

**From:** Joshua Kim <jkim388@hawaii.edu>  
**Sent:** Wednesday, February 21, 2024 9:39 AM  
**To:** DLNR.BLNR.Testimony  
**Subject:** [EXTERNAL] Testimony for 2/23/24 Agenda Item C.1.  
**Attachments:** JKIM Written Testimony.pdf

Hello,

I am writing to provide written testimony for agenda item C.1.: Request for Approval for the Use of a Request for Proposals for Mosquitoes for Incompatible Insect Technique Deployment on Kaua'i.

Very Respectfully,

Josh Kim

J.D. Candidate, Class of 2024

William S. Richardson School of Law | University of Hawai'i at Mānoa

(203) 892-7638

Chairperson Dawn N.S. Chang  
Board of Land and Natural Resources  
1151 Punchbowl Street Room 131  
Honolulu, HI 96813

RE: Proposals for Mosquitoes for Incompatible Insect Technique (IIT) Deployment on Kauaʻi  
(Agenda item C.1.)

Dear Chair Chang and Members of the Board of Land and Natural Resources,

My name is Josh Kim, and as a Hawaiʻi resident and current student at the University of Hawaiʻi William S. Richardson School of Law, I respectfully provide the following comments regarding the use of mosquitoes for IIT on Kauaʻi. I encourage the board to authorize the implementation of IIT as quickly as possible and to bolster forest management tools, such as invasive species removal, fencing, and native plant restoration.

The Hawaiian honeycreepers are considered to be one of the most diverse groups of birds in the world. Historically, more than fifty species lived in Hawaiʻi, but only seventeen remain. Many of which face extinction. One of the greatest threats to these species is mosquitoes' spread of avian diseases. There used to be a clear physical separation between the honeycreepers' and mosquitoes' habitats because mosquitoes live in warmer, lower elevations. However, the increasing average temperatures experienced in Hawaiʻi due to climate change have put the remaining honeycreeper populations at risk of extinction in the next two to five years as mosquitoes are spreading to higher elevations, honeycreeper habitats are destroyed, and invasive species outcompete our native birds.

IIT is one of the most effective and safe methods of reducing mosquito populations. Using male mosquitoes that carry the incompatible strain of Wolbachia to mate with wild mosquito females to produce non-viable offspring has very few risks to the environment and public health. However, this method can be expensive and requires time to reduce the mosquito populations on Kauaʻi effectively. Additionally, while reducing mosquito populations is a solution to the greatest risk facing honeycreepers, an integrated management approach championed by the Birds, Not Mosquitoes multi-agency partnership is required to ensure the safety of Hawaiian honeycreepers for generations to come.

I am hopeful for the survival of Hawaiian honeycreepers as this Board has taken major steps in implementing IIT and has issued a Finding of No Significant Impact for both the federal and state environmental assessments. Nonetheless, I implore this Board to continue to engage the public for comment and support, consider establishing a facility to produce incompatible male mosquitoes in Hawaii rather than relying on mainland facilities, and support the other methods included in the integrated management approach to saving Hawaiian honeycreepers.

Sincerely,

Josh Kim  
(203) 892-7638 || [jkim388@hawaii.edu](mailto:jkim388@hawaii.edu)

**From:** Tina Lia <tinalia@live.com>  
**Sent:** Wednesday, February 21, 2024 8:44 PM  
**To:** DLNR.BLNR.Testimony  
**Subject:** [EXTERNAL] BLNR Meeting 2/23/24 9:00am Testimony Agenda Item C1: Oppose  
**Attachments:** 2023\_0620\_Dr.  
\_Lorrin\_Pang\_Statement\_and\_CV\_Hawaii\_Unites\_and\_Lia\_v\_BLNR\_and\_DLNR\_Plaintiffs\_Motion\_for\_TRO\_Preliminary\_Injunction\_Filed.pdf

**Subject:** BLNR Meeting 2/23/24 9:00am Testimony Agenda Item C1: Oppose

RE: BLNR Meeting 2/23/24 9:00am Testimony Agenda Item C1: Oppose

Hawai'i Unites is a nonprofit organization dedicated to the conservation and protection of our environment and natural resources. We are opposed to the BLNR's 2/23/24 agenda item C1 DOFAW "Request for Approval for the Use of a Request for Proposals for Mosquitoes for Incompatible Insect Technique (IIT) deployment on Kaua'i; and Request for Approval for a Delegation of Authority to the Chairperson to Award, Execute, and Extend Agreements with Successful Providers."

The "Final Environmental Assessment for Use of *Wolbachia*-based Incompatible Insect Technique for the Suppression of Non-native Southern House Mosquito Populations on Kaua'i" states the following in reference to a commenter's concern about monitoring the response of birds to this bacteria-infected mosquito release experiment:

"Monitoring of birds is beyond the scope of this EA."

"Monitoring the response of forests bird to mosquito suppression via the Incompatible Insect Technique (IIT) mosquito control is outside the scope of the proposed action of this EA."

The environmental assessment (EA) specifically states that the managing agencies take no responsibility for the effects of the mosquito releases on the native birds this plan is purported to protect. Therefore, the entire basis of this project is fraudulent.

These mosquitoes are an experiment that could harm the health of the people, wildlife, and ecosystems of Kaua'i. Peer-reviewed studies have shown *Wolbachia* to cause mosquitoes to become more capable of transmitting avian malaria and West Nile virus (bird and human). Southern house mosquitoes transmit human diseases, including West Nile virus, elephantiasis, encephalitis, and potentially Zika virus. Male mosquitoes transmit bacteria and pathogens to females. Pathogen screenings for these lab-altered mosquitoes are unknown, and that information is being withheld from the public. EPA guidelines allow for the release of thousands of female mosquitoes that bite, breed, and spread disease. No biosecurity protocols for the imported mosquitoes have been disclosed, and no mitigation measures are in place if something goes wrong. Population replacement of wild mosquitoes with the lab-altered mosquitoes could cause significant impacts.

The *Birds, Not Mosquitoes* multi-agency partnership, the proposing agency State of Hawai'i Department of Land and Natural Resources (DLNR), and the approving agency State of Hawai'i Board of Land and Natural Resources (BLRN) have failed to address tropical disease expert Dr. Lorrin Pang's serious concerns about horizontal transmission of introduced bacteria, biopesticide wind drift of lab-altered mosquitoes into unintended areas, superinfection of mosquitoes with multiple bacteria strains, increased pathogen infection and disease-spreading capability in mosquitoes, and the experimental nature of the release plan.

No studies have been done to evaluate the direct, indirect, and cumulative impacts of these mosquito releases. These lab-altered southern house mosquitoes, and the *Wolbachia* bacteria they're infected with, are life forms, and there is no way for this experimental project to be self-contained. The release of these mosquitoes could cause the extinction of endangered native birds, and it may impact people's health.

Mosquitoes for this biopesticide are foreign organisms that originate from Palmyra Atoll. *Wolbachia* bacteria for this biopesticide are foreign organisms that originate from Kuala Lumpur in Malaysia. *Birds, Not Mosquitoes* partnering agencies have repeatedly lied to the public about the details of this project and the import and release of foreign organisms.

It is unconscionable that this multi-agency partnership continues to risk the health of Hawai'i's people, wildlife, and 'āina with this dangerous biotech industry experiment. Agency partners have had over seven years to do the necessary comprehensive studies required by the Hawai'i Environmental Policy Act (HEPA) for a project of this scope, magnitude, and potential significant impact. There is no excuse for the lack of study, failure to complete an Environmental Impact Statement, and willful disregard for the voice of the people opposed to the release of these lab-altered mosquitoes on our island home.

This desecration of sacred lands will be your legacy, and you can be sure the story will continue to be told.

The mission of Hawai'i Unites is honoring and protecting our sacred connection to the natural world. We stand in solidarity with the Kingdom of Hawai'i and denounce all unlawful actions against these lands.

Aloha,  
Tina Lia  
Founder  
Hawai'i Unites  
[HawaiiUnites.org](http://HawaiiUnites.org)

Attached: CV and Statement of Dr. Lorrin Pang

MARGARET WILLE & ASSOCIATES LLLC  
Margaret Wille #8522  
Timothy Vandevener #11005  
P.O. Box 6398  
Kamuela, Hawai'i 96743  
MW: (808) 854-6931  
TV: (808) 388-0660  
mw@mwlawhawaii.com  
tim@mwlawhawaii.com

Attorneys for Plaintiffs  
Hawai'i Unites and Tina Lia

**Electronically Filed**  
**FIRST CIRCUIT**  
**1CCV-23-0000594**  
**20-JUN-2023**  
**10:59 AM**  
**Dkt. 37 MOT**

IN THE CIRCUIT COURT OF THE FIRST CIRCUIT

STATE OF HAWAI'I

HAWAI'I UNITES, a 501(c)(3) nonprofit  
corporation; TINA LIA, an individual,

Plaintiffs,

v.

BOARD OF LAND AND NATURAL  
RESOURCES, STATE OF HAWAI'I, and  
DEPARTMENT OF LAND AND  
NATURAL RESOURCES, STATE OF  
HAWAI'I,

Defendants.

Civil No. 1CCV-23-0000594 (JMT)  
(Environmental Court)

**PLAINTIFFS' MOTION FOR  
TEMPORARY RESTRAINING  
ORDER AND PRELIMINARY  
INJUNCTION; MEMORANDUM IN  
SUPPORT OF MOTION;  
DECLARATION OF COUNSEL;  
DECLARATION OF TINA LIA;  
DECLARATION OF DR. LORRIN W.  
PANG; EXHIBITS 1-11; NOTICE OF  
HEARING; CERTIFICATE OF  
SERVICE**

HEARING MOTION

Judge: Hon. John M. Tonaki  
Hearing Date: July 21, 2023  
Hearing Time: 9:00 a.m.

MARGARET WILLE & ASSOCIATES LLLC  
Margaret Wille #8522  
Timothy Vandevener #11005  
P.O. Box 6398  
Kamuela, Hawai'i 96743  
MW: (808) 854-6931  
TV: (808) 388-0660  
mw@mwlawhawaii.com  
tim@mwlawhawaii.com

Attorneys for Plaintiffs  
Hawai'i Unites and Tina Lia

**Electronically Filed**  
**FIRST CIRCUIT**  
**1CCV-23-0000594**  
**20-JUN-2023**  
**10:59 AM**  
**Dkt. 41 DEC**

IN THE CIRCUIT COURT OF THE FIRST CIRCUIT

STATE OF HAWAI'I

HAWAI'I UNITES, a 501(c)(3) nonprofit  
corporation; TINA LIA, an individual,

Plaintiffs,

v.

BOARD OF LAND AND NATURAL  
RESOURCES, STATE OF HAWAI'I, and  
DEPARTMENT OF LAND AND  
NATURAL RESOURCES, STATE OF  
HAWAI'I,

Defendants.

Civil No. 1CCV-23-0000594 (JMT)  
(Environmental Court)

**DECLARATION OF**  
**DR. LORRIN W. PANG**

## DECLARATION OF DR. LORRIN W. PANG

I, DR. LORRIN W. PANG, under pain of perjury and law, do hereby state and declare as follows:

1. I am a resident of the County of Maui in the State of Hawai‘i.
2. I am over the age of eighteen (18).
3. I believe that the intent to save rare birds is sound and if the action called “Suppression of Invasive Mosquito Populations to Reduce Transmission of Avian Malaria to Threatened and Endangered Forest Birds on East Maui” (“the Action”) goes as planned, this would be a valuable tool for future interventions. However, with new life forms coming to the islands, there is too much potential for unexpected, dangerous, irreversible “evolutionary” events. This is especially true when the new organisms cannot be contained to their target ecosystem.
4. I have been compiling studies documenting horizontal *Wolbachia* bacterial spread, and I’m concerned about the potential for significant adverse outcomes of the Action.
5. The evidence of horizontal spread of *Wolbachia* bacteria (documented in peer-reviewed studies) shows that the bacteria go not only to sexual cells, but also to somatic cells (non-sexual cells of the body). *Wolbachia* can also live outside of intra-cellular systems for several months. Horizontal transmission of the *Wolbachia* bacteria can occur through mating, shared feeding sites, and serial predation of larva in standing water breeding sites. Studies that downplay the possibility of horizontal transmission based on aedes aegypti mosquitoes are flawed references because aedes aegypti are resistant to *Wolbachia*.
6. Peer-reviewed studies have shown *Wolbachia* bacteria in mosquitoes to cause increased pathogen infection and to cause mosquitoes to become more capable of spreading diseases such as avian malaria and West Nile virus. West Nile virus can infect birds and humans. This project has the potential to cause the extinction of endangered native birds, and it could impact human health.
7. The final EA for the Action failed to address biopesticide wind drift – the movement of biopesticide mosquitoes through wind to unintended areas. Mosquitoes carried on the wind into and out of the release sites of the project area have not been factored into the math model or the overall plan.
8. The final EA for the Action failed to adequately address the potential for the release of biopesticide mosquitoes to cause unexpected evolutionary events and population replacement.

## AUTHENTICATION

1. Attached hereto as **Exhibit 9** is a true and correct copy of my CV/Resume.
2. Attached hereto as **Exhibit 10** is a true and correct copy of a statement further detailing my concerns regarding the action called "Suppression of Invasive Mosquito Populations to Reduce Transmission of Avian Malaria to Threatened and Endangered Forest Birds on East Maui".
3. Attached hereto as **Exhibit 11** is a true and correct copy of an undated draft research article that I co-authored with other scientists entitled "Barriers with valve mechanisms are predicted to protect crops from Rat Lungworm disease transmitted by slug hosts" highlighting how population changes are often determined by pathways set up in parallel, not just sequentially; that models must be set up by the initial assumptions with the math derivations of the formula to follow; that the models must predict intuitively the changes in populations when extreme limits are reached (steady state and non-steady state); that tracking units of the parameters of the math expression is a very useful practice in complicated models. Because this draft article is awaiting publication and the copyright does not belong to me, I asked that it be filed under seal.

## FURTHER DECLARANT SAYETH NAUGHT

This Declaration is based upon my personal knowledge or as otherwise indicated, and I am competent to testify as to the truth of the statements contained herein.

DATED: Wailuku, Hawai'i, June 18, 2023.

Signed: \_\_\_\_\_

  
Dr. Lorrin W. Pang



CURRICULUM VITAE 2018

Name: Lorrin Wayie Pang

Military Rank: Lt. Colonel, Medical Corp (Retired)  
Walter Reed Army Institute of Research

Date/Birthplace: 30 March 1953  
Honolulu, Hawaii

Wife's Name: Kathleen K. Shida Pang

Children Two daughters

Education/Training: 1971-75 Princeton University, BS  
Chemistry, Cum Laude

1975-79 Tulane Medical School, MD

1976-79 Tulane School of Public Health  
MPH in Tropical Medicine

1979-80 Federal University of Brazil;  
Recife, Pernambuco, Post Graduate  
Studies in Pathology and Infectious Diseases

1980-81 Letterman Army Hospital, San  
San Francisco, CA, Medicine Intern

1981-82 Walter Reed Army Institute of  
Research, Washington DC, Preventive  
Medicine Residency

Positions Held: 1982-87 Epidemiologist, AFRIMS (Walter Reed  
Inst. Overseas Laboratory) Bangkok, Thailand

1987-90 Chief, Preventive Medicine Service,  
Tripler Army Medical Center, Honolulu, Hawaii

1987-89 Clinical Associate Professor, School of Public Health,  
University of Hawaii, Honolulu, Hawaii

1990-92 Medical Officer, Malaria Unit,  
World Health Organization, Geneva, Switzerland.

1992-97 Clinician/Epidemiologist,  
Walter Reed Institute of Research  
Overseas Laboratory, Brazil.

1994-95 Adviser to Pan American Health  
Organization (Meningitis Vaccine)

1985-05 Adviser to World Health/UNDP  
Organization (Tropical Disease Research Unit: Chagas  
Disease, Leishmaniasis, Malaria, Clinical Trials),  
2000 malaria program changed to United Nations Global  
Fund (for work in Central America)

1997-00 Chief, Department of Bacteriology and Molecular Genetics,  
AFRIMS,  
Walter Reed Institute of Research  
Overseas Laboratory, Bangkok, Thailand.

1997-00 Faculty of Tropical Medicine,  
Mahidol University, Bangkok, Thailand.

2000-Present District Health Officer, Maui County  
State of Hawaii

2002-04 Consultant Glaxo Smith Kline Pharmaceuticals-

2013 Consultant DNDI (Drugs for Neglected Disease Initiative,  
affiliate of Doctors without Borders)

2013 Visiting Professor of Medicine, Federal University of  
Brasilia, Brazil

2013-Present Reviewer of grants for US Congress (CDMRP, Congress  
Directed Medical Research Program)

Awards: Army Achievement Medal, 1982, 1996  
Army Research and Development Medal, 1987  
Army Meritorious Service Medal, 1990, 1997

Certification: Medical License State of Louisiana, 1980- 2000  
Hawaii State License, 2000-present  
Board Certification in Preventive Medicine, 1990

2002 Discovery Channel feature covering dengue outbreak and eradication on Maui

2006-8 listed on Americas Best Doctors list (3% of nation's doctors)

Publications Peer Reviewed Journals:

1. Lemon SM, Miller RN, Pang LW, Prier RE, Bernard KW. Failure to achieve predicted antibody responses with intradermal and intramuscular human diploid cell rabies vaccine. *Lancet* 1984;19:1098-1100.
2. Webster HK, Boudreau EF, Childs GE, Yongvanitchit, Pang LW. Antimalarial drug susceptibility testing of *P. falciparum* in Thailand using a microdilution radiosotope method. *Am J Trop Med Hyg* 1985;34(2):228-35.
3. Pang LW, Boudreau EF, Childs GE, Webster HK, Supernantalerk C, Somutsakorn P. The failure of large dose erythromycin in combination with standard doses of chloroquine or quinine to treat human falciparum malaria. *Bull WHO* 1985;63(4):739-43.
4. Tan SG, Green CA, Andre RG, Baimai V, Pang LW. Genetics of esterases and 6 phosphogluconate dehydrogenase in the anopheles maculatus complex. *Acta Tropica* 1986;43:113-23.
5. Childs GE, Pang LW, Wimonwattrawatee T, Pooyindee N, Nanakorn A, Limchitree S, Webster HK. *In vitro* mefloquine resistance of *Plasmodium falciparum* isolated from the Burmese border region of Thailand. *SEA J Trop Med Publ Hlth* 1987;18(4):438-43.
6. Pang LW, Limsomwong N, Boudreau EF, Singharaj P. Doxycycline prophylaxis for falciparum malaria. *Lancet* 1987;23:1161-4.
7. Webster HK, Boudreau EF, Pang LW, Permpanich B, Sookto P, Wirtz RA. Development of immunity in natural *Plasmodium falciparum* malaria antibodies to the falciparum sporozoite vaccine 1 antigen (R32tet32). *J Clin Microbiol* 1987;25(6):1002-8.
8. Harbach RE, Gingrich JB, Pang LW. Some entomological observations on malaria transmission in a remote village in northwestern Thailand. *J Am Mos Contr Assn* 1987;3(2):296-301.
9. Pang LW. Doxycycline prophylaxis for malaria (letter). *Lancet* 1987;24:970.
10. Boudreau EF, Pang LW, Dixon KE, Webster HK, Pavanand K, Tosingha L, Somutsakorn P, Canfield C. Treatment efficacy of halofantrine (WR171,669) in initial field trials in Thailand. *Bull WHO* 1988;66(2):227-35.

11. Limsomwong N, Pang LW, Singharaj P. Malaria prophylaxis with proguanil in children living in a malaria endemic area. *Am J Trop Med Hyg* 1988;38(2):231-6.
12. Pang LW, Limsomwong N, Singharaj P. Falciparum and vivax malaria prophylaxis with low dose doxycycline. *J Infect Dis* 1988;158(5):1124-7.
13. Pang LW, Limsomwong N, Webster HK, Karwacki JJ. Circumsporozoite antibodies and falciparum malaria incidence in children living in a malaria endemic area. *Bull WHO* 1988;66(3):359-63.
14. Childs GE, Pang LW. Analysis of dose-response curves for the *in vitro* susceptibility of *Plasmodium falciparum* to antimalarials using a pocket computer. *Am J Trop Med Hyg* 1988;38:15-8.
15. Pang LW, Limsomwong N, Singharaj P, Canfield CJ. Malaria prophylaxis with proguanil and sulfisoxazole in children living in a malaria endemic area. *Bull WHO* 1989;67(1):51-8.
16. Childs GE, Boudreau EF, Milhous WK, Wimonwattraatee T, Pooyindee N, Pang LW, Davidson DE. A comparison of the *in vitro* activities of amodiaquine and desethylamodiaquine against isolates of *Plasmodium falciparum*. *Am J Trop Med Hyg* 1989;40:7-11.
17. Shida KK, Lewchalermvongse B, Pang LW. *Plasmodium berghei* malaria infection causes increased cardiac output in rats. *Experiment Parasitol* 1989;68:253-9.
18. Pang LW. Chemoprophylaxis and treatment of malaria (letter). *NEJM* 1989;320:1561.
19. Boudreau EF, Fleckenstein L, Pang LW, Childs GE, Schroeder AC, Ratnavotorn B, Phintuyothin P. Mefloquine kinetics in cured and recrudescing patients with acute falciparum malaria and in healthy volunteers. *Clin Pharm Ther* 1990;48(4):399-409.
20. Desowitz R, Shida K, Pang L, Buchbinder G. *Plasmodium berghei* malaria in the rat: a model for malaria in pregnancy. *Am J Trop Med Hyg* 1990;41(6):630-4.
21. Sanchez JJ, Hoke CC, McCown J, DeFraitess RF, Takafuji ET, Diniega BM, Pang LW. Further experience with Japanese encephalitis vaccine. *Lancet* 1990;21:972-3.
22. Roscelli JD, Bass JW, Pang L. Guillain-Barre syndrome and influenza vaccination in the US Army, 1980-1988. *Am J Epidemiol* 1991;133:952-5.
23. Boudreau EF, Pang LW, Chaikummao S, Witayraut C, Thiemanum W, Pookasorn M. Comparison of mefloquine, chloroquine plus fansidar and chloroquine alone as malarial prophylaxis in eastern Thailand. *SEA J Trop Med Publ Hlth* 1991;22:183-9.

24. Sasaki D, Pang LW, Minette H, et al. Incidence and risk factors of leptospirosis in Hawaii. *Am J Trop Med Hyg* 1993;48(1):35-43.
25. Shmuklarsky MJ, Boudreau EF, Pang L, et al. Failure of doxycycline as a causal prophylactic agent against *Plasmodium falciparum* malaria in healthy non-immune volunteers. *Ann Intern Med* 1994;120(4):294-9.
26. Withers BJ, Kelley PW, Pang LW, et al. Vaccine-Preventable disease susceptibility in a young adult Micronesian population. *SEA J Trop Med Publ Hlth* 1994;25(3):569-72.
27. Kramer KJ, Pang LW, Minette HP, Perrone JB. Evaluation of the quantitative buffy coat analysis (QBC) system for the detection of *Leptospira* in human blood. *SEA J Trop Med Publ Hlth* 1994;25:788-9.
28. Andrade AL, et al. High prevalence of asymptomatic malaria in gold mining areas of Brazil. *Clin Infect Dis* 1995;20:475.
29. Pang LW, Alencar FEC, Cerutti C, et al. Hepatitis E infection in the Brazilian Amazon. *Am J Trop Med Hyg* 1995;52(4):347-8.
30. Alencar FEC, Cerutti C Jr, Durlacher RR, et al. Atovaquone and Proguanil for the treatment of malaria in Brazil. *J Infect Dis* 1997;175:1544-7.
31. Berman JD, Badaro R, Thakur CP, et al. Efficacy and toxicity of liposomal-amphotericin B (AmBisome) for visceral leishmaniasis in developing nations: A review of a TDR clinical development program. *Bull WHO* 1998;76(1):25-32.
32. Gomes M, Wayling S, Pang LW. Interventions to improve the use of antimalarials in Southeast Asia: an overview. *Bull WHO* 1998;76(S1).
33. Zalis MG, Pang L, Silveira MS, Milhous WK, Wirth DF, et al. Characterization of *Plasmodium falciparum* isolated from the Amazon region of Brazil: evidence for quinine resistance. *Am J Trop Med Hyg* 1998;58(5):630-7.
34. Cerutti C Jr, Durlacher RR, de Alencar FEC, Segurado AAC, Pang LW. *In Vivo* Efficacy of Mefloquine for the Treatment of *Falciparum* Malaria in Brazil. *J Infect Dis* 1999;180:2077-80.
35. Dalsgaard A, Forslund A, Bodhidatta L, Serichantalergs O, Pitarangsi C, Pang L, Shimada T, Echeverria P. A high proportion of *Vibrio cholerae* strains isolated from children with diarrhoea in Bangkok, Thailand are multiple antibiotic resistant and belong to heterogeneous non-O1, non-O139 O-serotypes. *Epidemiol Infect* 1999;122:217-26.
36. [Cerutti Junior C, Marques C, Alencar FE, Durlacher RR, Alween A, Segurado AA, Pang LW, Zalis MG.](#) Antimalarial drug susceptibility testing of *Plasmodium falciparum* in Brazil using a

radioisotope method. Mem Inst Oswaldo Cruz. 1999 Nov-Dec;94(6):803-9.

37. [Fonseca MO, Pang L, de Avila Sdo L, Arruk VG, Tozetto-Mendoza TR, Ferreira AW, Saes-Alquezar A, Boulos M.](#) Cross-reactivity of anti-Plasmodium falciparum antibodies and HIV tests. Trans R Soc Trop Med Hyg. 2000 Mar-Apr;94(2):171-2.

38. [Sethabutr O, Venkatesan M, Yam S, Pang LW, Smoak BL, Sang WK, Echeverria P, Taylor DN, Isenbarger DW.](#) Detection of PCR products of the ipaH gene from Shigella and enteroinvasive Escherichia coli by enzyme linked immunosorbent assay. Diagn Microbiol Infect Dis. 2000 May;37(1):11-6.

39. [Sanchez JL, Bendet I, Grogl M, Lima JB, Pang LW, Guimaraes MF, Guedes CM, Milhous WK, Green MD, Todd GD.](#) Malaria in Brazilian military personnel deployed to Angola. J Travel Med. 2000 Sep-Oct;7(5):275-82.

40. [Wongsrichanalai C, Sirichaisinthop J, Karwacki JJ, Congpuong K, Miller RS, Pang L, Thimasarn K.](#) Drug resistant malaria on the Thai-Myanmar and Thai-Cambodian borders. Southeast Asian J Trop Med Public Health. 2001 Mar;32(1):41-9. Review.

41. [Houng HS, Sethabutr O, Nirdnoy W, Katz DE, Pang LW.](#) Development of a ceuE-based multiplex polymerase chain reaction (PCR) assay for direct detection and differentiation of Campylobacter jejuni and Campylobacter coli in Thailand. Diagn Microbiol Infect Dis. 2001 May-Jun;40(1-2):11-9.

42. [Isenbarger DW, Hien BT, Ha HT, Ha TT, Bodhidatta L, Pang LW, Cam PD.](#) Prospective study of the incidence of diarrhoea and prevalence of bacterial pathogens in a cohort of Vietnamese children along the Red River. Epidemiol Infect. 2001 Oct;127(2):229-36.

43. [Wongsrichanalai C, Lin K, Pang LW, Faiz MA, Noedl H, Wimonwattrawatee T, Laoboonchai A, Kawamoto F.](#) In vitro susceptibility of Plasmodium falciparum isolates from Myanmar to antimalarial drugs. Am J Trop Med Hyg. 2001 Nov;65(5):450-5.

44. [Duarte EC, Pang LW, Ribeiro LC, Fontes CJ.](#) Association of subtherapeutic dosages of a standard drug regimen with failures in preventing relapses of vivax malaria. Am J Trop Med Hyg. 2001 Nov;65(5):471-6.

45. [Cunha ML, Piovesan-Alves F, Pang LW.](#) Community-based program for malaria case management in the Brazilian Amazon. Am J Trop Med Hyg. 2001 Dec;65(6):872-6.

46. [Pang LW, Piovesan-Alves F.](#) Economic advantage of a community-based malaria management program in the Brazilian Amazon. Am J Trop Med Hyg. 2001 Dec;65(6):883-6.

47. PV, Pang L, Kitsutani P, et al. Dengue Fever, Hawaii 2001-2002, EID 2005 May 11(5).
48. Faiz MA, Yunus EB, Rahman MR, Hossain MA, Pang LW, Rahman ME, Bhuiyan SN. Failure of national guidelines to diagnose uncomplicated malaria in Bangladesh. *Am J Trop Med Hyg* 2002 Oct;67(4):396-9.
49. Fontes CJ, Ribeiro LC, Pang LW. Proguanil plus sulfamethoxazole in the treatment of uncomplicated *Plasmodium falciparum* malaria. *Southeast Asian J Trop Med Public Health*. 2002 Dec;33(4):685-8.
50. Sanders JW, Isenbarger DW, Walz SE, Pang LW, Scott DA, Tamminga C, Oyofu BA, Hewitson WC, Sanchez JL, Pitarangsi C, Echeverria P, Tribble DR. An observational clinic-based study of diarrheal illness in deployed United States military personnel in Thailand: presentation and outcome of *Campylobacter* infection. *Am J Trop Med Hyg* 2002 Nov;67(5):533-8.
51. Noedl H, Faiz MA, Yunus EB, Rahman MR, Hossain MA, Samad R, Miller RS, Pang LW, Wongsrichanalai C. Drug-resistant malaria in Bangladesh: an in vitro assessment. *Am J Trop Med Hyg* 2003 Feb;68(2):140-2.
52. Murine Typhus – Hawaii 2002, *MMWR* vol 52/No 50 19 Dec 2003, pp 1224-25.
53. Duarte EC, Pang L, Fontes CJ. [Internal validity of clinical trials for *Plasmodium vivax* malaria treatment: analysis of evaluation study of in vivo *Plasmodium vivax* emergence of resistance to standard doses of primaquine]. *Rev Soc Bras Med Trop*. 2003 May-Jun;36(3):383-6. Epub 2003 Jul 31. Portuguese.
54. Duarte EC, Gyorkos TW, Pang L, Abrahamowicz M. Epidemiology of malaria in a hypoendemic Brazilian Amazon migrant population: a cohort study. *Am J Trop Med Hyg*. 2004 Mar;70(3):229-37. Erratum in: *Am J Trop Med Hyg*. *Am J Trop Med Hyg*. 2004 Apr;70(4):459.
55. Erdem G, Abe L, Kanenaka RY, Pang L, Mills K, Mizumoto C, Yamaga K, Effler PV. *Pediatr Infect Dis J* Characterization of a community cluster of group A streptococcal invasive disease in Maui, Hawaii. 2004 Jul;23(7):677-9.
56. Kalmar EM, Alencar FE, Alves FP, Pang LW, Del Negro GM, Camargo ZP, Shikanai-Yasuda MA. Paracoccidioidomycosis: an epidemiologic survey in a pediatric population from the Brazilian Amazon using skin tests. *Am J Trop Med Hyg*. 2004 Jul;71(1):82-6.
57. Rohner AL, Pang LW, Iinuma G, Tavares DK 3rd, Jenkins KA, Geesey YL. Effects of Upcountry Maui water additives on health. *Hawaii Med J*. 2004 Sep;63(9):264-5.
58. Fonseca MO, Pang LW, de Paula Cavalheiro N, Barone AA, Heloisa Lopes M. Randomized trial of recombinant hepatitis B vaccine in HIV-infected adult patients comparing a standard dose to a double dose. *Vaccine*. 2005 Apr 22;23(22):2902-8.

59. Hayes JM, Rigau-Pérez JG, Reiter P, Effler PV, Pang L, Vorndam V, Hinten SR, Mark KE, Myers MF, Street K, Bergau L, Meyer C, Amador M, Napier M, Clark GG, Biggerstaff BJ, Gubler DJ. Risk factors for infection during a dengue-1 outbreak in Maui, Hawaii, 2001. *Trans R Soc Trop Med Hyg.* 2006 Jun;100(6):559-66. Epub 2005 Dec 13.
60. Simpson JA, Agbenyega T, Barnes KI, Di Perri G, Folb P, Gomes M, Krishna S, Krudsood S, Looareesuwan S, Mansor S, McIlleron H, Miller R, Molyneux M, Mwenechanya J, Navaratnam V, Nosten F, Olliaro P, Pang L, Ribeiro I, Tembo M, van Vugt M, Ward S, Weerasuriya K, Win K, White NJ. [Population pharmacokinetics of artesunate and dihydroartemisinin following intra-rectal dosing of artesunate in malaria patients.](#) *PLoS Med.* 2006 Nov;3(11):e444.
61. Tribble DR, Sanders JW, Pang LW, Mason C, Pitarangsi C, Baqar S, Armstrong A, Hshieh P, Fox A, Maley EA, Lebron C, Faix DJ, Lawler JV, Nayak G, Lewis M, Bodhidatta L, Scott DA . [Traveler's diarrhea in Thailand: randomized, double-blind trial comparing single-dose and 3-day azithromycin-based regimens with a 3-day levofloxacin regimen.](#) *Clin Infect Dis.* 2007 Feb 1;44(3):338-46. Epub 2006 Dec 28.
62. Tribble DR, Baqar S, Pang LW, Mason C, Houg HS, Pitarangsi C, Lebron C, Armstrong A, Sethabutr O, Sanders JW. *J Clin Microbiol.* [Diagnostic approach to acute diarrheal illness in a military population on training exercises in Thailand, a region of campylobacter hyperendemicity.](#) 2008 Apr;46(4):1418-25. Epub 2008 Jan 30.
63. Ling C, Henderson S, Henderson R, Henderson M, Pedro T, Pang L. Cost benefit considerations of preventing elderly falls through environmental modifications to homes in Hana, Maui. [Hawaii Med J.](#) 2008 Mar;67(3):65-8.
64. Sugihara N, Watanabe M, Tomioka M, Braun KL, Pang L. Saving money through exercise: Estimating the investment-to-return ratio of an elderly exercise program on Kaua'i. *Hawai'i Medical Journal.* 2011:116-120. Erratum correction in following issue.
65. Desure AR, Peterson K, Gianan FV, Pang LW. An Exercise Program to Prevent Falls in Institutionalized Elderly with Cognitive Deficits: A Crossover Pilot Study. *Hawaii J Med Public Health.* Nov 2013; 72(11): 391–395.
66. Coradi de Freitas D, Gomes LT, Fontes CJ, Tauil PL, Pang LW, Duarte EC. Sensitivity of nested-PCR for plasmodium detection in pooled whole blood samples and its usefulness to blood donor screening in endemic area. *Transfusion and Apheresis Science.* Published online 10 Feb 2014.
67. Elisabeth Carmen Duarte, Walter Massa Ramalho, Pedro Luiz Tauil, Cor Jésus Fernandes Fontes, Lorrin Pang. The changing distribution of malaria in the Brazilian Amazon, 2003-2004 and 2008-2009. *Rev. Soc. Bras. Med. Trop.* vol.47 no.6 Uberaba Nov./Dec. 2014. <http://dx.doi.org/10.1590/0037-8682-0274-2014>.



68. Mnatzaganian CL, Pellegrin KL, Miyamura J, Valencia D, Pang L. Association between sugar cane burning and acute respiratory illness on the island of Maui. *Environ Health*. 2015 Oct 7;14:81. doi: 10.1186/s12940-015-0067-y.
69. Olivia Jenkins, Sara Routley, MA, Tina Pedro-Gomes, MS, and Lorrin Pang, MD, MPH. A Pilot Dental Survey on Maui. *Hawaii J Med Public Health*. 2016 Nov; 75(11): 332–336.
70. Mills KM, Sadler S, Peterson K, Pang L. An Economic Evaluation of Preventing Falls Using a New Exercise Program in Institutionalized Elderly. *J Phys Act Health*. 2018 Jun 1;15(6):397-402.
71. Mills KM1\* and Pang LW. Importance of Utilizing Standardized Method of Calculating Cost Benefit of Physical Activity Interventions. *J Health Sci Educ Vol 2(5)*: 1-2.
72. Challenges of Measuring Individuals versus Events as Health Outcomes: Falls in Elderly as an Example Pang LW1 and Mills KM2, Vol 3(5). *J Health Sci Educ* -1-173. Nov 2019.
73. Pang GC, Calder M, Hauschild EM, et al. (2020) A Reduced Serial Interval Can have a Higher Impact on the Spread of Covid-19 Relative to R0: An Educational Video Demonstrating the Spread of Flu, Covid-19 and Covid-19 with Early Transmission. *J Health Sci Educ* 4: 195. *J Health Sci Educ Vol 4(5)*: 1-5.
74. Amy T. Hou, Genevieve C. Pang, Kristin M. Mills, Krizhna L. Bayudan, Dayna M. Moore, Luz P. Medina, Lorrin W. Pang (2021). A Rapid Method to Evaluate Pre-Travel Programs for COVID-19: A Study in Hawaii, *MedRxiv*, doi: <https://doi.org/10.1101/2021.03.06.21251482>.
75. In Press 2022. RE: AJTMH-21-1053.R2, An Effective Barrier to Prevent Crop Contamination by Slug Vectors of *Angiostrongylus cantonensis* by Pang, Lorrin; Coppolo, Christy; Hauptman, Sara - published: *Am. J. Trop. Med. Hyg.*, 00(00), 2022, pp. 1–6  
doi:10.4269/ajtmh.21-1053  
Copyright © 2022 by The American Society of Tropical Medicine and Hygiene.
76. Pre-procedural testing improves estimated COVID-19 prevalence and trends  
View ORCID ProfileGenevieve C. Pang, View ORCID ProfileAmy T. Hou, Krizhna L. Bayudan, Ethan A. Frank, Jennifer Pastiglione, Lorrin W. Pang doi:  
<https://doi.org/10.1101/2022.04.13.22273200><https://www.medrxiv.org/content/10.1101/2022.04.13.22273200v1>.
77. Pham K, Pang L: JAMA (<https://jamanetwork.com/journals/jama/fullarticle/2793357>)  
Comment to Paxlovid failure.
78. Summary article airport testing.
79. Rat Lung barrier valve effect.

**Statement: Dr. Lorrin Pang, Private Citizen**

**BACKGROUND**

I am a tropical disease and vector expert speaking as a private citizen on this matter. I've authored over 75 publications in peer-reviewed medical journals covering a broad range of studies such as malaria, dengue, rabies, rat lungworm, and COVID. I've been an advisor and voting member of the U.S. Congress Medical Research Program for the past several years, serving on committees for infectious diseases – many of which are mosquito-borne. From 1985-2005, I worked with the World Health Organization (WHO) and Walter Reed Institute's Malaria Program, focusing on global malaria control efforts through interventions combining diagnostics, chemotherapeutics, vector control, and vaccine development. As a public health leader on the islands, I've mitigated mosquito-borne illnesses – including dengue and Zika – for over two decades. I was honored for my life-saving intervention in Hawaii's dengue fever outbreak.

I've attached a confidential submission for publication which highlights some of the items discussed below: That population changes are often determined by pathways set up in parallel, not just sequentially; that models must be set up by the initial assumptions with the math derivations of the formula to follow; that the models must predict intuitively the changes in populations when extreme limits are reached (steady state and non-steady state); that tracking units of the parameters of the math expression is a very useful practice in complicated models.

(CV attached; confidential research article attached)

**CONCERNS**

Horizontal Transmission: Non-Sexual

A primary concern is non-sexual horizontal transmission of the introduced *Wolbachia* strains between the introduced biopesticide mosquitoes and the existing wild mosquitoes. Imported *Wolbachia* bacterium strain *wAlbB* has been disclosed as the strain for use in this biopesticide. Additional strains *wAlbA* and *wPip4* are also planned for import in connection with this project. These newly introduced strains (referred to here as "X") are not currently present within the corresponding *Culex quinquefasciatus* species of Hawaii's established mosquito population.

I have been compiling studies documenting horizontal *Wolbachia* bacterial spread, and I'm concerned about the potential for significant adverse outcomes of the state's proposal. The intent to save rare birds is sound. If the project goes as planned, this would be a valuable tool for future interventions. However, with new life forms coming to the islands, there is too much potential for unexpected, dangerous, irreversible "evolutionary" events. This is especially true when the new organisms cannot be contained to their target ecosystem. Already there are published papers pointing out the real threat of horizontal spread of the novel *Wolbachia* beyond the male *Culex* mosquito. The papers cover two general areas – the widespread detection of *Wolbachia* across so many diverse types of insects, and more recently, the growing number of reports of mechanisms of how this might occur. First, we all must agree that unintended horizontal spread of the imported strain(s) to, say, female *Culex*, *Aedes* mosquitoes, or other insect vectors of diseases

would be a catastrophe, and probably irreversible. Hawaii has a bad history of invasive species entering and spreading unabated, including their spread of infectious diseases.

A recent study out of Singapore<sup>1</sup> describes *Wolbachia* bacteria strain “evolutionary associations” between mosquito hosts. The results of this mechanism widespread into diverse insect populations are not known. It may start with a few horizontal transfers to female mosquitoes. After that, the mating *Wolbachia*-X-compatible pair will quickly produce viable X offspring and spread the X bacteria strain (the term for this is “sweep”). If that were to happen here, the full capacity of those offspring to transmit disease would be unknown. This type of spread and sweep could also affect other insects, not just the targeted mosquito.

The possibility of unintentionally producing X-infected females in the wild has not been adequately addressed. The introduced *Wolbachia* strain can spread horizontally as a life form to other mosquitos (including *Aedes* – vectors of human disease) and perhaps create that *Wolbachia* female *Culex*, which everyone is bending over backwards to avoid via lab contamination.

There is a big difference between the standard Sterile Insect Technique (SIT) strategies used in the past that were based on radiation or chemicals, and the relatively new Incompatible Insect Technique (IIT). The mathematical models may be similar for estimating threshold criteria to affect mosquito population dynamics, but standard methods of sterility are not bacterial life forms that might escape horizontally and amplify in other ecological niches. While sterility models can predict the thresholds needed to exterminate a species (in this case insects), the radiation sterility factor (standard SIT) does not behave the same as a life form (*Wolbachia* bacteria). There may be different modeling between radiation and *Wolbachia* “sterility” for the male mosquitoes, depending on male mosquito fitness – but more importantly, for the unintended female *Culex* to which the *Wolbachia* X spreads horizontally. How is this supposed to be self-contained? Horizontal spread has the potential to be a disaster that cannot be recalled. The bacterium is a life form, and you might not be able to turn back the clock by simply shutting off the male mosquito “fountains.”

The evidence of horizontal spread of *Wolbachia* shows that the bacteria go not only to sexual cells, but also to somatic cells (non-sexual cells of the body). *Wolbachia* can also live outside of intra-cellular systems for several months.<sup>2</sup> Two additional studies clearly document widespread horizontal transmission of *Wolbachia*. The first focuses on predatory wasps spreading the bacteria through contaminated mouth parts when feeding serially on target insects such as aphids<sup>3</sup>. More research into which predators, like the damselfly and dragonfly, sequentially feed on both male and female mosquitoes is needed to determine how this may affect Maui’s ecosystems. This scenario might play out in either the predator of adults feeding on adult mosquitoes (X-infected and wild), or the X-infected predator of larvae feeding on wild mosquito larvae in common breeding sites. The second study looks at ant colonies spreading *Wolbachia* through the gastrointestinal (GI) tract when the ants feed on their fungus gardens.<sup>2</sup> What about shared sugar feeding sites for X-infected male and wild adult male and female mosquitoes? The sparser the sugar sites, the more communal interaction they will have. I find these studies of horizontal transfer across species of insects highly concerning. Even if this project achieved miraculous blocking of avian malaria to the native birds, what else would it do?

Studies that downplay the possibility of horizontal transmission based on *aedes aegypti* mosquitoes are flawed references because *aedes aegypti* are resistant to *Wolbachia*.

#### Horizontal Transmission: Venereal

An additional concern is the possibility of sexual/venereal horizontal transmission of the introduced bacteria through mosquitoes mating. This pathway is not well published and requires more study<sup>4</sup>, specifically with the *Culex q.* mosquitoes planned for use in this project. While the proponents of the project claim that horizontal transmission only occurs on an evolutionary scale with a very slow spread, there are examples showing that it may occur during a short duration of weeks and then months. X-infected male mosquitoes may transmit the introduced strain to wild females through blood, mucous, and semen during mating. Granted, if this occurs via venereal route in the wild female mosquito, the first half of their life their matings will be sterile. However, after this their matings will produce offspring of both sexes and soon will “sweep” the population with the introduced *Wolbachia* strain.

There is a paper in *Nature*<sup>5</sup> by Frydman et al. studying a fruit fly lab model of entry into the germline from somatic tissue in about a week or two. Germ cells just touching somatic cells within the female mosquito’s body can pick up the bacteria. Whether or not accidentally released X-infected females and wild males would have sterile mating outcomes would become irrelevant at this stage. Even if the introduction of X-infected males was stopped, the initial mating with females X-infected through horizontal transmission (and compatible through entry of the bacteria into the female germline) would produce viable offspring of both sexes of X-infected mosquitoes.

#### Vertical Transmission Suppressed: Horizontal Transmission Increased

When vertical transmission of the *Wolbachia* bacteria is suppressed, horizontal transmission of the bacteria can increase.<sup>6</sup> The *Wolbachia* is trying to survive. If vertical transmission is blocked, the bacteria maintain horizontal transmission until the host is fertile again, then they return to vertical transmission. During the time that the bacteria is challenged by the inability to transmit vertically, it may spread horizontally to other mosquitoes, spiders, fruit flies, and other insects (including insect vectors of disease).

A related topic is beginning to be examined in the science community. Human pathogens (i.e., Zika and dengue viruses) used to be thought of as “dead-end” infections in male mosquitoes who may have become infected through horizontal transmission mechanisms. Males don’t bite humans to expand the virus in human hosts. However, it is now of concern that these viral pockets in male mosquitoes, though relatively rare, serve as back-up reservoirs to reinoculate females when the female-mosquito/human cycle breaks down. For example, if all humans get a virus and mass immunity puts the cycle on “hold” until enough non-immune humans are born or transient immunity is lost, the female mosquitoes will tap into the viral back-up reservoir via horizontal transmission.

Proponents of the use of this biopesticide argue that horizontal transmission, venereal or otherwise, is so rare that it can be ignored in the math models. They extrapolate from the models

where cytoplasmic incompatibility (CI) is not operating for sterilization of matings, for example in the sweep model. Much of the spread of *Wolbachia* is vertical (V). Let us say that for every *Wolbachia* spread, 99.9% are via vertical spread and only 0.1% are horizontal (H). Let us pick a unit population where 100K new mosquitoes become infected with *Wolbachia* via sex. Of this 100K, only 100 would have become infected with the bacteria through H and the rest through V. But in the CI application, none get it through V and still females are inoculated somatically through the H mechanism of mating. This 100 may move quickly to the germline cells, but does the bacteria remain only in 100, or can it expand through lack of competition to fill the niche that the V transfers would have occupied? Was there competition between V and H descending lines; and if there is no longer a V line (due to CI), will H females expand?

Even when there is successful vertical transmission, there is horizontal transmission to non-germ cells such as neural tissue, which changes the behavior of the host to support what is in the germ cells. The bacterium is altruistic and helps sister cells to dominate as a safety backup, sacrificing the individual self for the sake of the larger group. This is useful because the larger group does have some common genes which the individual shares. When the two systems (V and H) are running predominantly vertical transmission with some relatively minor horizontal transmission, the horizontal is a back-up system to reinoculate the vertical system if the vertical system ever fails. This horizontal system is relatively small compared to the vertical system but is rather important in many systems including *Wolbachia*. If the CI process shuts down vertical transmission, the horizontal system is still running, and it may grow because that lineage does not compete with a vertical system which has been blocked by sterility.

With the *Wolbachia*, when the vertical production is plentiful, the horizontal movement will seem inconsequential, often a dead end; but once the vertical system collapses (through CI or through natural sterility of the insect – for instance, through mosquito HIV), the horizontal system in males will still be there and can restart the vertical system again when it moves to the germ cells in females. With the use of this biopesticide, the sterility might not stop completely, but the horizontal system will still act to save the *Wolbachia* line in males by making females that will expand the strain line vertically. All of the sacrificed horizontal transmission when the vertical system operates will be useful to reinoculate the system when CI passes or is “low.”

#### Math Model: Choke Points and Rate Limiting Step

The math model for this project does not seem to account for choke points. If only a certain number of larvae from compatible mosquitoes will survive due to availability of, say, food sources in standing water breeding sites, then any reduction in viable offspring due to incompatibility may not significantly affect the number of surviving larvae. The viable larvae will compete for microbes to eat, and only a specific number of larvae will have enough food to survive (rate determining step). That number may remain relatively constant based on volume of food-source microbes, and the non-viable offspring of incompatible mosquitoes may have no effect, or limited effect, on the survival rate of larvae in the breeding site overall.

Determination of efficacy of the biopesticide might be based on a flawed set up of the math model. The question is, do things affecting a population occur in sequence or in parallel; and if we treat them like resistors on an electrical circuit, isn't the rate limiting step like a capacitor

somewhere in the circuitry? A very restrictive rate limiting step such as the paucity of microbial food in breeding water severely limiting the number of larvae reaching the adult stage would cause the reproduction/sterility interventions to be ineffective. Even if the proportions of X-infected male mosquitoes released were increased, there would be very little impact.

#### Math Model: Biopesticide Wind Drift

Further diluting the math model basic assumptions is the factor of wind drift. Mosquitoes carried on the wind into and out of the release sites of the project area have not been factored into the math model or the overall plan. Lowland male (and female) wild mosquitoes can travel by wind drift up from lowlands to the project area and dilute the intervention mating pool, affecting the efficacy goal of 90% lab-reared male matings. This rapid drift could dilute the proportion of novel *Wolbachia*-infected male mosquitoes.

Considering these factors, the mark-release-recapture study to estimate whether more or less mosquitoes would be released could be open to interpretation. In human trials, empirical data from feasibility analysis precedes formal studies. We go over numbers from human subjects and use the control group to draw conclusions. If this biopesticide mosquito project is to draw on historical controls, the cause-and-effect interpretation will have many ecological confounders and will risk the ecologic fallacy. If this possibility is inevitable, these conditions should be stated now.

#### Superinfection: Multiple Strains

Mosquitoes and other insects can be infected with more than one strain of *Wolbachia* bacteria at the same time. This is called “superinfection.” *Culex q.* mosquitoes are very susceptible to many strains of *Wolbachia*. Superinfection in *Culex q.* has not been studied for this project. Superinfection could affect cytoplasmic incompatibility, horizontal transmission, evolutionary events, and population replacement.

#### *Wolbachia*: Increased Pathogen Infection and Disease-Spreading Capability

Peer-reviewed studies have shown *Wolbachia* bacteria to cause increased pathogen infection in mosquitoes<sup>8</sup> and to cause mosquitoes to become more capable of transmitting both avian malaria<sup>8</sup> and West Nile virus (avian and human)<sup>9</sup>. More study is needed in this area, specifically study of the *Culex quinquefasciatus* mosquito and the wAlbB, wAlbA, and wPip4 *Wolbachia* strains, along with any combinations (superinfections) of bacteria strains planned for use in this project. Increased pathogen infection and increased disease-spreading capability could be detrimental to the endangered native bird populations, other animals, insects, humans, and subsequently the ecosystems as a whole.

#### Novel Experiment

This biopesticide mosquito release is an experiment. *Culex q.* has never been used for cytoplasmic incompatibility stand-alone field release. Scientists advising on this project have not studied horizontal transmission or movement of *Wolbachia* from somatic cells to germ cells in

*Culex q. Wolbachia*-infected mosquitoes are more widely released globally for population replacement, not suppression. Efficacy studies are focused on the population replacement method. The population suppression method has not been sufficiently studied. The potential collateral damage from the use of this biopesticide is unknown.

#### Alternatives: Not Considered

Alternative approaches to mitigating avian malaria have not been considered, including treatment of avian malaria in the mosquito phase through antimalarial drug feeding (i.e., primaquine and ivermectin) in rabbits and/or battery-powered warm artificial blood packs containing the antimalarial drugs. The range of blood-feeding females is a lot wider than extrapolated from sugar feedings of males.

#### **CONCLUSION**

While I have chosen to address each mechanism separately, all mechanisms interact with each other. There has been insufficient study in each area of concern and in the combination of mechanisms. The precautionary principle calls for further study of the probability of efficacy and the potential for collateral damage. The use of this novel biopesticide requires a feasibility study, independent of the proposal itself, analyzing and considering all of the critical aspects of the proposed project in order to determine the likelihood of it succeeding. Though I have been presented with the math model, I would like to see the basic assumptions factored in prior to the derivation of the actual expressions/conclusions. I would like to see incorporation of choke points and rate limiting factors, wind drift and expansion of horizontal transfer reservoirs if/when vertical transmission is blocked. Mitigation measures must be established to assure that side-effects would be contained. Detailed study in each area of concern, separately and together, is needed.

Proponents may be right that this intervention will save the native birds in the short-term, but long-term consequences to other island ecologies and to these same native birds may ultimately be detrimental. When one realizes the latter, the damage may be impossible to recall or repair, like the effects we've seen with so many other invasive species in Hawaii.

#### **REFERENCES**

1. "Wolbachia infection in wild mosquitoes (Diptera: Culicidae): implications for transmission modes and host-endosymbiont associations in Singapore" – Huicong Ding, Huiqing Yeo, Nalini Puniamoorthy (BMC, 12/09/2020)  
<https://parasitesandvectors.biomedcentral.com/articles/10.1186/s13071-020-04466-8>
2. "Wolbachia Horizontal Transmission Events in Ants: What Do We Know and What Can We Learn?" – Sarah J. A. Tolley, Peter Nonacs, Panagiotis Sapountzis (Frontiers in Microbiology, 03/06/2019)  
<https://www.frontiersin.org/articles/10.3389/fmicb.2019.00296/full>

3. “The Intracellular Bacterium *Wolbachia* Uses Parasitoid Wasps as Phoretic Vectors for Efficient Horizontal Transmission” – Muhammad Z. Ahmed, Shao-Jian Li, Xia Xue, Xiang-Jie Yin, Shun-Xiang Ren, Francis M. Jiggins, Jaco M. Greeff, Bao-Li Qiu (National Center for Biotechnology Information, National Library of Medicine, 02/12/2015)  
<https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4347858/>
4. “Infection by *Wolbachia*: from passengers to residents” – Hervé Merçot, Denis Poinsot (Comptes Rendus Biologies, 2009)  
<https://www.sciencedirect.com/science/article/pii/S1631069108002709>
5. “Somatic stem cell niche tropism in *Wolbachia*” – Horacio M. Frydman, Jennifer M. Li, Drew N. Robson, Eric Wieschaus (Nature, 05/25/2006)  
<https://people.bu.edu/hfrydman/publications/Frydman%202006%20-%20Somatic%20stem%20cell%20niche%20tropism%20in%20Wolbachia.pdf>
6. “The rich somatic life of *Wolbachia*” – Jose E. Pietri, Heather DeBruhl, William Sullivan (MicrobiologyOpen, 2016)  
<https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5221451/>
7. “*Wolbachia* transinfections in *Culex quinquefasciatus* generate cytoplasmic incompatibility” – T. H. Ant, C. Herd, F. Louis, A. B. Failloux, S. P. Sinkins (Insect Molecular Biology, 06/13/2019)  
<https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7027843/>
8. “*Wolbachia* Can Enhance *Plasmodium* Infection in Mosquitoes: Implications for Malaria Control?” – Grant L. Hughes, Ana Rivero, Jason L. Rasgon (PLOS Pathogens, 09/4/14)  
<https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4154766/>
9. “*Wolbachia* Enhances West Nile Virus (WNV) Infection in the Mosquito *Culex tarsalis*” – Brittany L. Dodson, Grant L. Hughes, Oluwatobi Paul, Amy C. Matarachiero, Laura D. Kramer, Jason L. Rasgon (PLOS Neglected Tropical Diseases, 07/10/14)  
<https://journals.plos.org/plosntds/article?id=10.1371/journal.pntd.0002965>



**From:** Vernelle Oku <vernellehnl@gmail.com>  
**Sent:** Sunday, February 18, 2024 9:18 PM  
**To:** DLNR.BLNR.Testimony  
**Subject:** [EXTERNAL] Written Testimony BLNR 2/23/24 agenda item C1

Dear BLNR,

I oppose releasing any genetically modified mosquitoes in any of the Hawaiian Islands. We have an already fragile ecosystem with many diverse populations near extinction, please do not release an experimental genetically modified mosquito in this kind of environment.

Honor your oath to protect the people of Hawaii.

Kind Regards,  
Vernelle Oku

Sent from my iPhone

**From:** Tammy Ash Perkins <tammyaperkins@protonmail.com>  
**Sent:** Tuesday, February 20, 2024 9:03 AM  
**To:** DLNR.BLNR.Testimony  
**Subject:** [EXTERNAL] Opposition to item C1

**I oppose** the BLNR 2/23/24 agenda item C1, which involves a bacteria-infected mosquito release project in our islands. This project poses significant risks as it involves releasing female mosquitoes capable of transmitting diseases to people, with concerns about the potential impacts on native birds and human health. Pathogen screenings have not been adequately disclosed, and the Wolbachia bacteria used in the project could potentially make mosquitoes more efficient disease vectors. I demand a thorough environmental impact statement to address these serious concerns before moving forward with the project.

Me Ke Aloha  
Tammy

Tammy Ash Perkins  
Rethinking Hawaii  
Maui District 12-02  
Precinct President  
Maui VC & Events & Rule Rep  
HRP Rules Committee Vice Chair  
Maui IPPRC Rep

Sent with [Proton Mail](#) secure email.

[REDACTED]

---

**From:** Franz Weber <FIM2020@outlook.com>  
**Sent:** Monday, February 19, 2024 12:52 PM  
**To:** DLNR.BLNR.Testimony  
**Subject:** [EXTERNAL] Opposition to BLNR 2/23/24 agenda item C1

I'm opposed to the BLNR 2/23/24 agenda item C1. This bacteria-infected mosquito release project is a dangerous experiment on our islands. Serious concerns about this plan have not been adequately addressed. Southern house mosquitoes transmit diseases to people, and pathogen screenings are not being disclosed. Female mosquitoes that bite, breed, and spread disease will be released. *Wolbachia* bacteria can cause mosquitoes to become more capable of spreading diseases. This project has the potential to cause the extinction of the native birds it is meant to protect, and it could impact the health of the people. I demand an environmental impact statement.

*Franz Weber*  
75-5660 Kopiko St.  
Ste. C 7, # 106  
Kailua-Kona, Hi 96740  
(808) 896-6655  
[FIM2020@outlook.com](mailto:FIM2020@outlook.com)

[REDACTED]

---

**From:** Joanna Weber <om528peace@outlook.com>  
**Sent:** Monday, February 19, 2024 12:16 PM  
**To:** DLNR.BLNR.Testimony  
**Subject:** [EXTERNAL] Opposition to the BLNR 2/23/24 Agenda Item C1

ALOHA,  
I'm opposed to the BLNR 2/23/24 agenda item C1.

This bacteria-infected mosquito release project is a dangerous experiment on our islands. Serious concerns about this plan have not been adequately addressed. Southern house mosquitoes transmit diseases to people, and pathogen screenings are not being disclosed.

Female mosquitoes that bite, breed, and spread disease will be released. *Wolbachia* bacteria can cause mosquitoes to become more capable of spreading diseases. This project has the potential to cause the extinction of the native birds it is meant to protect, and it could impact the health of the people.

**I demand an environmental impact statement.**

ALOHA, JOANNA WEBER