservation partnerships, such as the West Maui Mountains Watershed Partnership and the Three Mountain Alliance on Hawaii Island, unifies the resource management of public and private land, and enables landscape-level control of avian malaria, while introduced feral pigs have been removed as they can create larval habitat for mosquitoes in forests. Biological introductions have been a popular and mostly successful tool in the control of introduced species to Hawaii, and two freshwater fish (*Gambusia affinis* and *Mollienesia latipinna*) that eat mosquito larvae have become well established in Hawaiian streams and ponds (an example of biological pest management**:** Section 9.4.3).

Newer techniques allow the creation of transgenic mosquitoes that carry a lethal trait, killing the offspring of those released, and may be a successful way of reducing their efficacy as a vector of *Plasmodium* (Figure B). This technique has been used in other mosquito species to reduce transmission of human malaria. Before a genetically modified mosquito release can be initiated there are many technical and regulatory issues to overcome, not least developing existing methods to work successfully on *C. quinquefasciatas*.

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FURTHER READING

Overview of avian malaria in Hawaii: Atkinson, C.T. & LaPointe, D.A. (2009) Introduced avian diseases, climate change and the future of Hawaiian honeycreepers. *Journal of Avian Medicine and Surgery*, Volume 23, 53–63.

Conservation of honeycreepers: Scott, J.M., Kepler, C.B., van Riper III, C., & Fefer, S.I. (1988) Conservation of Hawaii's vanishing avifauna. *BioScience*, Volume 38, 238–253.

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