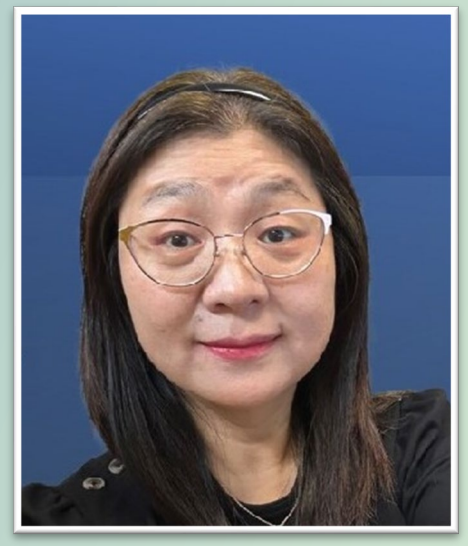
Vectors & the Environment

Matthew “Matt” Kurano

Hawaii Department of Health

Environmental Health Services Division



Dr. Jeomhee Hasty

Hawaii Department of Health

Vector Control Branch

Lirio Hittle

Climate Change Strategist

Climate Change and Invasive Vector-Borne Disease in Hawai‘i

Hawai'i Department of Health

Matt Kurano
Administrator of Environmental Health Services Division, and acting Program Manager of Vector Control Branch

Dr. Jeomhee Hasty, PhD
State Vector Control Entomologist

Timeline of Mosquitoes in Hawai‘i

1826

Culex quinquefasciatus arrives

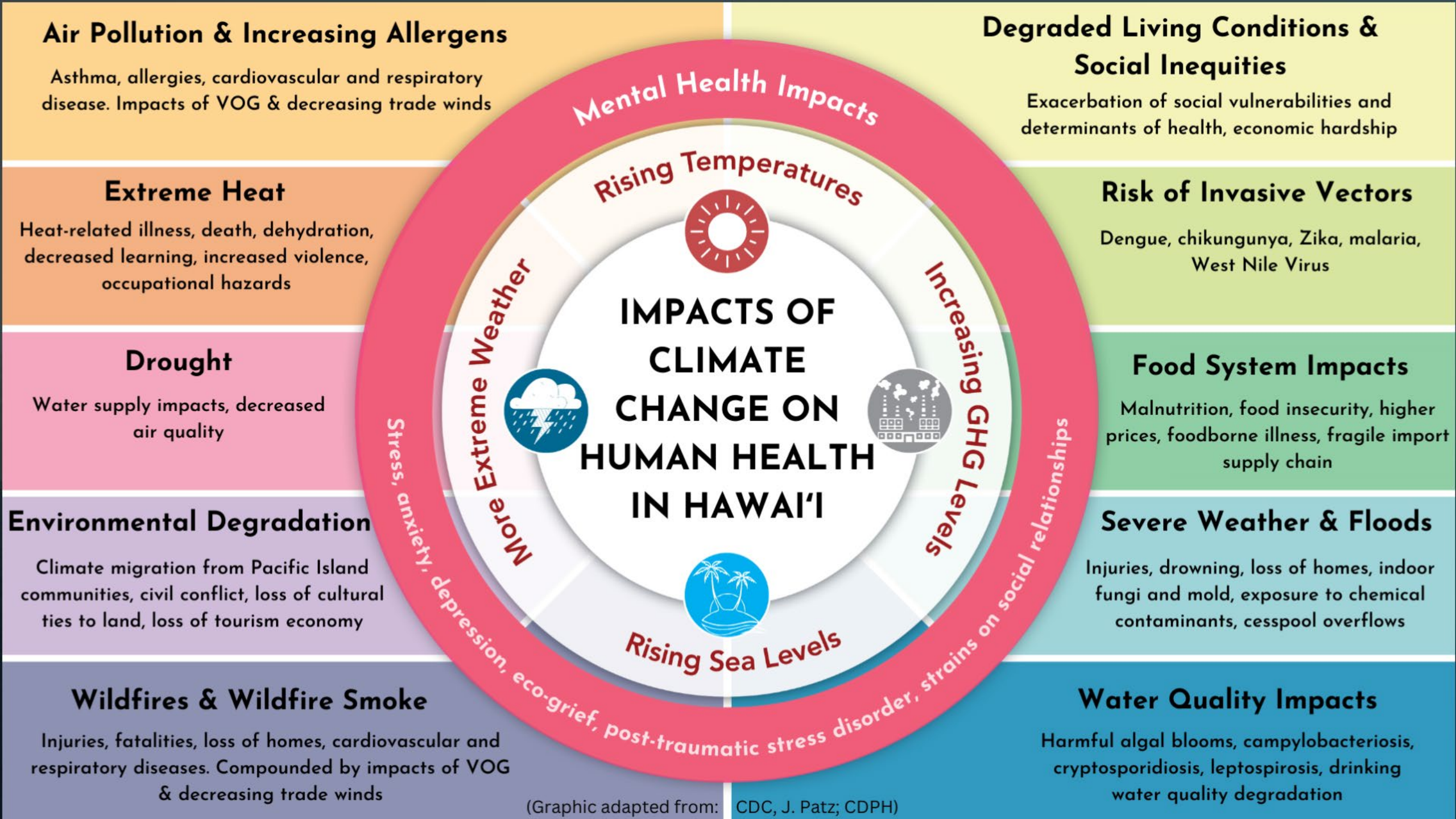
1890

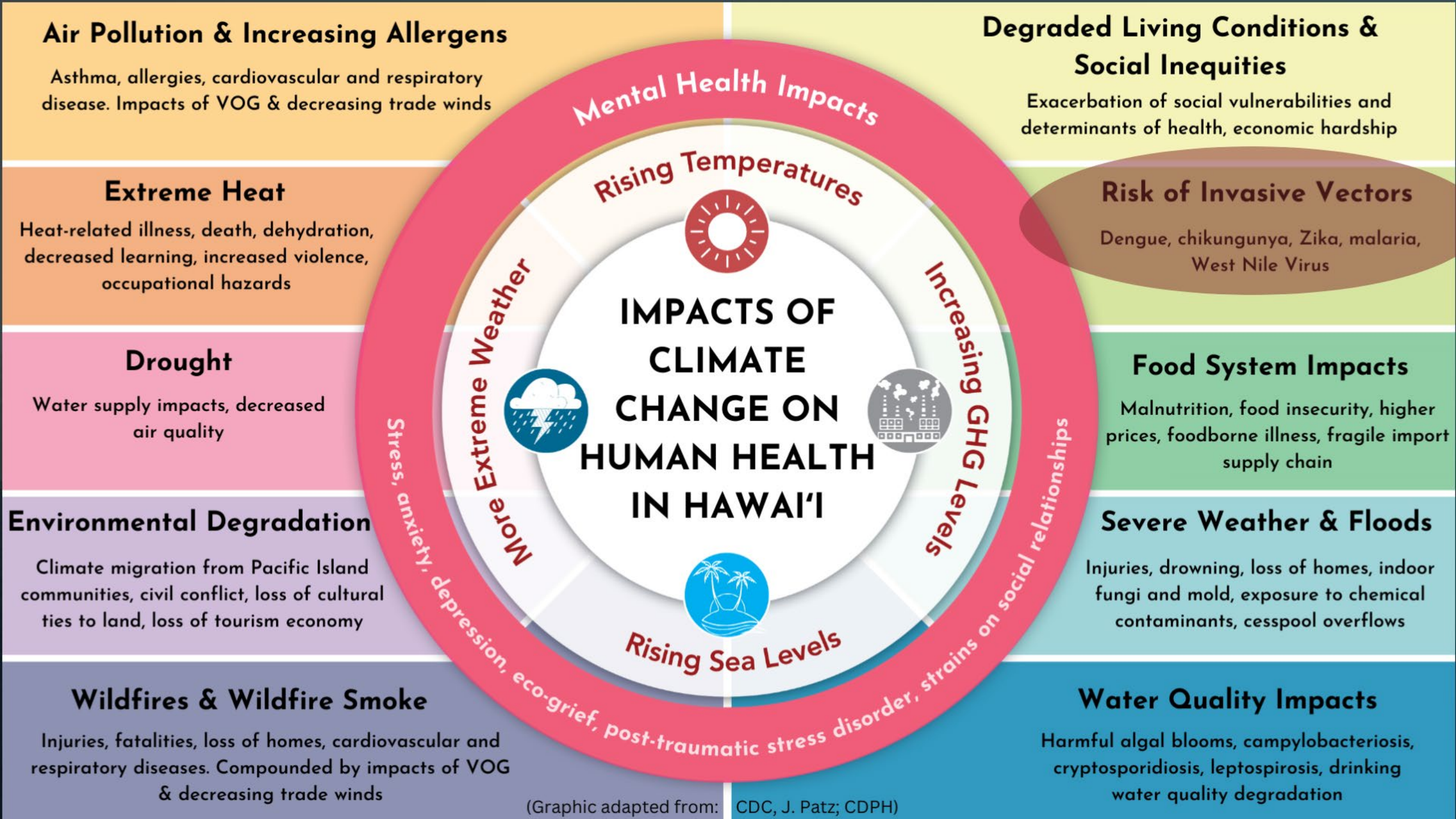
Aedes aegypti arrives

Climate Change is a Public Health Crisis.

Climate change is not only an environmental crisis -- it also threatens the health and well-being of all people in Hawai‘i.

Climate change is a complex, interconnected, risk amplifier.


Air Pollution & Increasing Allergens
Asthma, allergies, cardiovascular and respiratory disease. Impacts of VOG & decreasing trade winds
Degraded Living Conditions & Social Inequities
Exacerbation of social vulnerabilities and determinants of health, economic hardship
Extreme Heat
Heat-related illness, death, dehydration, decreased learning, increased violence, occupational hazards
Risk of Invasive Vectors
Dengue, chikungunya, Zika, malaria, West Nile Virus
Drought
Water supply impacts, decreased air quality
Food System Impacts
Malnutrition, food insecurity, higher prices, foodborne illness, fragile import supply chain
Environmental Degradation
Climate migration from Pacific Island communities, civil conflict, loss of cultural ties to land, loss of tourism economy
Severe Weather & Floods
Injuries, drowning, loss of homes, indoor fungi and mold, exposure to chemical contaminants, cesspool overflows
Wildfires & Wildfire Smoke
Injuries, fatalities, loss of homes, cardiovascular and respiratory diseases. Compounded by impacts of VOG & decreasing trade winds
Water Quality Impacts
Harmful algal blooms, campylobacteriosis, cryptosporidiosis, leptospirosis, drinking water quality degradation
Mental Health Impacts
Rising Temperatures
Increasing GHG Levels
Rising Sea Levels
More Extreme Weather
Stress, anxiety, depression, eco-grief, post-traumatic stress disorder, strains on social relationships
IMPACTS OF CLIMATE CHANGE ON HUMAN HEALTH IN HAWAI'I
(Graphic adapted from: CDC, J. Patz; CDPH)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How does climate change impact vectors?

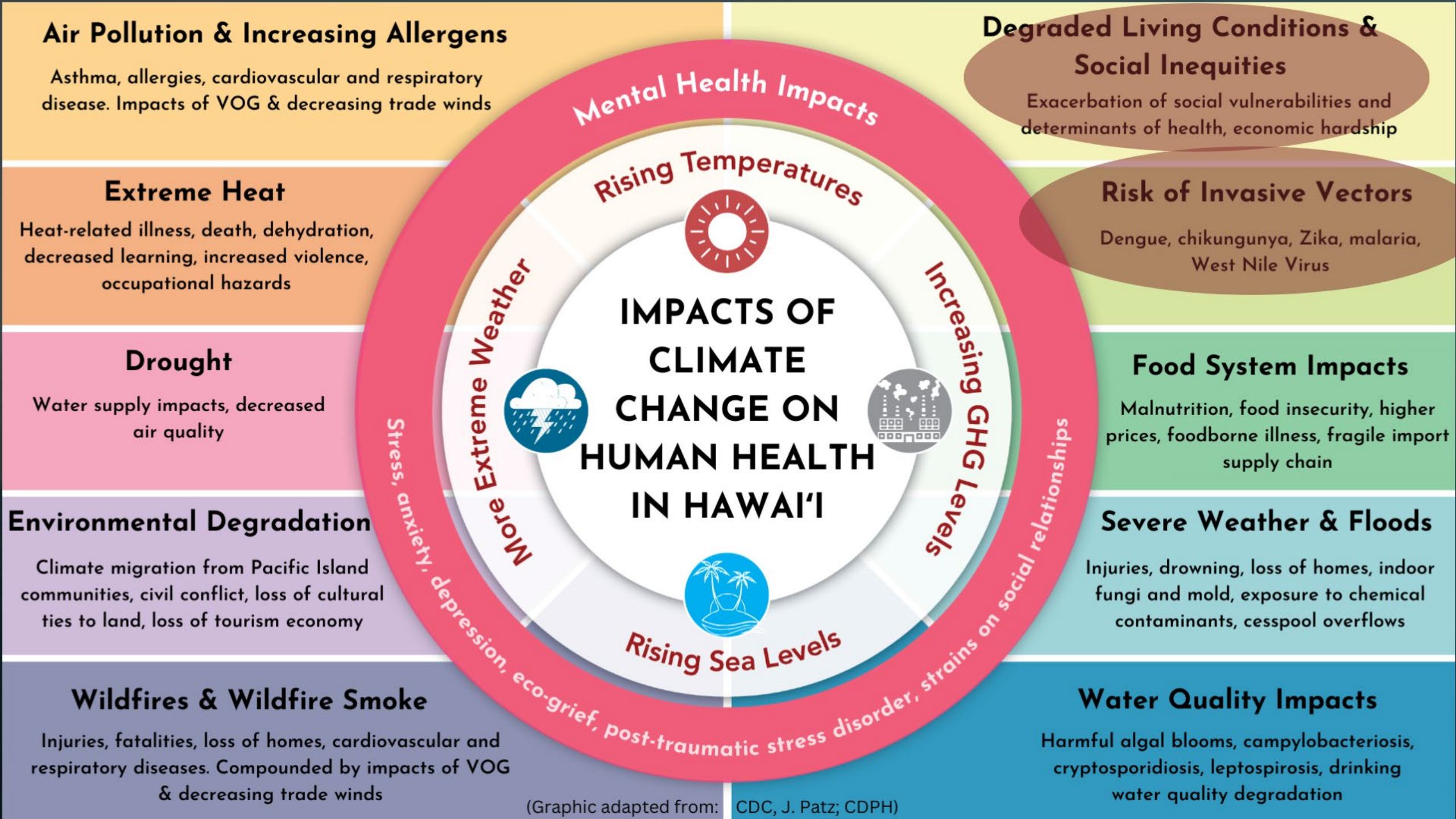
Changing temperatures and precipitation patterns impact the distribution, behavior, and survival rates of vectors

The rate of development and replication for the pathogens (viruses, bacteria, and parasites) within the vectors *can* increase with warmer temperatures to a threshold

Potential shift of regions, currently less favorable, becoming more favorable environments

Global Spread of Vectors and Vector-Borne Disease

Country of Origin for Positive Travel-Related Cases of Dengue Fever on O‘ahu, 2024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What are Social Determinants of Health?

- **Income**
- **Age**
- **Race & Ethnicity**
- **Rural vs. Urban**
  Built environment, access to public transportation
- **Education**
- **Community Resiliency**

One Health

- Conservation vs Health
- Healthy environments limit proliferation and spread of vectors
- Extends outside vector disease: ex. coconut rhinocerous beetle and shade

Source: followtheoutbreak.wordpress.com

Hawaii Vector-Borne Disease Risk Level

Vector Present	Occurrence in Hawaii: Never/ Rarely Seen Before (<1 per decade)	Sometimes Present (1-10 per decade)	Always Present (1 or more per year)
Primary	Medium	High	High
Secondary	Low	Medium	High
No Vector	Low	Low	Medium

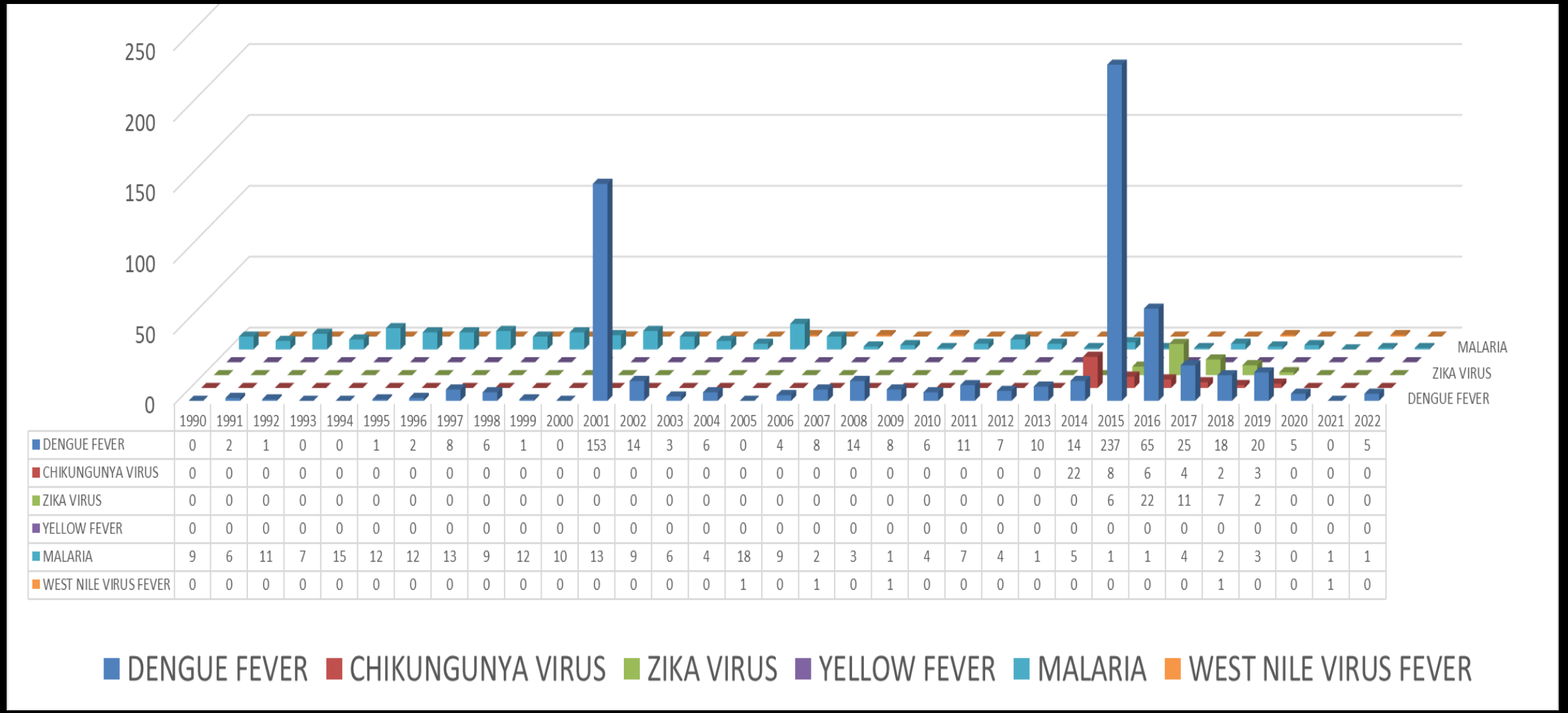
Consideration

- Presence of disease and vector
- Disease occurrence
- Human activities

Vector-borne Disease	Vector	Vector in Hawai'i?	Pathogen in Hawai'i?	History of Locally Acquired Transmission?	Risk of impact US	Risk of impact Hawaii	Response Strategy & Climate factors
Dengue	Aedes albopictus, Aedes aegypti	Yes	No	Yes	High	High	Vector Control*
Chikungunya	Aedes albopictus, Aedes aegypti	Yes	No	No	High	Moderate	Vector Control*
Zika	Aedes albopictus, Aedes aegypti	Yes	No	No	High	Moderate	Vector Control*
Malaria	Anopheles spp.	No	No	No	High	Low	2023 7 FL, 1 TX, 1 MD Local transmission Invasive Vector**
West Nile Virus	Culex spp. (Culex quinquefasciatus)	Yes	No	No	High	Moderate	The vector mosquito is the most prevalent sp.
Lyme Disease	Deer tick (Ixodes scapularis)	No	No	No	High	Low	Tick favorable condition Human behavior** Invasive Vector
Rocky Mountain Spotted Fever	American dog ticks Rocky Mountain wood tick (Dermacentor SPP.) Brown Dog Tick* (Rhipicephalus sanguineus)	Yes	No	No	High	Low	Invasive disease
Leptospirosis	Livestock (cows, pigs, horses, sheep, goats, etc,) Dogs, Cats Rodents (rats, mice, etc.) Marine mammals (sea lions, seals, etc.)	Yes	Yes	Yes	Low	High	Heavy rain can cause outbreak
Murine Typus*	Oriental rat flea (Xenopsylla cheopsis) Cat flea (Ctenocephalides felis)	Yes	Yes	Yes	Low	High	Droughts can cause outbreak
Rat Lungworm	Rats and mollusks	Yes	Yes	Yes	Low	High	Human behavior
Chaga's disease	Kissing Bug (Triatoma spp.)	Yes	No	No	Low	Low	Invasive Disease

2023 Malaria Local Transmission in the US
2024 WNV 38 States-endemic status in the US
2024 EEE case in North-East US
2024 Oropouche Virus-Midge, Culex mosquitoes

OCCURRENCE OF MOSQUITO-BORNE DISEASE IN HAWAII



	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
DENGUE FEVER	0	2	1	0	0	1	2	8	6	1	0	153	14	3	6	0	4	8	14	8	6	11	7	10	14	237	65	25	18	20	5	0	5
CHIKUNGUNYA VIRUS	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	22	8	6	4	2	3	0	0	0
ZIKA VIRUS	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	6	22	11	7	2	0	0	0
YELLOW FEVER	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
MALARIA	9	6	11	7	15	12	12	13	9	12	10	13	9	6	4	18	9	2	3	1	4	7	4	1	5	1	1	4	2	3	0	1	1
WEST NILE VIRUS FEVER	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	0	1	0	0	0	0	0	0	0	0	1	0	0	1	0

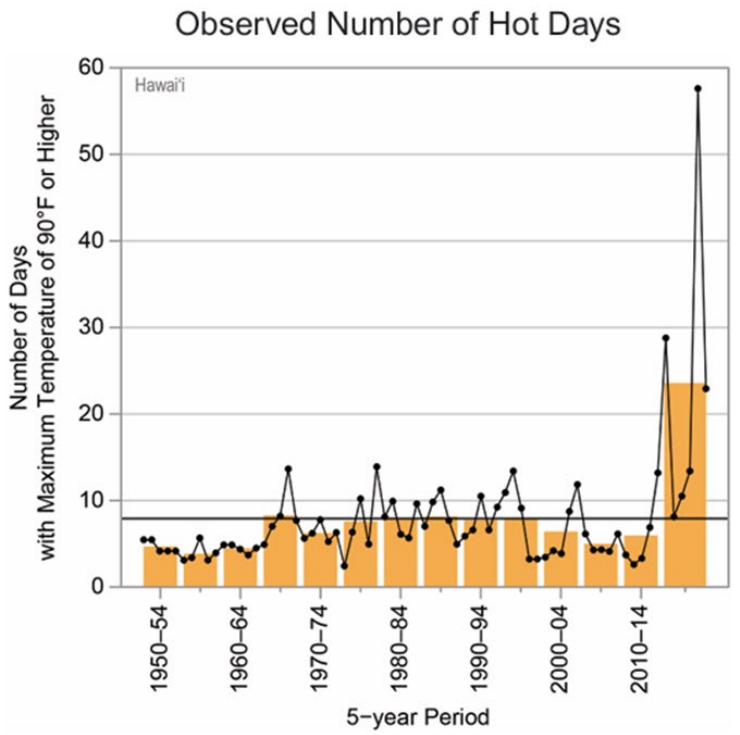
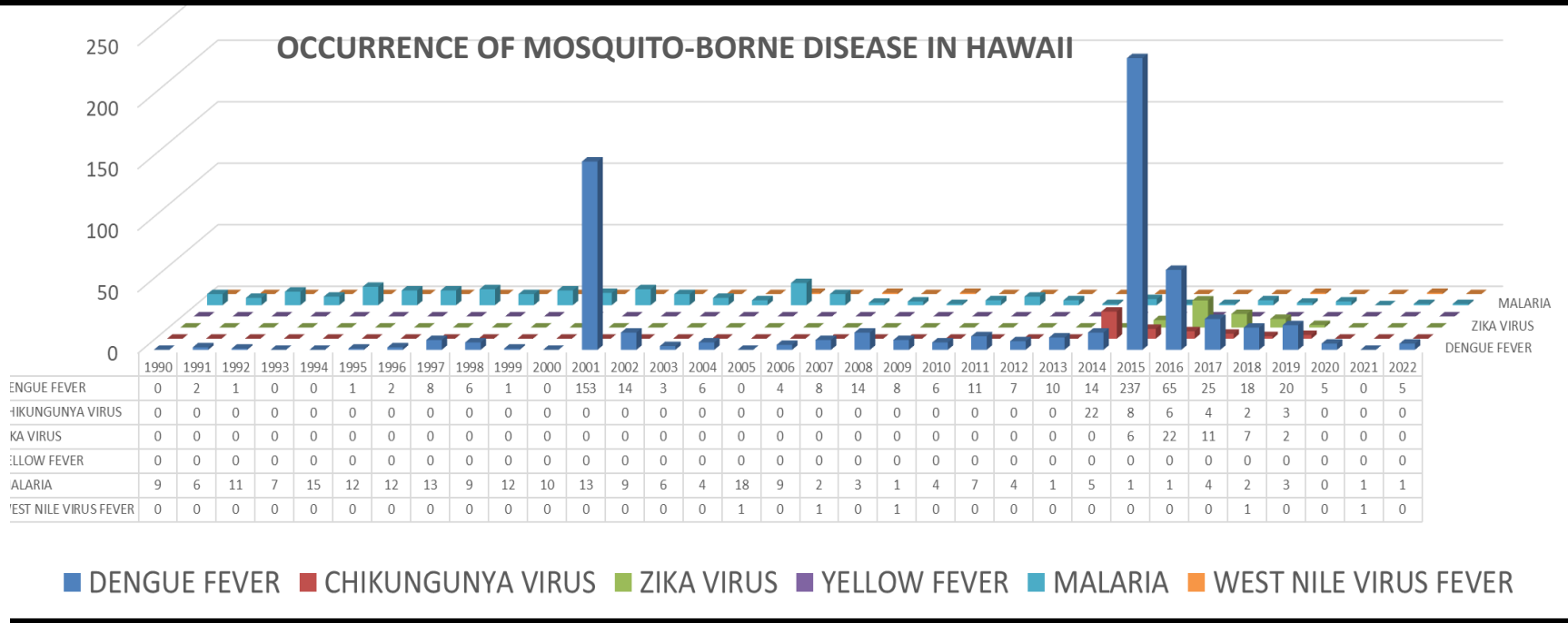


Figure 3: Observed annual number of hot days (maximum temperature of 90°F or higher) for Hawai'i from 1950 to 2020. Dots show annual values. Bars show averages over 5-year periods (last bar is a 6-year average). The horizontal black line shows the long-term (entire period) average of 7.9 days. The number of hot days increased dramatically during the 2015–2020 period, with a multiyear average more than double the long-term average. Sources: CISESS and NOAA NCEI. Data: GHCN-Daily from 6 long-term stations.



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ENGUE FEVER	0	2	1	0	0	1	2	8	6	1	0	153	14	3	6	0	4	8	14	8	6	11	7	10	14	237	65	25	18	20	5	0	5
HIKUNGUNYA VIRUS	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	22	8	6	4	2	3	0	0	0
KA VIRUS	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	6	22	11	7	2	0	0	0
LLOW FEVER	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ALARIA	9	6	11	7	15	12	12	13	9	12	10	13	9	6	4	18	9	2	3	1	4	7	4	1	5	1	1	4	2	3	0	1	1
EST NILE VIRUS FEVER	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	0	1	0	0	0	0	0	0	0	0	1	0	0	1	0

The Warmer, Longer warmer days, Precipitation and Humid climates

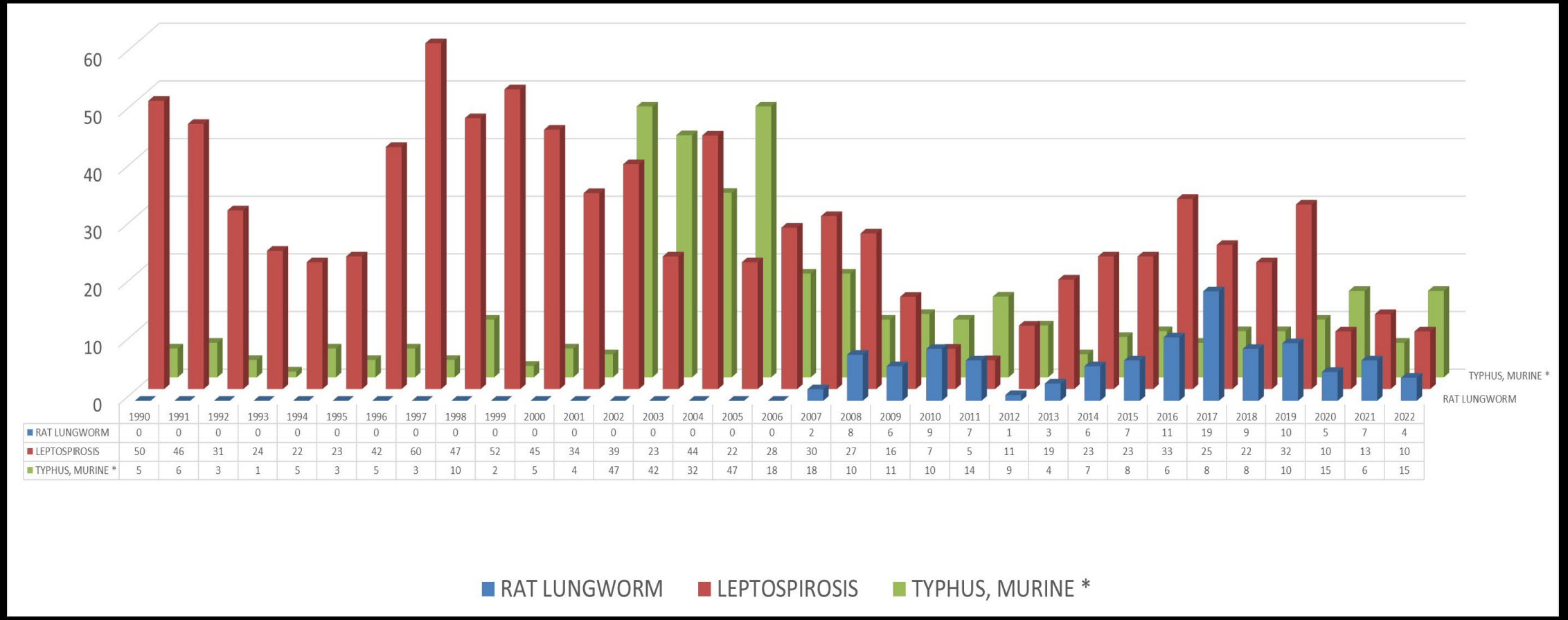
Establishment of the Vector mosquito (Anopheles spp.) and favorable weather conditions for pathogen inoculation in the vector

New invasive diseases such as EEE, Orapouche etc.

Temperature is particularly critical.
EX) Plasmodium falciparum (causes severe malaria)
At temperatures below 20°C (68°F), it cannot complete its growth cycle in the Anopheles mosquito. Therefore, it cannot spread in these areas.

OCCURRENCE OF RODENT-RELATED DISEASE IN HAWAII

Storms and heavy rainfall
Droughts
Human Behavior



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RAT LUNGWORM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	8	6	9	7	1	3	6	7	11	19	9	10	5	7	4
LEPTOSPIROSIS	50	46	31	24	22	23	42	60	47	52	45	34	39	23	44	22	28	30	27	16	7	5	11	19	23	23	33	25	22	32	10	13	10
TYPHUS, MURINE *	5	6	3	1	5	3	5	3	10	2	5	4	47	42	32	47	18	18	10	11	10	14	9	4	7	8	6	8	8	10	15	6	15

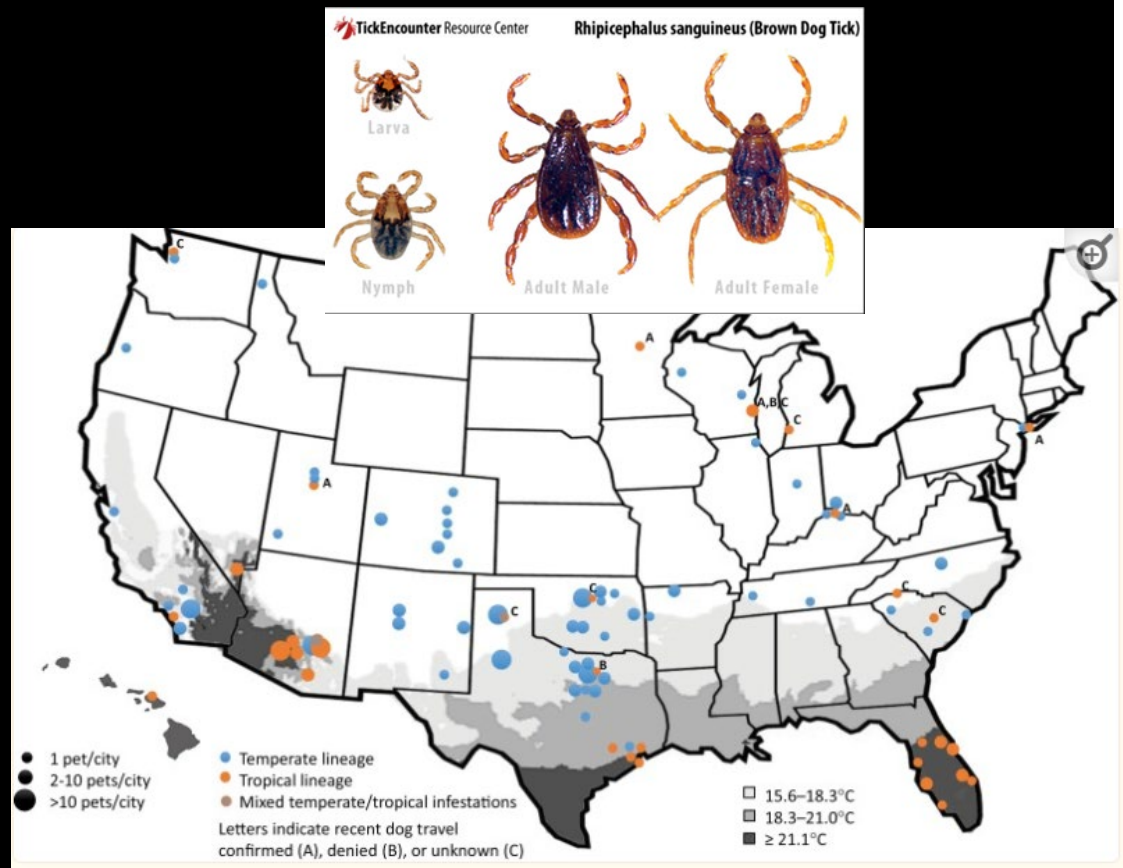
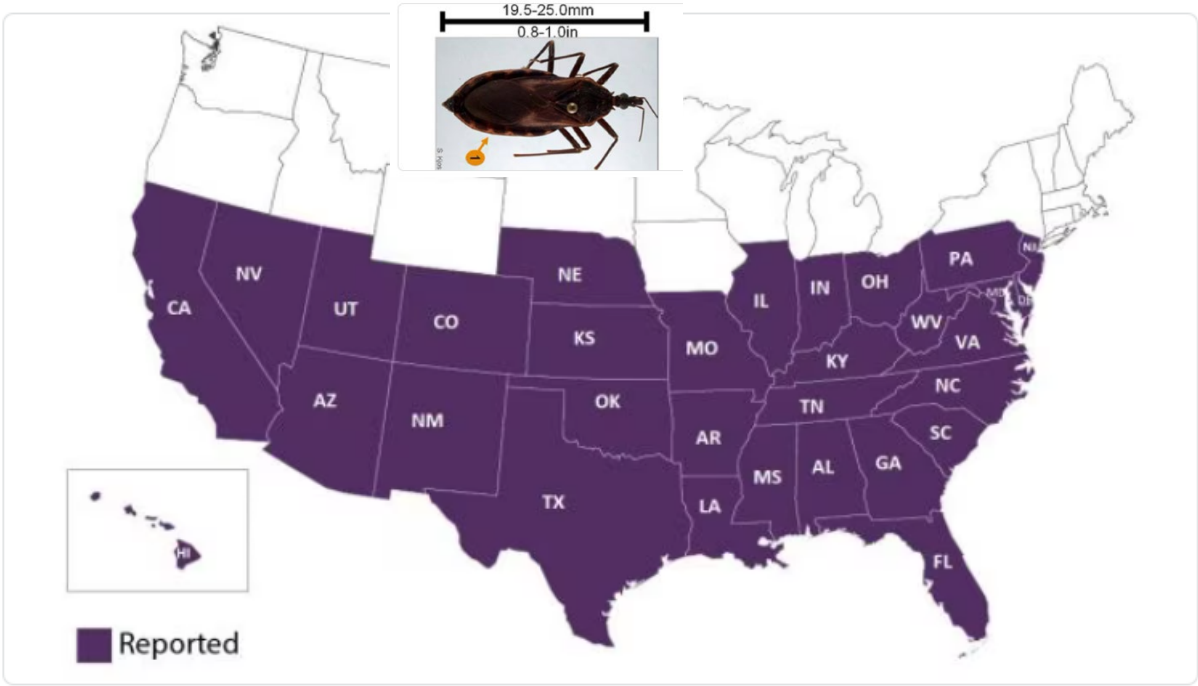


Fig. 1.

Geographic location of pets infested with *Rhipicephalus sanguineus* sensu stricto (temperate) (blue) and tropical (orange) lineages of *Rhipicephalus sanguineus* sensu lato across the United States, 2018–2021. Grayscale shading indicates areas with warmer annual mean daily average temperature. Superscripts indicate travel history status of dogs with tropical lineage ticks identified in cooler climates.

Triatomine Species in the Southern United States

Triatomine bugs are typically found in the southern United States, Mexico, Central America, and South America (as far south as southern Argentina). Eleven different species of triatomine bugs have been found in the southern United States:



Map of the U.S., with states that have reported triatomine bugs highlighted.

Vector-Borne Disease Risk Increasers

Environmental Conditions

- Expanded habitat favorable to the spread of disease carrying vectors

https://www.birdsnotmosquitoes.org/

- Increased Temperatures
- Longer “warm” seasons
- Increased frequency of storms/droughts
- Movement of animal hosts into areas previously unoccupied
- Movement of invasive species

Vector-Borne Disease Risk Increasers

Human Behaviors

- Greater exposure to vector-borne diseases
- Greater movement of people intra and intercontinentally
- Increased international shipping
- Increased shipping to locations previously not exporting (southeast asia)
    - “Lucky Bamboo”

OPINION

GUEST ESSAY

Anthony Fauci: A Mosquito in My Backyard Made Me the Sickest I’ve Ever Been

Oct. 7, 2024

Vector-Borne Disease Risk Reducers

Human Interventions

- Expand knowledge/awareness (Vector/Disease)
  - Reduce exposure
  - Reduce breeding
- Identify and characterize populations- Trap and Analyze (Vector)
  - Molecular Methods/Genomics
- Adulticide-Larvacide (Vector)
- Explore biocontrol agents (Vector)
- Eradication where possible, control where eradication is impossible (Vector)
- Isolate and contain disease (Disease)

Hawaii Vector-Borne Disease Control Program

HAWAII STATE DEPARTMENT OF HEALTH

<u>DOH Partners in Preventing Outbreaks of Vector-Borne Diseases</u>

- Health Care Providers
- Disease Outbreak and Control Division
  - Disease Investigation Branch
- State Laboratories
  - Medical Microbiology Branch (Dayna)
  - Bioterrorism Branch (Remie)
- Vector Control Staff (Statewide)
  - Kauai, Oahu, Maui, Hawaii (East and West)
- Communications Office

Vector-Borne Disease Control Program

Six Tier Strategy

Disease Intervention

- Biosecurity
- Inspection
- Surveillance and Abatement
- Outreach and Education
- Research

What does DOH do with suspected cases?

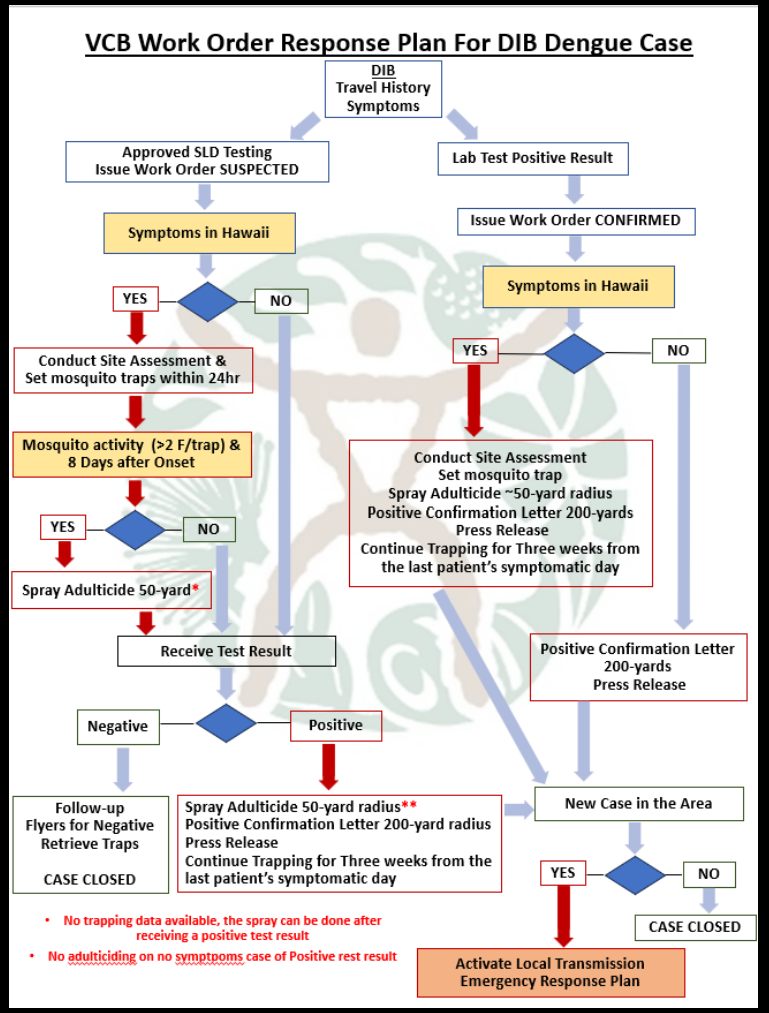
Source: Storydoc

HAWAII STATE DEPARTMENT OF HEALTH

Hawaii Vector-Borne Disease Response Protocols

Hawaii Vector-Borne Disease Partners In Action

- Epis-Lab-Vector Staff in action
- Time and Space Matter



2024 Climate & Vector Study

- Update statewide mosquito distribution maps
- Follow CDC's BRACE Framework to develop future projections of statewide mosquito distrubtions based on changing climate factors
- Overlay distrubution maps with most vulnerable populations to best develop prevention and education programs

Mahalo!

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