

A lush green tropical forest with a waterfall cascading down a mossy cliff. The waterfall is the central focus, surrounded by dense vegetation including ferns and large-leafed plants. The scene is captured in a vibrant, natural light, highlighting the textures of the water and the surrounding foliage.

Invasive Species of Hawaii

AND THEIR IMPACTS ON WATER
INFRASTRUCTURE

What Defines an Invasive Species?

- **A species generally non-native to the surrounding ecosystem of an area, usually introduced by human either intentionally or accidentally**
- **A species that reproduces and spreads at a fast rate without any natural means of control (i.e predators, high mortality rates, etc.)**
- **A species that, by its presence and fast spread has a negative impact on the surrounding area including, but not limited to: human quality of life, native species survival and infrastructure.**

What Threats Do Invasive Species Represent to Hawaii's Water Utilities?

Depending on the species, invasives can directly impact a water system.

- **Pose a threat to immediate safety of personnel in the area.**
- **Damage to critical equipment and system components such as SCADA systems, electrical lines, pumps and pump motors, water lines, meters etc.**
- **Impede and delay needed maintenance or repairs to a system.**
- **Pose a contamination to water storage tanks and/or source water.**

What Threats Do Invasive Species Represent to Hawaii's Water Utilities?

Invasives can be costly to a water utility's budget

- **Incurring damages that require the repair or replacement of expensive equipment or infrastructure.**
- **Causing injuries that remove personnel from a work team, requiring medical leave, insurance payouts and requiring others to work overtime in the absence of the injured individual(s)**
- **Incurring expenses by needing eradication/mitigation effort of the invasive species from a utility.**
- **Mitigation expenses as the result of contamination event in the water system.**
- **Particularly difficult for smaller systems that may not have the financial means or resources to mitigate or eradicate an invasives species incursion on their water system.**



Cane Grass (Centrus purpureus)

Photo by Mike Ogata HRWA

Cane Grass (Centrus purpureus)

- **Direct threats to health and safety of personnel.**

- **Sharp edged leaves that can cause cuts and laceration's when contacted.**
- **Spicules (glass needles) cover the grass type that can cause severe skin irritation and have been know to penetrate through clothing**



Cane Grass (Centrus purpureus)

- **Impacts on infrastructure**
 - **Grows rapidly and can block access to sites, block drainage canals, impede vehicles and overgrow equipment, fences and outdoor pumps.**
 - **If overgrowth is dense enough can potentially block RFI signals from meters and SCADA units.**





Photo by Mike Ogata HRWA

Cane Grass (Centrus purpureus)

- **Mitigation**

- **Grass should be removed from the root. Affected area should then be covered (wood planks, tar paper, weed mat, etc.) for several weeks to prevent grow back. Additionally, ground area may be treated with water softening salts and/or spraying of hypo sodium chloride. Avoid use of herbicides in areas of source water.**



A wide landscape of tall grass under a cloudy sky. The foreground is filled with dense, tall grass. In the middle ground, there are several tall, thin trees and utility poles. The sky is blue with large, white, fluffy clouds.

Fountain Grass (Pennisetum setaceum)

Photo by Forest and Kim Starr

Fountain Grass (*Pennisetum setaceum*)

- **Direct threat to personnel**
 - **Extreme fire hazard. Propagates and spreads by fire. Highly flammable even when green. After fire grows back faster.**
 - **Increase hazardous conditions on site conducting “hot work” (such as welding, soldering, cutting or brazing) as small sparks can rapidly ignite any nearby growth.**

Photo courtesy of Hawaii Invasive Species Council



Fountain Grass (*Pennisetum setaceum*)

- **Impacts on Infrastructure**
 - **Small seeds carried by wind can settle into small spaces and begin germination around pumps, well heads and concrete foundations. Known to grow on bare rock. Threatens structures as any growth is flammable.**
 - **Large amounts of growth have the potential to cause large highly destructive fires.**



Fountain Grass (*Pennisetum setaceum*)

- **Mitigation**

- **Cutting back grass in affected sites prior to “hot work” can help with fire prevention.**
- **Hypo sodium chloride spraying can be used.**
- **Successfully eradicated on the islands of Maui and Molokai by use of herbicides.**



A photograph of a dense thicket of climbing vines and ferns on a hillside. The vines are various shades of green, some with small purple flowers. The ferns are bright green and feathery. The background is a mix of green and brown, suggesting a natural, somewhat overgrown environment.

Climbing Vines: multiple species types

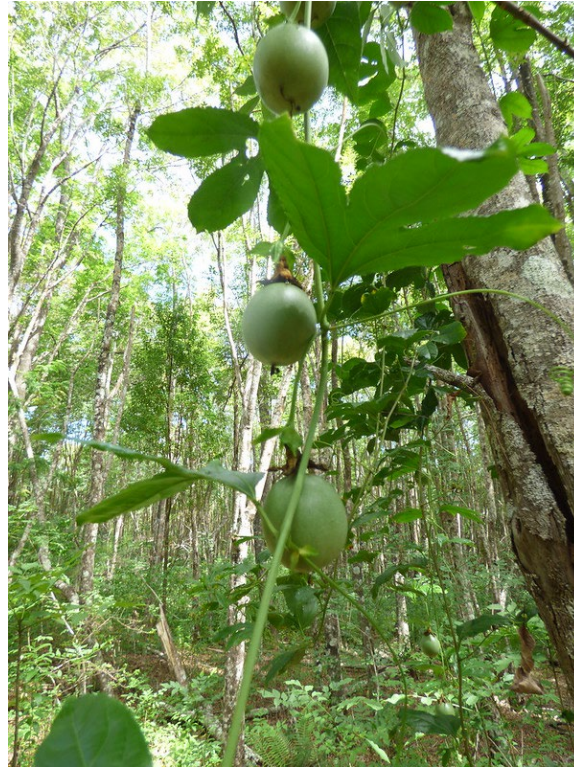
Photo by Forest and Kim Starr

Climbing Vines: Examples in Hawaii

Photos By Forest and Kim Starr



Banana Pokka
(*Passiflora tarminiana*)



Passionfruit
(*Passiflora edulis*)



Kudzu
(*Pueraria lobata*)

Climbing Vines

- **Impacts on infrastructure**
 - **Certain climbing vines can overgrow phone and power cables, interweaving themselves with the lines, impeding repair and maintenance. If overgrowth becomes heavy enough, climbing vine have the potential to down cables.**
 - **Vines can also overgrow outdoor pumps or motors, as well as heavy equipment stored in outdoor areas impeding use.**
 - **Vine overgrowth can create “bridges” from fences to storage tanks that vermin can use to gain access and leading to potential contamination.**
 - **Can also block personnel access to sites if overgrowth is heavy enough.**

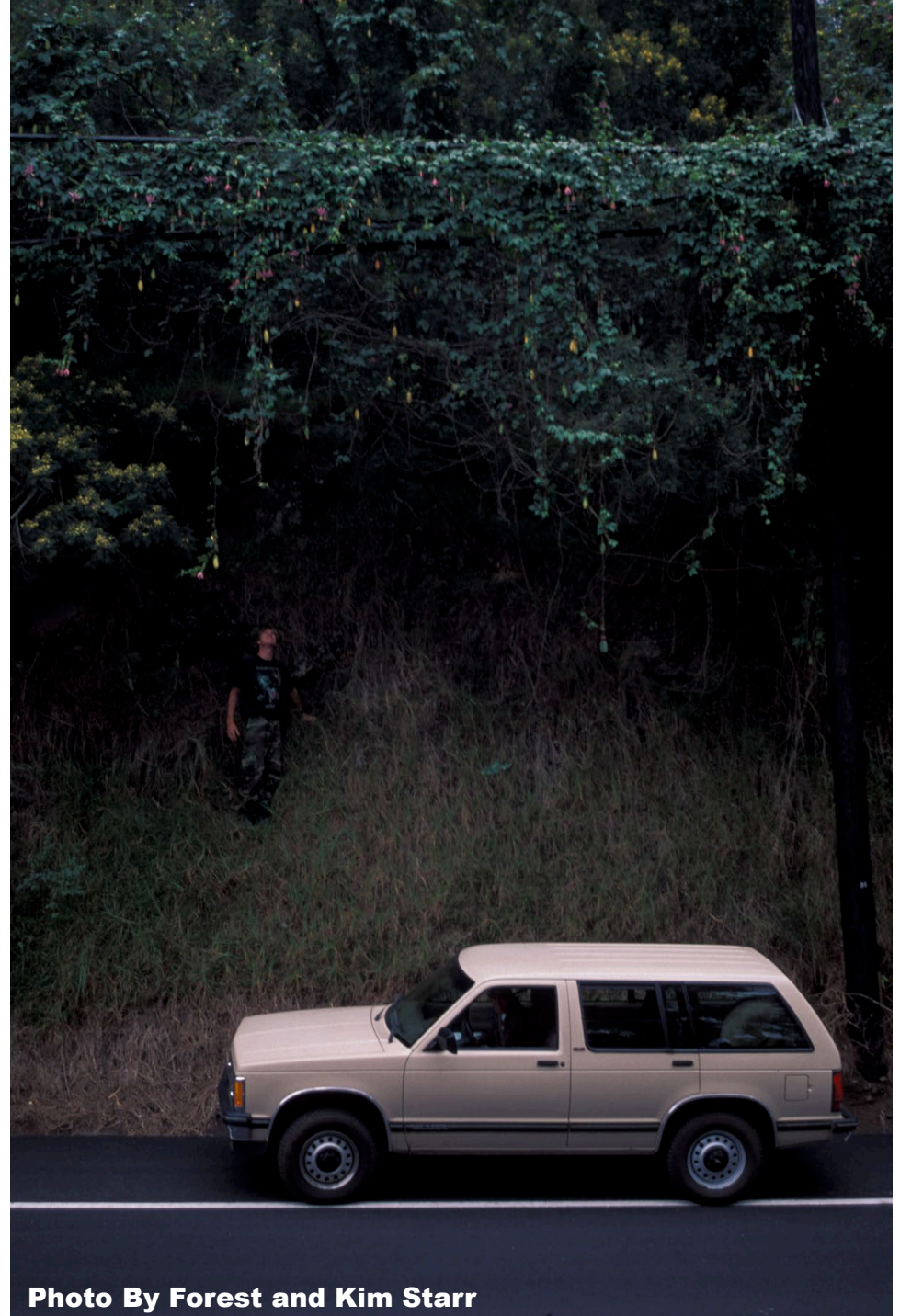


Photo By Forest and Kim Starr

Photo by Mike Ogata HRWA



Photo by Mike Ogata HRWA



Climbing Vines

- **Mitigation**
 - **Cutting vines as close to their ground source as possible followed by physical removal from area needing to be cleared.**
 - **Spraying with hypo sodium chloride where possible.**



Photo by Mike Ogata HRWA



Long thorn Kiaawe (Prosopis juliflora)

Photo by Forest and Kim Starr

The image shows three kiawe leaves of different species laid out on a reddish-brown, gravelly soil. The largest leaf on the left is a long thorn kiawe, characterized by its long, slender, and numerous leaflets. The middle leaf is a common kiawe, with shorter and more rounded leaflets. The smallest leaf on the right is another common kiawe, showing a similar structure to the middle one but with fewer leaflets. The leaves are bright green and cast soft shadows on the ground.

Long thorn Kiawe
(Prosopis juliflora)

Common Kiawe
(Prosopis padilla)

Long thorn Kiawe (Prosopis juliflora)

- **Direct threat to personnel**
- **Multiple long sharp thorns that can inflict injury through punctures and lacerations and are known to go through heavy clothing and footwear.**
- **Under dry conditions, represent a fire hazard, and can ignite where “hot work” is being done.**



Long thorn Kiawe (Prosopis juliflora)

- **Impacts on Infrastructure.**
 - **Thorns have ability to puncture vehicle tires. In some instances, have punctured radiators.**
 - **Grows densely enough to physically block access to work sites and easements.**
 - **Increases fire danger to a well or pump site by providing fuel.**



Long thorn Kiawe (Prosopis juliflora)

- **Mitigation**
 - **Basal bark applications of triclopyr blended with diesel or crop oil. Cutting tree down to stump may not always work as root runners can germinate more saplings.**
 - **Not yet found on Kauai. Kauai Invasive Species Committee should be contacted if sited for immediate control measures.**





Albizia Tree (Falcataria moluccana)

Photo by Forest and Kim Starr

Albizia Tree (*Falcataria moluccana*)

- **Direct threat to personnel**
 - **Large heavy trunk and branches have tendency grow up to heights of 100ft to 150ft at a rate of around 15 ft a year. Due to having wood type of weak strength, its susceptible to limb breakage under adverse conditions creating a dangerous crushing hazard to any personnel in the immediate area as well as occupied structures and vehicles. In some instances, the entire tree may fall over.**



Albizia Tree (*Falcataria moluccana*)

- **Impacts on Infrastructure**
 - **Falling branches and/or trees can damage structures vehicles and vital equipment on site. Known to fall on power lines and take down utility poles.**
 - **Puts down deep roots, that intrude on distribution and wastewater pipes, entering through connection points and causing breakages in lines. Can damage paving and structure foundations.**
 - **Fallen trees can block access roads and paths.**



Albizia Tree (*Falcataria moluccana*)

- **Mitigation**

- **Cut-surface applications of herbicide (triclopyr). Reportedly use of heavy equipment to damage root system also effective.**
- **DLNR estimates removal of 1 full grown tree at around \$1000, due to hazards represented during removal process.**
- **DLNR Currently looking for bio-control candidates.**



Ants *(Formicidae)*

- **All ant types are non native to the Hawaiian islands and nearly all have the potential to become damaging invasives to a water system once populations reach a large enough size.**



Ants (Formicidae)

Direct threats to personnel

- **Biting species of ants such as the little fire ant (*Wasmannia auropunctata*) cause severe bites that envenomate the victim on contact. Described as an “electric shock”, followed by an acute burning sensation, bite can be severe for personnel who may be allergic to venom. Can leave burn-like blisters on the skin.**
- **Stinging ants such as the Large Tropical Fire Ants (*Solenopsis geminate*) represent a similar threat to human health and can rapidly swarm a person that violates an area that they are using for a nest. Sting is described as a “burning needle” sensation followed by continuous irritation.**



Photo courtesy of HISC



Photo by Forest and Kim Starr

Ants (Formicidae)

- **Direct threats to personnel**
 - **Most ant types will carry out some form of aggressive nest defense if disturbed, and many species will set up nests in parts of a water systems structure such as meter boxes, valve boxes, and manholes, and can impede personnel from conducting maintenance or repairs.**



Ants (*Formicidae*)

- **Impacts on Infrastructure**

- **White footed ants (*Technomyrmex albipes*) and Crazy Ants (*Paratrechnia longicornis*) are known to set up nests in electrical housing. Possibly attracted to electro magnetic fields, they can cause electrical shorts and damage or destroy components within and electrical system. They are also known to set up nest among computer circuitry as well. Can cause serious damage to SCADA components as well as RFI equipment if they are able to gain entry.**

Photo by Forrest and Kim Star



Ants *(Formicidae)*

- **Impacts on Infrastructure**

- **Under dry conditions ants will seek out whatever water sources they can find and due to smaller size may be able to bypass screening on vents and overflows in water storage. A large number has the potential to introduce contamination to a storage unit depending on the size of the tank and the number of ants entering the system.**



Ants (Formicidae)

- **Mitigation**

- **Setting bait in pump stations and well houses is good preventative measure**
- **Drawing chalk lines around housing for electrical components and computer systems acts as barrier against entry.**
- **Use compressed air to clear established nests from electrical components**
- **Periodically using diatomaceous earth in small amounts in meter boxes, valve cans and in vaults can prevent nests from being set up.**
- **Locating any nests near infrastructure and treating it with an approved insecticides, bait or diatomaceous earth.**

Photo by Mike Ogata HRWA



Feral Hogs *(Sus scrofa)*

- **Feral hogs (*Sus scrofa*) are the result of cross breeding between Polynesian introduced domesticated pigs and European introduced boar. As such has a very high rate of reproduction (that of agricultural pigs) with aggressive disposition and high survival ability of European boar, with no natural predators present in the Hawaiian ecosystem.**

Photo courtesy of Haleakala Bike Company



Feral Hogs (Sus scrofa)

- **Direct threats to personnel**
- **Though normally timid in human presence, feral hogs have been known to charge aggressively if they should feel threatened. Unprovoked attacks have occurred, particularly by females that have litters of piglets or young males in rut.**
- **Charging can be induced (especially at night) by flashlights, loud sounds or sudden movements, should the pig have nowhere to run or feel trapped. Can run faster than a human in a sprint.**





Feral Hogs (*Sus scrofa*)

- **Direct threats to personnel**
 - **Sharp teeth, normally used on woody plants and shrubs, can be severely injurious in a bite, capable of breaking bones. Even piglets have a very strong bite.**
 - **Tusks, used for digging up roots and tubers, become effective stabbing implements, and can be severely injurious in aggression.**

Feral Hogs (*Sus scrofa*)

- **Impacts on infrastructure.**
 - **Known to dig up and break open shallow distribution lines, particularly during dry periods, to access water. Can damage electrical conduits, and communications lines in the process.**
 - **Known to break through insufficient fencing and barriers to access pump sites and well heads. Tend to travel in social groups multiplying the level of damage done to a site once access is gained.**



Photo by Mike Ogata HRWA

Feral Hogs (Sus scrofa)

- **Impacts on infrastructure**

- **Represents a contamination risk to source water area of primary influence (API), especially to surface water sources, requiring extra treatment, in the form of fecal and urine contamination. Known carriers and spreaders of disease including, but not limited to:**

- **tuberculosis,**
- **trichinosis,**
- **brucellosis**
- **leptospirosis**

Photo by Forest and Kim Starr



Feral Hogs (*Sus scrofa*)

- **Impacts on infrastructure**
 - **Due to wallowing behavior (used by pigs for thermal regulation), and long hairs, have tendency to pick up seeds of invasive plants and spread them wherever they go. Seed spread also occurs in feces. Can introduce problematic invasive plants to a well or pump site furthering costs of mitigation of invasive damage.**



Feral Hogs (Sus scrofa)

• Mitigation

- **Barriers are the most effective method of protecting infrastructure and personnel. Hog wire fencing should be installed and have its base at least 8"-13" buried into the soil to deter digging below fence line to gain access. Gates should have solid frame and be suspended no more that 3" from ground and entry points should be paved or have solid pavers placed under gate to prevent pigs from slipping under gate. All fences and gates should be at least 6-10 feet away from any vital components of a site. Traps may be placed in certain areas outside an operation site as a deterrent and/or means of determining extent of population establishment.**



Photo by Forest and Kim Starr



Photo by Mike Ogata HRWA

Feral Hogs (Sus scrofa)

• Mitigation

- Mace or pepper spray maybe used as a potential deterrent, in the event immediate defense becomes necessary. As pigs have a highly sensitive nose, pepper spray or other such irritants may be effective in deterring the approach or charge of a feral hog.

- **WARNING:** Lethal projectile weapons (firearms, high powered air guns, bows, slingshots, atlatls, etc.) are **ABSOLUTELY NOT** recommended!!! These potentially create a more dangerous situation for personnel and could cause further damage to infrastructure in use.



Mahalo Nui Loa!!!!!!

Special thanks to:

- **Forest and Kim Starr, Photographers, Starr Environmental**
- **Chelsea Arnott, Coordinator and Chuck Chimera, Weed Risk Assessment Specialist,
Hawaii Invasive Species Council**
- **Franny Brewer, Manager, Big Island Invasive Species Committee**
- **Sam Gon III, Senior Scientist and Cultural Advisor, The Nature Conservancy of Hawaii**
- **Teya Penniman, Manager, Maui Invasive Species Committee**
- **Helaman Aiwohi, Superintendent, Maui Department of Water Supply**
- **Lewis A. Upfold, Vice President, Haleakala Bike Company**
- **Georgie Hunter, Agent, Hawaii Life Real Estate Brokers**