

HISC & CGAPS 2025 Joint Strategy

In Support of the
Hawai'i Interagency
Biosecurity Plan



COORDINATING GROUP ON
ALIEN PEST SPECIES





Kamehameha Butterfly on 'Ōhi'a lehua.
Photo credit: Nate Yuen.



Contents

Executive Summary	5
Acronyms	7
HISC & CGAPS Joint 2025 Strategies	8
A. Overview	8
Strategy 1: Prevention & Early Detection/Rapid Response for New Terrestrial Invasions	10
Strategy 2: Inter/Intra-Island Movement of Terrestrial Invasive Species	12
Strategy 3: Aquatic Biosecurity	14
Strategy 4: Large-Scale Control of High-Impact Invasive Species	16
Strategy 5: Pacific Regional Biocontrol Center	18
Strategy 6: Increased & Diversified Funding for Invasive Species Priorities	20
Strategy 7: Engaged & Supportive Community	22
Strategy 8: HISC Engagement Across Sectors	24
Strategy 9: Strong CGAPS Network	26
Strategy 10: Stable CGAPS Funding & Staffing	28
Project Background	30
A. Invasive Species in Hawai'i	30
B. Hawai'i Interagency Biosecurity Plan	33
C. HISC Role & Accomplishments	34
D. CGAPS Role & Accomplishments	36
Taking Action & Measuring Success	38
Acknowledgements	39
Key Terms	41
A. HIBP Abbreviations	42
References	43

Appendices - Available on request

- A. Partners Participating in HISC/CGAPS 2025 Planning Process
- B. 2025 Joint Strategies for HISC & CGAPS
- C. HISC/CGAPS Planning Process
 - 1. HISC/CGAPS Planning Process & Timeline 2019-2020
 - 2. Summary of Partner Input to HISC/CGAPS Planning Process
- D. CGAPS & HISC Progress Reports (2015 – 2019)
 - 1. CGAPS Progress & Lessons – August 2019
 - 2. HISC & HIBP Accomplishments – August 2019
- E. Climate SMART Principles for Invasive Species
- F. HIBP Linkages to HISC/CGAPS 2025 Strategies
- G. HISC/CGAPS 2025 Working Action Plan

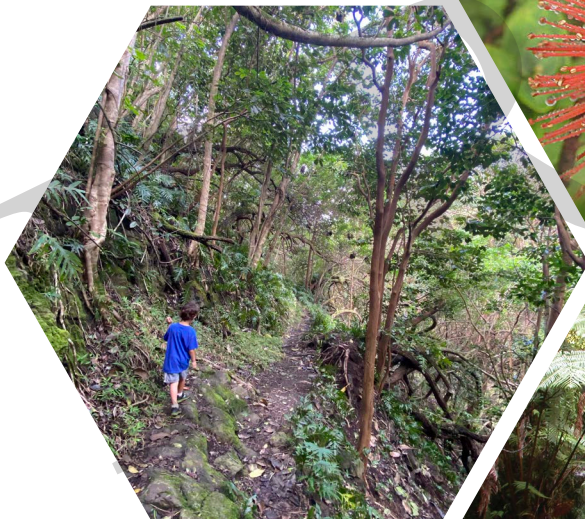


Photo Credits (Left to Right):

Priscilla Billig
Candle Sense
Merrie Monarch
Nate Yuen
J Atwood
DLNR DAR
Keola Magazine
DLNR DAR

■ Executive Summary

Invasive species are the single greatest threat to Hawaii's economy, natural environment, and the health and lifestyle of Hawaii's people and visitors (LRB 2015). This 2025 Joint Strategy for the Hawai'i Invasive Species Council (HISC) and the Coordinating Group for Alien Pest Species (CGAPS) reflects the highly productive collaboration of these two statewide networks to achieve our shared vision:

Hawaii's natural environment, agriculture, economy, and the health, lifestyle, and culture of its people are protected from the impacts of invasive species.

The HISC and CGAPS networks have complementary missions, tools and approaches. CGAPS is a voluntary partnership of state, federal, county, non-profit and private sector experts and managers, who coordinate and catalyze action on statewide invasive species priorities and communicate key issues to the public.

HISC is a formal state council established by statute to coordinate the state's position across agencies on invasive species policy, funding, and projects. HISC's members are cabinet-level decisionmakers representing six state departments. Together, HISC and CGAPS engage and mobilize all the critical partners to address Hawaii's invasive species challenges.

This HISC & CGAPS 2025 Joint Strategy (HISC/CGAPS 2025) builds on more than 25 years of effective action, successful network-building, gap analyses and lessons learned – starting with the creation of CGAPS in 1995 and the establishment of HISC by state statute in 2003. In the last five years, major collaborative invasive species achievements include:

- Successful emergency response and statewide planning to understand, address, and reduce the spread of **Rapid 'Ohi'a Death (ROD)**.
- New multi-agency collaboration working on **marine biosecurity threats**, especially ballast water and vessel biofouling.
- Ongoing early detection and rapid response to **limit the spread of priority pests**, including little fire ant (LFA), coqui frog, coconut rhinoceros beetle (CRB) and ROD.
- **Stronger quarantine and inspection tools** developed, including the landmark Myrtle restriction package for federal protection and the re-establishment and expansion of the detector dog program.
- **First Hawai'i Interagency Biosecurity Plan (HIBP)** launched in 2017 with strong support from the Governor and all HISC agencies.

Importantly, the HIBP provides an in-depth, ten-year analysis of invasive species capacity and policy needs. Progress on all 147 HIBP actions is reported semi-annually. Gaps in action or progress on HIBP actions guided the priorities in this five-year plan (Figure 1).

HISC/CGAPS 2025 was developed using a broad participatory process with input from more than 100 partners across both networks (Appendix A). Together, they agreed on ten statewide strategies to address critical invasive species threats, pathways and opportunities requiring broad collaboration (Appendix B & Section 5). These include three essential organizational development priorities for HISC (Strategy 8) and CGAPS (Strategies 9 & 10) to strengthen their networks' ability to achieve tangible results.

HISC Mission

Provide strategic policy and fiscal direction, coordination, and planning among state departments and other stakeholders to address invasive species issues in a science-based, culturally and socially conscious way.

CGAPS Mission

To coordinate and catalyze action among government and non-government partners to prevent and manage invasive species in Hawai'i, as well as communicate key issues to the public.

■ Acronyms

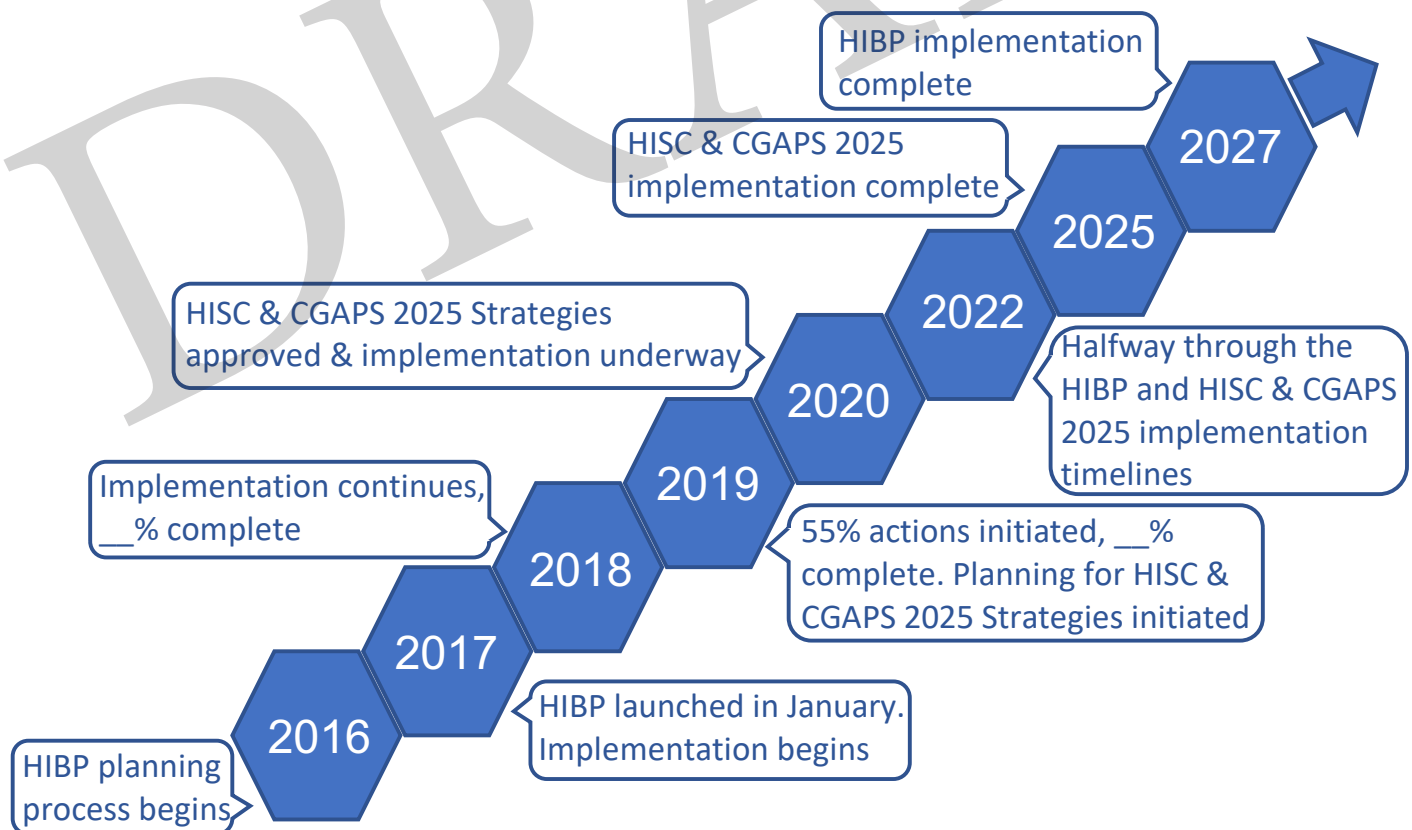
Acronym	Definition	Acronym	Definition
AHB	Africanized honeybees	HRS	Hawai'i Revised Statutes
ANS	Aquatic Non-native Species	HTA	Hawai'i Tourism Authority
APHIS	USDA-Animal & Plant Health Inspection Service	IPPC	International Plant Protection Convention
ARS PBARC	USDA-Agricultural Research Service Pacific Basin Agricultural Research Center	ISC	Invasive Species Committee
BIISC	Big Island Invasive Species Committee	KMWP	Ko'olau Mountain Watershed Partnership
BMP	Best Management Practices	LFA	Little fire ant
CBP	U.S. Customs and Border Protection	LRB	Legislative Reference Bureau
CGAPS	Coordinating Group on Alien Pest Species	MISC	Maui Invasive Species Committee
CIP	Capital Improvement Project	MP	Māmalu Poepoe
CRB	Coconut rhinoceros beetle	NAVFAC	Naval Facilities Engineering Command
CTAHR	UH - College of Tropical Agriculture and Human Resources	NGO	Nongovernmental Organization
DAR	DLNR - Division of Aquatic Resources	NKO	Not known to occur
DBEDT	Hawai'i Department of Business, Economic Development & Tourism	NOAA	National Oceanic and Atmospheric Administration
DHS	U.S. Department of Homeland Security	OISC	O'ahu Invasive Species Committee
DLNR	Hawai'i Department of Land and Natural Resources	OTA	Office of Technology Assessment
DOFAW	DLNR - Division of Forestry and Wildlife	PPC	HDOA-Plant Pest Control HDOA Branch
ED/RR	Early Detection & Rapid Response	PPQ	USDA APHIS - Plant Protection and Quarantine
FY	Fiscal Year	PQ	HDOA-Plant Quarantine HDOA Branch
HAL	Hawai'i Ant Lab	RIFA	Red imported fire ant
HCA/HCAF	Hawai'i Conservation Alliance & HCA Foundataion	ROD	Rapid 'Ōhi'a Death
HDOA	Hawai'i Department of Agriculture	SMART	Specific, Measurable, Achievable, Relevant, Timebound
HDOH	Hawai'i Department of Health	TNC	The Nature Conservancy
HDOT	Hawai'i Department of Transportation	UH	University of Hawai'i
HIBP	Hawai'i Interagency Biosecurity Plan	USCG	U.S. Coast Guard
HISC	Hawai'i Invasive Species Council	USDA	U.S. Department of Agriculture
HISC/CGAPS 2025	HISC & CGAPS 2025 Joint Strategy	USFS	U.S. Forest Service
HMLF	Hau'oli Mau Loa Foundation	WGA	Western Governors' Association
HPWRA	Hawai'i Pacific Weed Risk Assessment	WP	Watershed Partnerships

Overview:

Together, the HISC and CGAPS networks implement ten priority strategies

- 1. Prevention & Early Detection/Rapid Response for New Terrestrial Invasions** – to keep top terrestrial invasive threats from arriving and establishing in the state.
- 2. Inter/Intra-Island Movement of Terrestrial Invasive Species** – to reduce the spread of invasive species between and across islands.
- 3. Aquatic Biosecurity** – to prevent the introduction and spread of aquatic invasive species.
- 4. Large-Scale Control of High-Impact Invasive Species** – to expand management of widespread, high-impact species (e.g. mosquitoes, rats, marine algae).
- 5. Pacific Regional Biocontrol Center** – to increase biocontrol work and critical infrastructure in Hawai'i.
- 6. Increased & Diversified Funding for Invasive Species Priorities** – to secure at least \$100M annually by 2025 from federal, state, county and private sources.
- 7. Engaged & Supportive Community** – to maintain strong community support (70%+ in polls) and mobilize action on these 2025 Joint Strategies.
- 8. HISC Engagement Across Sectors** – to improve engagement and support of all key agencies.
- 9. Strong CGAPS Network** – to engage all partners needed to implement these 2025 Joint Strategies.
- 10. Stable CGAPS Funding & Staffing** – to provide core support for CGAPS operations.

This HISC/CGAPS 2025 Strategy will guide leadership and action by both networks over the next five years, including growing Hawaii's invasive species networks to engage new partners critical to success. The HISC/CGAPS 2025 Strategy is already being implemented by many committed partners with a track record for leading effective invasive species initiatives across the archipelago. This is a "living plan", and it will be adapted over time based on results, lessons learned, innovations and new partners.



HISC & CGAPS

Joint 2025 Strategies

These ten joint strategies reflect broad agreement by the HISC and CGAPS Planning Teams and thoughtful input across this diverse partnership. They also build on 25 years of effective action, collaboration and lessons learned. Each joint strategy will guide leadership and action by both networks over the next five years, including growing Hawaii's invasive species networks to engage new partners critical to success. Importantly, this is a "living plan", and the strategies will be adapted over time based on results, lessons learned, innovations and new partners. Each strategy is presented in five parts:

1. **2025 Objective** - SMART (Specific, Measurable, Achievable, Relevant, Timebound) objectives describe the outcome we aim to achieve by 2025 or "what success will look like" for this key invasive species strategy.
2. **Strategy Team & Lead Partners** - Every strategy requires collaboration by many partners; none of this work can be accomplished by a single agency or organization. Committed leadership is the key to successful collaborations. For each strategy, one or more partner organizations volunteered to lead implementation and others agreed to collaborate on key actions. The founding members of these partner-led Strategy Teams are listed for each strategy below. Additional groups are welcome to join these teams, and their composition will undoubtedly change over time.
3. **Background** briefly describes the rationale and assumptions for each strategy.
4. **Key Actions** are considered essential for success. Together they are sufficient to achieve the 2025 Objective, assuming all key actions are successfully implemented. Some actions are important to achieving more than one objective. These synergies are noted, but the Key Action is not repeated in the other strategy sections.
5. **HIBP Linkages** - Each strategy addresses numerous HIBP tasks, often across multiple HIBP categories. These HIBP linkages are summarized here with a detailed list for each strategy in Appendix F.

In addition, reviewers identified many useful Tasks to guide partners implementing each Key Action. These are listed in the Working Action Plan for HISC/CGAPS 2025 in Appendix G. This workplan will change over time as each Strategy Team practices adaptive management to reach their objective.

1. **Prevention & Early Detection/Rapid Response for New Terrestrial Invasions** - to keep top terrestrial invasive threats from arriving and establishing in the state.
2. **Inter/Intra-Island Movement of Terrestrial Invasive Species** - to reduce the spread of invasive species between and across islands.
3. **Aquatic Biosecurity** - to prevent the introduction and spread of aquatic invasives.
4. **Large-Scale Control of High-Impact Invasive Species** - to expand management of widespread, high-impact species (e.g. mosquitoes, rats, marine algae).
5. **Pacific Regional Biocontrol Center** - to increase biocontrol work and critical infrastructure in Hawai'i.
6. **Increased & Diversified Funding for Invasive Species Priorities** - to secure at least \$100M annually by 2025 from federal, state, county and private sources.
7. **Engaged & Supportive Community** - to maintain strong community support (70%+ in polls) and mobilize action on these 2025 Joint Strategies.
8. **HISC Engagement Across Sectors** - to improve engagement and support of all key agencies.
9. **Strong CGAPS Network** - to engage all partners needed to implement these 2025 Joint Strategies.
10. **Stable CGAPS Funding & Staffing** - to provide core support for CGAPS operations.



Waianae Valley, O'ahu
(PC: Nate Yuen)

CLIMATE-SMART DESIGN

Three climate-smart design questions were applied to each strategy to increase resilience:

1. How will climate change affect threats being managed?
2. How can management actions be adapted to remain effective given those changes?
3. What other strategies or management actions may be needed to address vulnerability gaps?

Climate change is projected to directly impact both Hawaii's natural resources and invasive species challenges. Controlling invasive species (and other major threats) is one of the most practical ways to increase resilience to climate change. Three climate-smart design questions were adapted and applied to each of the ten joint strategies during the development of this plan (Courtney 2018). Adjustments were made to each strategy to increase climate resilience. Current principles for climate-smart planning are outlined in Appendix E. We will continue to use these questions and principles to adapt our invasive species management actions to the changing climate over time to ensure that we:

- Manage for change, not just for persistence
- Reconsider goals, not just strategies
- Integrate adaptation into existing work.

**NETWORK
PRIORITIES IN
SUPPORT OF THE
BIOSECURITY PLAN**

■ Strategy 1

PREVENTION & EARLY DETECTION/RAPID RESPONSE FOR NEW TERRESTRIAL INVASIONS



HDOA and HISC staff check for Africanized Honey Bees in monitoring traps around ports of entry (PC: HISC).

STRATEGY TEAM & LEAD PARTNERS*: HDOA*, USDA*, CBP*, OISC/ISCs, MP, UH

Objective: Keep Hawaii’s top invasive species threats from arriving and establishing in the state, by identifying and addressing high-risk pathways and major modes of introduction, and by improving early detection/rapid response.

Background

Preventing the arrival and establishment of invasive species is much more cost-effective than the costs of controlling an established invasive species or bearing the cost and impacts of these species in perpetuity. Prevention is a joint federal/state responsibility and requires close collaboration between federal and state agencies wherever possible. High-risk pathways include passengers, luggage, ships, packages, e-commerce, etc. To better communicate and measure progress toward the goal of improving invasive species prevention programs, we will use a non-regulatory Hawai‘i Prevention Priority List of different types of potential invaders which could arrive from a variety of source regions, and by different pathways. By focusing on the prevention of these

“sentinel” species and pathways, countless other potentially harmful species may also be prevented. Note that this is not a comprehensive list of all species of concern, nor is it intended to be a regulatory list—it is solely for planning, communication, and assessment purposes.

Preventing the arrival and establishment of marine invasive species is equally important. However, most marine invasive species arrive by different pathways, and the ability of science to forecast the risk of aquatic species is much less advanced. Hence, the prevention list largely includes those marine species likely to arrive via purposeful importation, and those that have proven to be harmful in similar environments. Aquatic invasive species are further addressed in Strategy 3.

Key Actions

1. HDOA, HISC, and other partners collaborate on generating a **non-regulatory Hawai'i Prevention Priority List** to guide prevention and rapid response.
2. Assess **capacity to detect, mitigate and/or treat each species on the Hawai'i Prevention Priority List**, including procedures, training, and technology.
3. Conduct **risk analyses and risk assessments** along known and high potential pathways for invasive species introductions.
4. Address **regulatory gaps** for terrestrial invasive species in Hawai'i to address high-risk pathways and other modes of introduction.
5. Continue to support adoption and implementation of **Myrtaceae import restriction** (domestic and foreign) and apply this approach for the protection of additional key native and economically important plant species.
6. Fund and **fill key positions in HIBP** to enforce existing and new Administrative Rules and Hawai'i Revised Statutes. [link to Obj 6]
7. Support HDOT to make the **Māmalu Poepoe airports pilot project** permanent to enhance monitoring and detection of the Federal Aviation Administration approved list of invasive species (disease spreading mosquitos, fire ants, coconut rhinoceros beetle, and Africanized bees). [link to Obj 2]
8. Identify and provide **Best Management Practices** (BMPs) for reducing pest risk at critical control points in systems, such as airports, harbors, and procurement contracts.
9. Strengthen **early detection and rapid response (ED/RR) capacity** on each island for regulatory agencies and partnership projects, including mobilizing species-specific teams for high-risk terrestrial incursions.
10. Support HDOA in implementing **transitional inspection facilities** and opportunities to inspect other high-risk commodities.
11. Support HDOA to promote and achieve **clean nursery operations** (e.g., treatment requirements, incentives). [link to Obj 2 & 7]
12. Maintain and strengthen the Pest Risk Committee and other mechanisms for **federal and state agencies to share data, effective practices, lessons learned** and informal observations.
13. Track and **report annually on status of Hawai'i Priority Prevention List species** (e.g. not established, prevented at source; detected & intercepted, established). [link to Obj 2]

HIBP Linkages: This Strategy addresses over 30 HIBP tasks for Pre-border Policy (PrePol), Process (PrePro), and Technology, Infrastructure, and Funding (PreTifs). Highlights include addressing high-risk packaging material, expanding inspections to include non-ag commodities, developing pre-screening requirements for horticultural and agricultural products, conducting risk analysis, enhancing early detection with working groups, action plans, and utilizing detector dogs and other technologies. See detailed list of all linkages in Appendix F.

‘Ōhi’a seedlings infected with myrtle rust. Passing a restriction on the importation of Myrtaceae family plants will help prevent the arrival of additional strains of the rust, and other pests and diseases that harm or kill Hawai'i's native and non-native myrtle species (PC: Maui Forest Bird Recovery Project)

■ Strategy 2

INTER/INTRA-ISLAND MOVEMENT OF TERRESTRIAL INVASIVE SPECIES



HDOA inspector on Hawai'i Island examines produce for little fire ant and other tiny hitchhikers to ensure plants are pest-free before being shipped out (PC: MISC)

STRATEGY TEAM & LEAD PARTNERS*: HDOA*, OISC/ISCS, MP

Objective: Keep Hawaii's top invasive species threats from spreading within Hawaii (inter- and intra-island), by identifying and addressing high-risk sources, pathways and major modes of introduction and spread, and by improving early detection/rapid response for new populations.

Background

Once species have arrived in Hawai'i, a key component of minimizing their impact is to prevent movement across and between islands. Within islands, species may spread by their own means or they may be transported intentionally or accidentally by humans. Spread of an invasive species across different types of land ownership, or into areas that are geographically challenging for workers to access, can make control efforts logistically challenging.

Despite being separated by miles of open ocean, Hawaii's islands do share pests with one another. While some species may spread interisland via wind, wings, or waves, many invasive species can move between

islands as a result of human travel and interisland cargo shipments. Focusing on the pathways through which species spread across and between islands, and the commodities with which they tend to be associated, is an important part of the HIBP. HDOA is compiling a non-regulatory Hawai'i Limited Distribution List of high-impact incipient or localized invasive species in coordination with other agencies to guide actions preventing inter-island and intra-island spread. Because aquatic invasive species tend to move through different pathways, the actions in this section focus on minimizing the movement of terrestrial species. Aquatic invasive species are further addressed in Strategy 3.

Key Actions

1. HDOA, HISC and other partners collaborate on generating a **Hawai'i Limited Distribution Priority List** of high-impact localized invasive species to address inter-island and intra-island movement.
2. Include an assessment of the Hawai'i Limited Distribution Priority List to support HDOA in developing and executing a **clean nursery program** that reduces inter/intra-island movement of invasive species. *[link to Obj 1]*
3. Conduct **risk analyses and assessments** to identify and prioritize pest pathways and high-risk gaps for movement of terrestrial invasive species within Hawai'i.
4. Identify and implement **cost-effective tools, technologies, and methods** that improve management of priority pathways by state agencies and private companies.
5. Clarify HDOA authority and determine capacity needed to assess and inspect **high-risk non-agricultural commodities and cargo** and develop voluntary initiatives to mitigate risk.
6. Work with ISCs to increase **County support for prevention and rapid response** of invasive species not known to occur on their island(s). *[link to Objective 6]*
7. Support **HDOT** implementation and 2022 update of the **Statewide Noxious and Invasive Pest Program Strategic Plan** in cooperation with public and private stakeholders.
8. Create **standardized contract language for BMPs** to minimize the spread of invasive species and incorporate into contracts by state agencies and other partners.
9. Promote the use of the **State Pest Reporting System**. *[link to Objective 7]*
10. Track and **report annually on status of species on the Hawai'i Limited Distribution Priority List** (e.g. prevented at source, detected & removed, established, other).

HIBP Linkages: This Strategy addresses over 10 HIBP tasks for Border & Post-Border Policy (Pol), Process (Pro), and Technology, Infrastructure, and Funding (Tifs). Highlights include increasing HDOA staff at PPC, implementing an electronic manifesting system for interisland transport of commodities, minimizing the movement of pest and pest-pathogens interisland with rule changes, utilizing detector dogs to intercept high-risk species, expanding interisland inspections to include non-ag commodities, and promoting the statewide pest hotline. See detailed list of all linkages in Appendix F.

■ Strategy 3

AQUATIC BIOSECURITY



Honolulu Harbor is the primary point of entry into the state for maritime vessels (PC: DLNR).

STRATEGY TEAM & LEAD PARTNERS*: DAR*, NOAA, HDOT, HDOH

Objective: Prevent the introduction and spread of aquatic non-native species (ANS) into, between, and around the Hawaiian Islands, by reducing species movement through ballast water, biofouling, intentional import and release, and unintentional modes of introduction.

Background

More than 417 non-native species and species of unknown origins have become established in Hawaii's marine and estuarine environments, and at least 84 fish, reptiles, amphibians and invertebrates have become established in freshwater habitats. While not all of these aquatic non-native species (ANS) are currently considered invasive, some of them are causing measurable harm to native species, ecosystems, and economic values. Unlike invasive species in terrestrial environments, ANS are often difficult to detect until they are well established, assessing "harm" is more difficult, and there are very few available options for controlling or eradicating an ANS. Therefore, this Strategy focuses on the largest gaps, opportunities, and needs over the next five years for prevention, ED/RR, movement between islands, and spread within individual islands.

Through multiple studies, ballast water and biofouling (the growth of species on the hulls and niche areas of


vessels) have been identified as the top two vectors of marine ANS introductions, with biofouling responsible for up to 78% of non-native marine invertebrates and algal species arrivals. While technologies, rules, and regulations continue to improve and reduce the risk posed by species in ballast water, the use of technologies and regulations to manage biofouling lag far behind. This Strategy recognizes and aims to improve the state's ability to manage these top two vectors in commercial and private vessels.

Another pathway is the legal and illegal importation of marine and freshwater species, followed by accidental or purposeful release of ANS into Hawaii's nearshore or inland waters. This Strategy aims to identify critical control points where additional prevention actions or risk mitigations may be applied. This Strategy also recognizes the existing framework and staff of agencies and NGOs already responding to ANS issues and aims to support these while raising capacity to address remaining gaps in biosecurity.

Key Actions

1. Conduct **risk assessments** to identify and prioritize aquatic pest pathways and risks into and within Hawai'i.
2. Develop **aquatic rapid response plans** to address high-risk vessels.
3. Establish a vessel inspection program in Hawai'i harbors with the maritime industry and government partners, including a framework to **co-regulate commercial vessels** related to ANS as incidental discharges regulated under VIDA.
4. Develop framework and associated rules to manage ANS risks from **non-commercial vessels** (those not exempted and not covered under VIDA).
5. Fund and establish an **aquatic biosecurity team** to perform vessel ballast water and biofouling risk assessments within Hawai'i. *[link to Obj 6]*
6. Identify and implement **tools, technologies, and methods** that improve detection and/or management of priority species and pathways. *[link to Obj 1 & 2]*
7. **Increase awareness of key private stakeholders** of their role and opportunities to help address aquatic invasive species introduction and spread. *[link to Obj 7]*
8. Research and develop a **list of high-risk aquatic animals** and prohibit their introduction to Hawai'i.
9. Establish a **baseline** for aquatic biosecurity and initial measures for **tracking effectiveness** at preventing introduction and spread of ANS.

HIBP Linkages: This Strategy addresses over 20 HIBP tasks for Pre-Border, Border & Post-Border Policy (Pol), Process (Pro), and Technology, Infrastructure, and Funding (Tifs). Highlights include adding high-risk ANS to prohibited/restricted lists, creating procedures to managed ballast water and hull fouling, standardizing state and federal language regarding ballast water, increasing DAR's capacity, testing and implementing new technologies for in-water cleaning for hulls of ships, and conducting risk assessments. See detailed list of all linkages in Appendix F.



Invasive seaweed smothers coral reefs and damages reef habitats. If prevention fails, limited tools exist for controlling the unwanted impacts of harmful marine and freshwater species (PC: DLNR-DAR).

■ Strategy 4

LARGE-SCALE CONTROL OF HIGH-IMPACT INVASIVE SPECIES



Widespread invasive species like rats have far-reaching negative impacts including on public health, production of food crops, clean water, buildings and infrastructure, and native species. Some widespread invasive species, like rats, require larger, more comprehensive control efforts and public support for the need to expand efforts (PC: Jared Clarke/BirdTheRock).

STRATEGY TEAM & LEAD PARTNERS*: DLNR*, HDOA*, BIISC/ISCS, FWS

Objective: Implement at least one new large-scale control or eradication project for an invasive species population with highly significant ecological, economic, and/or health impacts in Hawai'i, and build momentum for action on other widespread high-impact species (e.g. mosquitoes, rats, marine algae).

Background


Hawai'i's history of species introductions long precedes our understanding of the impacts of invasive species and the need for biosecurity measures. As a result, many species in Hawai'i are widespread throughout the state and are not well-suited to small-scale control actions. Examples include rodents, mongoose, marine algae, and mosquitoes. For control of such species,

new tools and technologies are required that can be applied over large geographic scales. Because of the large number of established, non-native species in Hawai'i, the highest priority candidates for control are species that have significant ecological, economic and/or health impacts and for which there are potential tools that could result in meaningful, large-scale control or eradication.

Key Actions

1. Identify and **prioritize at least five established invasive species** (aquatic or terrestrial vertebrates, invertebrates or plants) with populations that have highly significant ecological, economic and/or health impacts and where large-scale projects could be implemented in the next 10 years (e.g. mosquitoes, rodents, marine algae).
2. Research and identify **tools, technologies, and methods** that are proven effective (or have high potential) for large-scale control or eradication of at least three priority invasive species by 2021.
3. Select **first pilot/demonstration large-scale eradication project** and identify political, regulatory, funding, social, cultural, and other barriers/opportunities to implementation with possible ways to reduce barriers and leverage opportunities.
4. Develop and implement a **model community engagement plan** (BMP) for the first large scale control or eradication project(s) and make it available for future large-scale projects. *[link to Obj 7]*
5. Work with partners to **implement at least one large-scale project** and initiate planning for at least one more.
6. Ensure the large-scale impact is sustained, including **regular monitoring and follow-up**. *[link to Obj 6]*
7. Assist lead agencies to **evaluate** the large-scale project(s), including model community engagement, evaluation and follow-through.

HIBP Linkages: This Strategy addresses some critical HIBP tasks for Post-Border & Public Awareness Policy (Pol), Process (Pro), and Technology, Infrastructure, and Funding (Tifs). Highlights include funding new technologies for enhanced detection and control of priority species and building community support for large-scale control projects. See detailed list of all linkages in Appendix F.



Controlling certain types of widespread invasive species must be done on a larger scale than what is currently practiced. Working together to plan and implement larger control projects could help change future outcomes for issues like mosquito-borne diseases that have decimated Hawaii's native forest birds like this kiwīkiu (PC: Maui Forest Bird Recovery Project).

■ Strategy 5

PACIFIC REGIONAL BIOCONTROL CENTER



Under a Memorandum of Agreement, HDOA and the USDA Forest Service work together to provide biocontrol research aimed at managing some of the harmful invasive plants and pests in Hawaii and the Pacific, and USDA ARS provides some additional capacity. Even working together, these facilities lack the necessary buildings, space, and equipment to meet the needs for addressing agricultural, ornamental, and forest pests and weeds (PC: CGAPS).

STRATEGY TEAM & LEAD PARTNERS*: HDOA*, USDA*, UH, DLNR, USGS

Objective: Increase the capacity and scope of biocontrol work in Hawai'i by creating a Pacific regional biocontrol center with planning for new facilities, base funding, and core staff in place. With existing capacity, release biocontrol agents for at least three top priority established invasive species (invertebrates, weeds, and/or pathogens) and annually assess, prioritize, and advance critical biocontrol projects.

Background


This Strategy aims to increase state capacity to reduce the impacts of certain types of widespread invasive species through classical biocontrol methods -- finding a co-evolved natural enemy and testing to ensure it does not impact native and economically important taxa. Increasing biocontrol capacity includes planning, securing initial funds, and setting in motion the construction of facilities capable of housing multiple simultaneous projects across the different taxonomic groups. Biocontrol research and rearing for pests in Hawai'i and Pacific insular areas is currently conducted collaboratively by USDA USFS and USDA ARS PBARC

on Hawai'i island and HDOA on O'ahu, with some UH research assistance. However, the USDA and HDOA facilities are at the end of their life cycle and can only work on a small fraction of the necessary projects due to space and current containment capabilities. UH and USDA ARS PBARC are similarly constrained. Increasing biocontrol research capacity will protect Hawai'i, the mainland US and the Pacific region. At the same time, our partners will continue to demonstrate the value and effectiveness of classical biocontrol as a tool for managing widespread, established priority invasive species.

Key Actions

1. Build a **broad coalition** to support the building and long-term maintenance of Pacific regional biocontrol facilities that can test potential classic biocontrol organisms across different taxonomic groups.
2. Develop a **feasibility assessment** for raising capacity of new Pacific regional biocontrol facilities for Congressional delegates and agency use.
3. Identify and secure lines of potential **funding, site(s) and designs for climate-resilient containment facilities, including** options for natural hazard mitigation . *[link to Obj 6]*
4. Maintain and develop new **regional and international partnerships** to strengthen regional biocontrol capacity and success of exploration missions.
5. Secure funding and increase **biocontrol staff** for both state and federal biocontrol projects. *[link to Obj 6]*
6. Test at least eight **biocontrol agents**, and release five by 2025.
7. Evaluate and harmonize the **biocontrol regulatory process** for greater efficiency.
8. Build and maintain **public support** for 21st century biocontrol practices. *[link to Obj 7]*
9. Measure **effectiveness of released biocontrol agents** over time (>5 years) and track the number of biocontrol agents in pipeline and released annually.

HIBP Linkages: This Strategy addresses some critical HIBP tasks for Post-Border Policy (Pol), Process (Pro), and Technology, Infrastructure, and Funding (Tifs). Highlights include securing funding for new state-of-the-art biocontrol/containment facilities, increasing the number of biocontrol scientists and support staff, and increasing the yearly operating budget. See detailed list of all linkages in Appendix F.



In 2005, an invasive gall wasp was found to be killing native and non-native wili wili trees across the state. HDOA's exploratory entomologist traveled to the native range of wili wili and found a sesame-seed sized wasp that controls the gall wasp population. In 2008, it had passed testing and was released, allowing the native wiliwili to survive extinction (PC: Forest and Kim Starr)

■ Strategy 6

INCREASED & DIVERSIFIED FUNDING FOR INVASIVE SPECIES PRIORITIES



Increasing funding at the county, state, federal, and private levels is critical to continuing to implement the HIBP and stay on target for the 10 year commitment for “more biosecure Hawai‘i by 2027” (PC: Hawai‘i State Capitol).

STRATEGY TEAM & LEAD PARTNERS*: HISC*, MISC/ISC, DAR

Objective: Increase & diversify funding for invasive species priorities to secure at least \$100M annually through county, state, federal, regional, and private sources, including \$90M for operational and personnel requirements and \$10M for essential facilities.

Background

The core concept of the Hawai‘i Interagency Biosecurity Plan is that investments in Hawai‘i’s biosecurity programs must be substantially increased using a holistic approach that strengthens the essential, complementary programs that exist across multiple agencies and partnerships.

In 2015 the Legislative Reference Bureau conducted a survey of invasive species programs in Hawai‘i and estimated that \$57M in state, federal, county, and private funds were being expended annually. Approximately \$40M/year in additional support is needed to implement the Hawai‘i Interagency Biosecurity Plan, including operating, personnel, and infrastructure costs for most of the 147 specific actions. To meet this critical need, HISC & CGAPS will work together to diversify the mix of state, federal,


county and private partners supporting invasive species programs across the state and increase total funding to roughly \$100M annually.

Managing invasive species is a highly dynamic process. HIBP priorities form the foundation for this projected funding target, but funding for priority actions in this Joint Strategy or agreed by the CGAPS and HISC Networks can also be “counted”, even if they are not specified in the HIBP. To ensure cost-effective investments, this Strategy calls for a clear, outcome-oriented programmatic/CIP case to support any funding request. The \$100M annual target also includes \$10M in CIP funding to support initial work on essential facilities – biocontrol, inspection, biocontainment (following HDOA pilot program model).

Key Actions

1. Work with a diverse group of advocates to increase **State general funds** to DLNR, HDOA, UH, HDOH and HDOT for implementing HIBP actions (e.g. staff, electronic databases, adopting new technologies).
2. Secure additional **HISC project funding** to support specific critical new initiatives in the HIBP and 2025 Strategy, including risk assessments.
3. Secure a funding mechanism (public and/or private) to provide **at least \$1 million annually for emergency response** to new terrestrial or aquatic incursions.
4. Increase annual support from **all four counties** to ensure stable and effective Invasive Species Committees (ISCs), ROD response and other priority invasive projects.
5. Double **private discretionary funding** to support CGAPS' ongoing and new invasive species initiatives. (estimated at \$700K per year) *[link to Obj 10]*
6. Build a relationship with **visitor industry** decision-makers and develop mutually beneficial projects.
7. Investigate existing and new lines of **federal funding** for invasive species work.
8. Identify invasive species management as a priority use for **DLNR's forest carbon offset program** and secure annual commitment in addition to annual appropriations to HISC funds and Watershed Partnership Program Grants.
9. Secure **capital funding** for essential facilities. *[link to Obj 5]*
10. Repeat **funding analysis** conducted by LRB in 2015 to assess progress.

HIBP Linkages: This Strategy addresses some critical HIBP tasks for Border, Post-Border & Public Awareness Policy (Pol), Process (Pro), and Technology, Infrastructure, and Funding (Tifs). Highlights include developing an "emergency response task force", allocating money to an emergency response fund for new pest incursions, and securing funding for a new biocontrol/containment facility. See detailed list of all linkages in Appendix F.



County funding for programs like the ISCs and HAL are essential to provide stable, year-round funding for island control and eradication of incipient pests like Miconia (above) and little fire ants (PC: OISC).

■ Strategy 7

ENGAGED & SUPPORTIVE COMMUNITY



Community engagement is vital to the success of these strategies. Coordinated investments in, and focus on engaging the community in protecting Hawaii from the impacts of invasive species and perpetuating island resources is necessary. Ambyr Mokiao-Lee, Statewide Rapid 'Ōhi'a Death Outreach Specialist, is part of a team that engages communities in understanding and protecting 'Ōhi'a forests (PC: UH-CTAHR).

STRATEGY TEAM & LEAD PARTNERS*: CGAPS*, DLNR DAR, BIISC/ISCS

Objective: Raise or maintain strong awareness and support (70%+ in polls) for key invasive species issues and expand, diversify and mobilize a network of allies to achieve 2025 Joint Strategies.

Background


The need for diverse, multi-sector community support was the most common priority identified by partners at the statewide planning meeting. This included support for funding, policy, current control programs, volunteer work, new techniques and sometimes controversial or poorly understood approaches (e.g. herbicides, biocontrol, feral cat management). Community is broadly defined to include residents, landowners, visitors, tourism sector, legislators and other elected officials, agencies, businesses, Hawaiian community, science community, and others. The ROD outreach campaign is an outstanding example of the importance of effective communications to empower invasive species management.

Work on this strategy will support implementation of all the Joint 2025 Strategies. Teams working on terrestrial and aquatic invasives at any level (prevention, ED/RR, large-scale control, biocontrol or funding) can use this strategy to guide their use of communications to effectively advance their outcomes. Strategic communications and social marketing are special communication tools that can motivate targeted groups to take important actions. The capacity to apply these new tools will be developed within our networks over the next five years. Ideally, our communications work will include opportunities to work across agencies, ecosystems and other “silos”.

Key Actions

1. Provide **quality, timely, accessible information** to community, decision-makers and allies.
2. Develop **resonant/targeted messages** (related to the core values of the audiences) and use effective methods/channels to help key audiences:
 - o **value** Hawaii's natural environment, agriculture, economy, and the health, lifestyle, and culture of its people
 - o **understand the threats** posed by invasive species and related compounding issues, such as climate change
 - o **respond to a call to action** to address these threats.
3. Increase **adoption of specific biosecurity behaviors at ports of entry**, especially airports. *[link to Objectives 1 & 2]*
4. Identify and engage **influencers in different sectors**, industries, and groups who can champion invasive species priorities.
5. Increase CGAPS & partner understanding and use of social science and raise capacity for the effective use of **social science concepts and social marketing** for invasive species messages.
6. Increase **political will** to support policy and funding needs.
7. **Coordinate statewide or regional strategies and messages** across lead agencies and partners; provide communications/coordination support for agencies and partners for key issues.
8. **Evaluate** effectiveness of communications periodically and use these lessons to improve future initiatives.

HIBP Linkages: *This Strategy addresses some critical HIBP tasks for Public Awareness Policy (Pol), Process (Pro), and Technology, Infrastructure, and Funding (Tifs). Highlights include coordinating shared messaging with partners, utilizing existing and new media outlets to disseminate information, providing regular updates to lawmakers on successes. See detailed list of all linkages in Appendix F.*



'Ōhi'a forests are essential for water collection and recharging our freshwater supplies. Sharing important facts like this with people is just one of the ways outreach specialists communicate the importance of invasive species work in Hawai'i (PC: J. Atwood).

■ Strategy 8

HISC ENGAGEMENT ACROSS SECTORS



Hawaii Invasive Species Awareness Month in February celebrates invasive species work across the state, including work by volunteers and the public. HISAM awardees are recognized by the Governor, HISC Council, and their county's legislators. (PC: Office of Governor Ige)

STRATEGY TEAM & LEAD PARTNERS*: HISC*, COUNCIL MEMBERS OR DESIGNEES, HISC WORKING GROUP CHAIRS

Objective: Improve HISC's engagement and support across key sectors (agriculture, conservation, economy, health, tourism, transportation, and culture/way of life) and systems (terrestrial and aquatic), as measured by engagement in HISC activities and effective use of HISC tools (e.g., funding, policy resolutions, testimony).

Background

HISC is the official state interagency coordinating body engaged in invasive species or biosecurity efforts. Legislation placed HISC within DLNR "for administrative purposes only," without emphasis on any of HISC's constituent agencies or sectors. Since HISC staff are housed by DLNR's Division of Forestry and Wildlife, there is a perceived (and perhaps real) bias to focus on invasive species issues important for terrestrial conservation. This unintentional focus may reduce attention to invasive species issues in other sectors, including aquatics, agriculture, economy, health, tourism, transportation, Hawaiian culture and


way of life. While developing this strategy, many felt this bias may occur across HISC activities and tools, including funding allocations, policy resolutions, and testimony on invasive species legislation.

The key actions below will improve HISC's engagement and support across the full breadth of sectors addressed by HISC's constituent agencies. As part of this strategy, HISC staff will also create a tracking system that quantifies engagement across sectors for all HISC tools. We will develop a baseline of sectoral engagement by examining efforts leading up to the 2020-2025 Strategy and then quantify changes during the implementation of this strategy.

Key Actions

1. Formalize and establish **liaison roles within each agency** to identify priorities that HISC can actively support (e.g., policies, resolutions, strategies, projects, research questions, communications, joint workday opportunities).
2. Improve engagement and interaction with **HISC Council members**.
3. Submit **HISC testimony** on bills that are important invasive species priorities, as requested by Council members. *(Historically, HISC regularly testified on bills within DLNR's scope. By 2025, the staff hopes to work more closely with all its member agencies on legislative priorities.)*
4. Review and reconvene **HISC Working Groups** to reflect 2025 strategies and address balance amongst sectors.
5. Increase participation in **Hawai'i Invasive Species Awareness Month** across all sectors.
6. Develop and use a **tracking system to assess balance across sectors** for HISC tools (e.g., quantifying the number of resolutions, testimonies, funded projects relevant to each sector).

No HIBP linkages



HISC will work with state agency representatives to achieve better balance across sectors. For example, reengaging with HDOT to manage invasive albizia along roadways. (PC: HISC)

■ Strategy 9

STRONG CGAPS NETWORK



Strengthening the CGAPS network looks to engage new partners that can help move projects forward, like working with vessel operators, UH, HDOT, USCG, DLNR DAR, NOAA, and other agencies to address ballast water and biofouling.

STRATEGY TEAM & LEAD PARTNERS*: CGAPS*, STEERING COMMITTEE MEMBERS

Objective: Include representatives across the diverse invasive species community of practice in the CGAPS Network and actively engage all partners needed to implement this 2025 Joint Strategy statewide.

Background

This objective is founded on the original goal of CGAPS, which is to bring together people in agencies, non-government organizations, and stakeholders to collaborate on and catalyze action to address invasive species issues. This strategy aims to further expand the CGAPS network and deepen CGAPS' recognition and reputation as a valuable source of information, respected catalyst for action on critical gaps in invasive species management, and convener of the invasive species community of practice.

Key Actions

1. Continue to engage and support CGAPS partners by assessing and improving current **network communications**, including general meetings, list-serve, website, information sharing and other network activities.
2. Provide and socialize a simple description of **what CGAPS does** and how it relates to HISC with all CGAPS participants, especially Steering Committee members.
3. Challenge the **CGAPS Steering Committee** to actively lead, implement and/or support elements of the 2025 Joint Strategies (Objectives and/or Key Actions) most relevant to their positions and agencies.
4. Identify and **recruit additional public and private sector partners** needed to implement the 2025 Joint Strategies, using various meeting formats, venues and other engagement mechanisms. Potential additions identified by partners include:
 - HTA & visitor industry (key partners for Prevention & Movement)
 - Nursery, horticulture & food industries (key partners for Prevention & Movement)
 - NOAA & USCG (key partners for Aquatic Biosecurity)
 - Department of Defense (strengthen existing partnership, key for Prevention, Movement & Aquatics)
 - Governor's Cabinet (strengthen existing partnership for all Joint Strategies)
 - Watershed Partnerships & private landowners (strengthen existing partnership, especially for Movement & Large-Scale Management)
 - County governments (expand existing partnership; key for Movement, Aquatics & Large-Scale Management)
 - Micronesia & Pacific islands (key partners for Prevention)
5. **Track member participation** and periodically gather input on their satisfaction with the CGAPS network and opportunities for adaptive management.

No HIBP linkages



Addressing some biosecurity issues require national and international partnerships, including testing technologies that can address the risk of biofouling while protecting clean water and improving vessel efficiency.

■ Strategy 10

STABLE CGAPS FUNDING & STAFFING



CGAPS staff have built relationships with decision makers, providing a conduit to communicate priority issues and needs. This strategy is aimed at building support to continue these important functions. (PC: CGAPS).

STRATEGY TEAM & LEAD PARTNERS*: CGAPS*, STEERING COMMITTEE MEMBERS

Objective: Secure committed consistent annual contributions from CGAPS partners to provide core support for two staff and core operations (est \$250K per year, not including project funds).

Background

The partner and stakeholder interviews revealed that CGAPS is highly valued for its professional services, trusted reputation and track record for successfully identifying and eliminating major invasive species management “gaps” (Appendix C). Partners also expressed concern for the long-term sustainability of this important network, which still depends on grant funding for roughly 75% of its annual income. Since the first CGAPS staff was hired in 2001, at least one CGAPS staff has been continually funded through grants and other “soft” funds from a variety of state, federal, and private sources. This model of multiple sources of funding has been successful over the years, even when funding amounts and sources have shifted between partner agencies. Starting in 2012,

HMLF’s strategic ten-year partnership with CGAPS made it possible to grow CGAPS’ capacity to launch and maintain critical new initiatives, such as the ROD and Legal Fellows programs. However, the HMLF partnership is due to end or change after 2021. This strategy recognizes the critical importance of the CGAPS Steering Committee members providing reliable funding from their agencies to support at least two CGAPS staff and core operations. This level of core funding will probably require an increase in the number of contributing partners and possibly the level of funding. In the next five years, it is critical to stabilize the CGAPS funding base and ensure continuity of its key roles, while continuing to secure grants for new and short-term initiatives.

Key Actions

1. Review CGAPS funding needs with **Steering Committee** and request/secure annual contribution commitments from all members.
2. Work with the CGAPS Steering Committee to **assess the potential core funding mechanisms**, contributors, and amounts to ensure CGAPS financial security and continuity after 2021 (when HMLF 10-year commitment ends).
3. Secure additional annual commitments from **active CGAPS partners** outside the Steering Committee.
4. Complete the first ten years of **partnership with HMLF** and agree on future partnership priorities by 2021.
5. Present CGAPS “value proposition” and funding needs to the **Environmental Funders Group** to seek core funding and/or project support.
6. Explore feasibility of **permanent funding for one CGAPS position** in a partner institution’s budget (e.g. faculty specialist at UH).
7. Provide **annual CGAPS budget and financial report** to Steering Committee, especially tracking core support from partners.

No HIBP linkages

Since the formation of CGAPS in 1997, one of the primary goals has been to bring agencies and NGOs together to facilitate communication and collaborations, and to catalyze change. Stable funding for core staff enables the relationship building, trust, and consistency that are the cornerstones for effective partnerships (PC: KMWP).

■ Project Background

Invasive species are the single greatest threat to Hawai'i's economy, natural environment, and the health and lifestyle of Hawai'i's people and visitors (LRB 2015).

Across the islands, invasive species have devastating impacts on agriculture and local food self-sufficiency, replace native ecosystems, diminish freshwater quality and quantity, and increase disease and other human health concerns. They are found on land, in streams and throughout our coastal waters. The movement of invasive species globally continues to increase, as commerce and transportation expand, and climate change opens new pathways.

This HISC & CGAPS 2025 Joint Strategy calls for accelerated action to protect Hawai'i from the

costly, and often irreversible, impacts of invasive species. Because invasive species impact many sectors, prevention and management requires strong, collaborative planning among diverse stakeholders. This Strategy was developed through a broad, participatory process with the full CGAPS and HISC networks, and officially approved by the leaders of all six HISC state agencies and the CGAPS Steering Committee. Hawai'i's collaborative invasive species approach is often recognized as a model and leader by other jurisdictions.

A. Invasive Species in Hawai'i

The Hawaiian Archipelago is the most isolated group of islands in the world, located over 3,700 kilometers (2,500 miles) from the nearest continental landmass.

Prior to human arrival, this extreme geographic isolation meant that one new species arrived roughly every 35,000 years (Ziegler 2002, Loope 1998, MacDonald 1983), and each new arrival created a marvelous array of unique species known only from Hawai'i. Many of these uniquely Hawaiian species lost defense mechanisms no longer required in an environment lacking any land mammals, reptiles or amphibians to eat or trample them. As a result, Hawai'i is a biodiversity hotspot with an estimated 90% endemism among native flora and fauna (Wagner et al. 2012).

The Polynesians first settled in Hawai'i around 1200 AD, bringing an estimated 33 plant species and several new land mammals, including Polynesian pigs and Pacific rats (Duffy & Martin 2019, Kirch 2011). With the arrival of Captain Cook in 1778, transportation of people and goods to the islands increased dramatically.

Today, Hawai'i is one of the most invaded locations worldwide (Dawson et al. 2017). Hawai'i's role as a hub for travel, commerce and military transport is a major contributor to its vulnerability to alien species incursions (Messing & Wright 2006). It is estimated that one new species is established in Hawai'i every 18 days (DLNR 2010). An assessment of incoming air cargo at Kahului Airport intercepted a daily average of one new insect or plant disease species that was not known to occur in Hawai'i (HDOA 2002). These are much higher rates than other states in the USA (OTA 1993).

US & Global Hotspot for Invasion & Extinction

Hawai'i represents only 0.2% of the total U.S. land area, yet our small islands are home to:

- 10,000 endemic plants and animals
- more than 30% of all threatened or endangered taxa in the USA
- 45% of US threatened or endangered plants
- 75% of all the animal and plant species documented as extinct in the country

Invasive species threaten almost all these at-risk species directly or through habitat degradation.

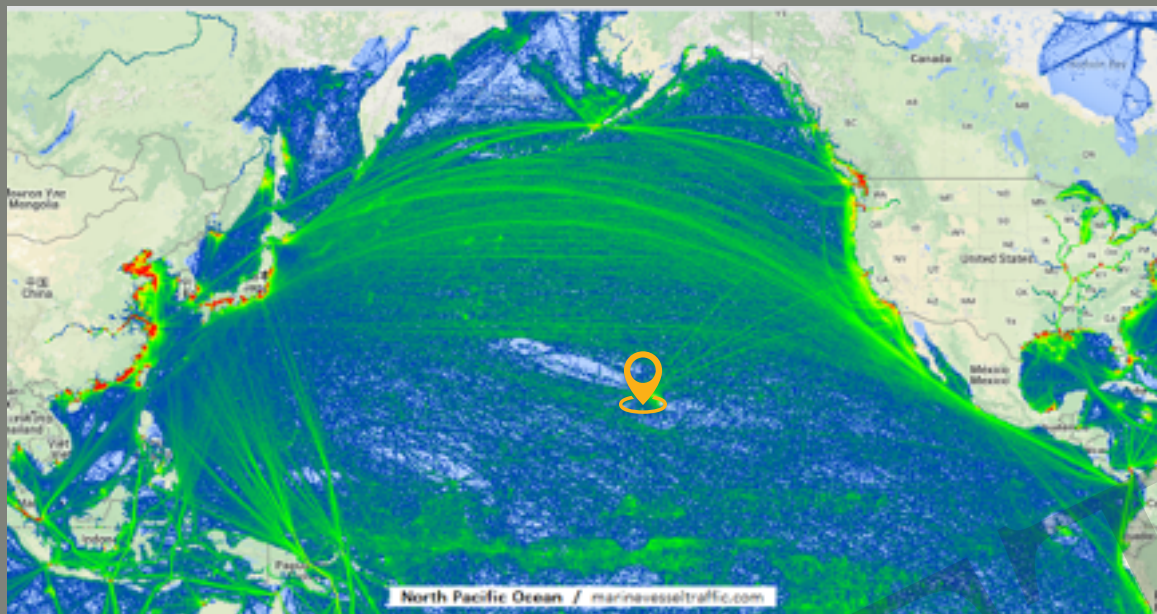
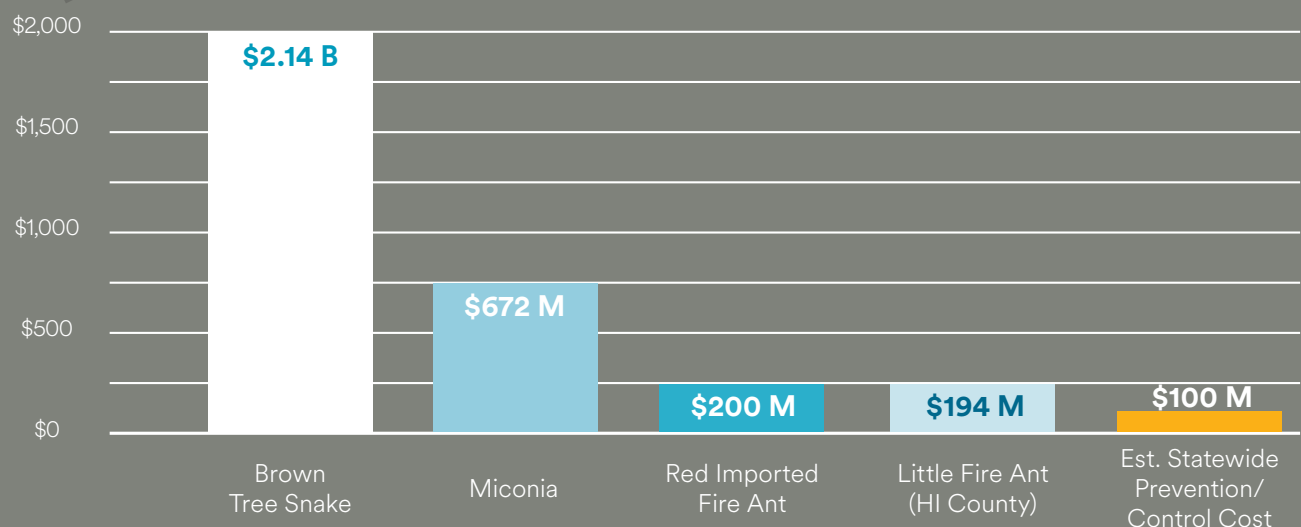


Figure 2. Shipping routes across the Pacific Ocean. Hawai'i = orange triangle. Image from marinevesseltraffic.com

Just three examples of established invasive species that cause serious economic and environmental damage in Hawai'i are:

- » **Formosan subterranean termite** - nearly **\$100 million yearly** in damage, prevention, repair and treatment costs (Grace et al. 2002).
- » **Miconia**, an escaped, aggressive landscape plant - approximately **\$700 million yearly** in damages from impacts to water recharge and native bird habitat (Burnett et al. 2007).
- » **Little fire ant (LFA)**, first detected on Hawai'i Island in 1999 - roughly **\$200 million yearly** in damages to agriculture, nurseries, residents and other sectors on Hawai'i Island alone, (DLNR 2017, Motoki et al. 2013). Only active detection and control are preventing similar infestations on the other islands.

Estimated Annual Damages/Cost (\$ millions of dollars)



And there are many new invaders that could cause even more serious harm in Hawai'i, including:

- » The **brown tree snake** in Guam causes power outages, decimates native bird populations, and even bites humans. Estimated economic impact in Hawai'i is **\$593 million to \$2.14 billion annually** from lost tourism revenue, infrastructure damage, and medical and other costs (Shwiff et al. 2010).
- » **Africanized honeybees** (AHB) are established on mainland USA, where they cause human deaths and extensive economic damage. AHB in Hawai'i would directly affect the Hawai'i beekeeping industry (over **\$220 million annually** in honey production, queen bee production and pollination), and could seriously affect tourism (USDA 2017).
- » The **red imported fire ant** (RIFA) is extremely aggressive, posing a serious threat to human health. If established in Hawai'i, RIFA could cause a potential **\$200 million annually** in damages to tourism and agricultural sectors (DLNR 2017, Gutrich et al 2007).



(From left to right) Brown treesnake, Miconia, and Africanized Honeybees.
Photo Credit: USDA, OISC, University of Alabama

The risk of invasive species introductions to Hawai'i via modern air and sea transportation pathways has increased exponentially due to our dependence on imports and tourism. Hawai'i imports about 80% of consumer goods (food, clothing, automobiles, construction supplies, machinery, medical supplies, etc.), and over 98% of imported goods are transported by maritime systems, with the remainder coming via air cargo (Laney 2007).

In 2017 the state received more than 9.4 million visitors (air and cruise ships), setting a new record for visitor arrivals and visitor spending (HTA 2017). During the same year, the state had over one million aircraft operations, landings and take offs (HDOT 2019). Hawai'i Department of Transportation (HDOT) reported that 596,111 containers were processed through Hawai'i's seaports in FY2017. Each of these arrivals and shipments provides a new opportunity for the introduction of invasive species.

Hawai'i's large military presence also contributes significantly to the state's economy. However, the high volume of military transport is believed to be another major pathway for invasive species introductions (OTA 1993).

Climate change will radically affect how we address invasive species in the coming decades. Climate change impacts include rising temperatures, changes in rainfall, rising sea levels and temperatures, increased frequency of storms and land use changes. Range expansions are already being observed for some of Hawai'i's most damaging species. For example, mosquitoes are moving into higher elevation forests, where many of Hawai'i's rarest native birds found refuge from the mosquito-borne avian malaria that devastated their populations at lower elevations (Liao et al. 2017).

Research has shown the effects of climate change and invasive species are often synergistic, with devastating consequences. For example, climate change increases severe weather events such as Hurricane Iselle, which battered the east side of Hawai'i Island in August 2014. Approximately 90% of the downed trees following this storm were invasive *Albizia*, a fast growing, tall but brittle tree that towers up to 200 feet above homes and roadsides. During Iselle, the trees came down *en masse* taking out power, isolating communities by blocking roads, and complicating and prolonging cleanup and relief efforts. The downed trees also greatly increased the cost of responding to this natural disaster (USGCRP 2018).

B. Hawai'i Interagency Biosecurity Plan

The Hawai'i Interagency Biosecurity Plan (HIBP) is a multidisciplinary strategy to manage all risks from invasive species, including impacts to agriculture, natural resources, human health, transportation, business, culture, and more. The HIBP directly addresses pre-border, border and post-border biosecurity actions, as well as relevant public engagement.

Led and approved by HDOA and endorsed by HISC and all its member agencies, the HIBP gives special attention to addressing the loss of civil service personnel and funding for biosecurity following the 2008 economic downturn, at the same time that incoming cargo and passengers were dramatically increasing. Based on extensive government and public consultation, the HIBP identifies 147 actions to be taken by state agencies and partners between 2017 and 2027. Governor David Ige highlighted the HIBP internationally as part of his Sustainable Hawai'i Initiative at the 2016 World Conservation Congress.

In January 2017, the HIBP was launched as a 10-year multi-agency plan to work towards “a more biosecure Hawaii” by addressing four key areas:

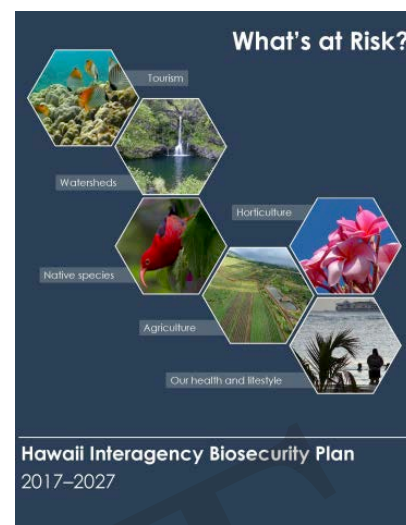
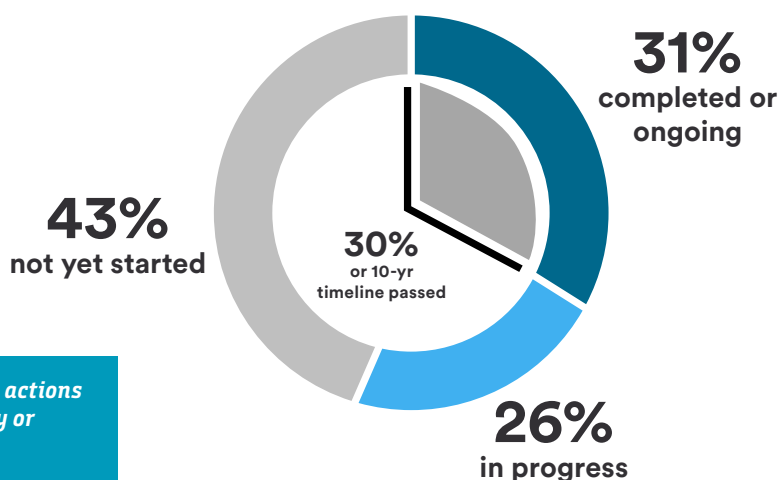
- » Prevent transport of invasive species to Hawai'i
- » Detect and control pests and diseases at ports of entry
- » Protect Hawai'i from invasive species already in the state
- » Enhance public awareness and support for Hawai'i biosecurity

Since its release, the HIBP has been the primary guiding document for state, federal and regional actions, including:

- » New state legislation, policy and funding by both legislators and the executive branch
- » Requests to federal agencies and congressional delegates on shared biosecurity policies
- » Governor Ige's Sustainable Hawai'i Initiative
- » Tracking progress on implementing invasive species goals of the Aloha+ Challenge
- » The Western Governors' Association's Biosecurity and Invasive Species Initiative starting in 2018 under the chairmanship of Hawai'i Governor David Ige (WGA 2019).

HISC tracks progress on the HIBP semi-annually based on lead agency updates for all 147 actions. As of January 2020, more than half (57%) of the actions were completed or underway (Figure 4). Most of these actions were addressed with existing staffing and funding. Only 22 new positions were added across multiple agencies, far short of the 2019 target of roughly 60 new positions.

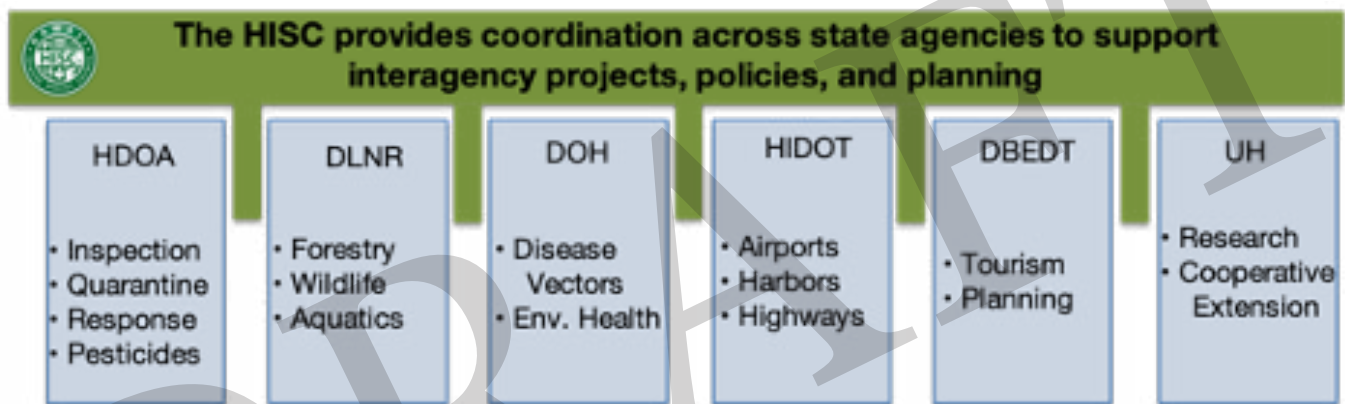
Figure 4. HIBP Progress 2020 57% of HIBP actions have been initiated, ongoing in perpetuity or completed as of January 2020.



C. HISC Role & Accomplishments

The Hawai'i Invasive Species Council (HISC) is a state interdepartmental collaboration established in 2003 by Hawaii's State Legislature.

HISC's members are cabinet-level decisionmakers representing six state departments - Department of Land and Natural Resources (DLNR, Co-chair, administrative host), Department of Agriculture (HDOA, Co-chair), Department of Health (DOH), Department of Business, Economic Development, and Tourism (DBEDT), Department of Transportation (HDOT), and the University of Hawai'i (UH). HISC was created by Chapter 194, Hawai'i Revised Statutes (HRS), to provide policy level direction, coordination, and planning among state departments, federal agencies, and international and local initiatives for the control and eradication of harmful invasive species infestations throughout the state and for preventing the introduction of other invasive species that may be potentially harmful.



In addition to interagency direction and coordination, HISC collaboratively develops an annual interagency spending plan with funds allocated by the State Legislature to support projects that fill gaps between agency mandates or existing agency programs, and/or advance our collective knowledge and tools through research and innovation. These funds strategically build upon existing departmental programs to quickly and effectively address new invasive species threats.

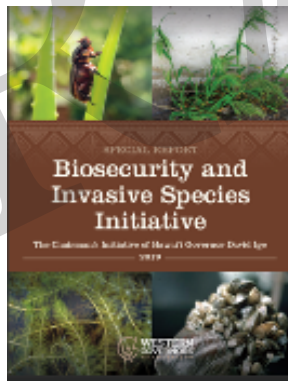
Most of HISC's achievements over the past five years focused on working with partners to develop and implement the 147 action items identified in the HIBP. Highlights include:

- » Awarded **over \$20.5 million in HISC funding** to support projects focused on invasive species in prevention, research, outreach, and control.
- » The State Legislature **increased HISC base (recurring) budget by \$1 million** in 2019, bringing the annual HISC appropriation to \$5.75 million.
- » **Seven HISC resolutions approved** to address key issues requiring collaboration across state departments, including support for keeping cats indoors and the use of the best available science in regulation of herbicides.
- » Hosted 7 years of **Hawai'i Invasive Species Awareness Week/Month** (2013 – 2019). In 2018, the Governor declared February as Hawai'i Invasive Species Awareness Month.



From left to right: Panelist, Vernon Harrington, Mark Fox, and Josh Atwood speak about Biosecurity and Invasive Species at the WGA Workshop on Hawai'i Island
Photo Credit: CGAPS

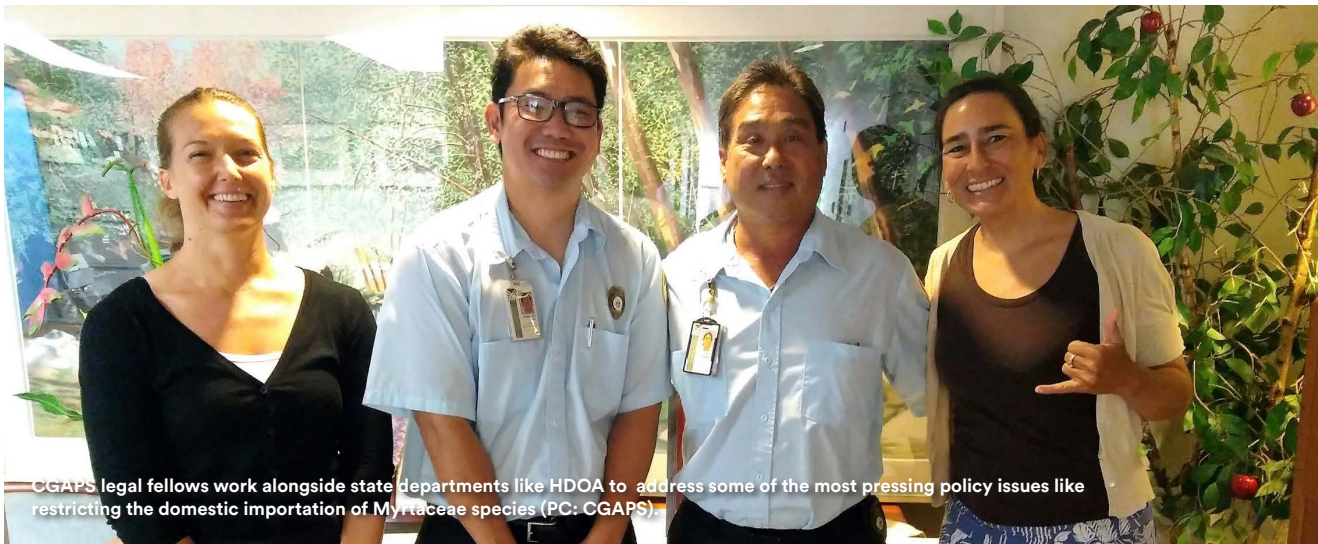
- » Advised Governor's **Biosecurity and Invasive Species Initiative** as Chair of the **Western Governors Association (WGA)**. Launched in 2018, WGA brought regional and national attention to Hawaii's biosecurity plan and issues, resulting in creation of a Western Invasive Species Council and political support for a new Pacific Regional Biocontrol Facility.
- » Assisted with establishing interagency support for the **Landscape-scale Mosquito Working Group**.
- » Developed and released the **Statewide Albizia Strategic Plan** with objectives and actions to control and mitigate hazards from the invasive tree.
- » Developed and launched **643-PEST mobile app and 643pest.org** in coordination with HDOA
- » Hosted the **Biosecurity Forum** at the beginning of the new legislative session in 2018 and 2019 to update legislators on HIBP progress and next steps.
- » Launched the interagency **Māmalu Poepoe** airports biosecurity program at the direction of DOT, DOH, and HDOA. Māmalu Poepoe deployed new traps at airports for high-risk species, including coconut rhinoceros beetle (CRB), mosquitoes, ants, and Africanized honeybees.



Additional achievements can be found in the 2015-2019 HISC and HIBP Accomplishments Report (Appendix D).

Important lessons learned from implementing the HIBP include:

- » Institutional change is hard. For example, efforts to institutionalize and provide stable funding for two key programs (the five island-based Invasive Species Committees [ISCs] and Hawai'i Ant Lab [HAL]) under the University system are ongoing, but little progress has been made to date.
- » The proposal to create a Hawai'i Invasive Species Authority was introduced to the Legislature for three years but was not approved. Perceptions varied about how the Authority would function and how it would relate to existing agency programs. Focus has shifted to increasing the base capacity of existing programs at each agency.
- » Positions are much harder to secure than operational funding. While many HIBP recommendations for new general and CIP funds have been funded, progress on increasing essential position counts has been slow. Positions that have been added include restoration of DOH Vector Control in response to outbreaks, new specialists at HDOA Plant Quarantine, and new extension agents at UH CTAHR.
- » Umbrellas come in handy. The HIBP has proven a very useful tool to provide larger context for individual policy and resource requests. It also appears, anecdotally, to enhance understanding that funding for invasive species programs at different agencies are complementary.



D. CGAPS Role & Accomplishments

Launched in 1995, the Coordinating Group for Alien Pest Species (CGAPS) was the first voluntary collaboration of state, federal, county, non-government organization (NGO), and private sector experts and managers working together to close the gaps in Hawaii's biosecurity programs.

Together, they coordinate and catalyze action on statewide invasive species priorities and communicate key issues to the public. CGAPS addresses the full range of actions from prevention and early detection/rapid response (ED/RR) to long-term control of terrestrial and aquatic invasive species.

Twenty-five years old and still growing, CGAPS works with a wide array of active partner organizations statewide. CGAPS' critical roles include:

- » identify collective priorities on invasive species challenges and critical gaps
- » catalyze collaborative, effective and long-term actions for Hawaii's most destructive invasive species
- » convene and coordinate information-sharing across diverse partner organizations
- » develop core messages to share with decision-makers and the public
- » facilitate inter-agency relationships and engage new partners needed to advance key initiatives.

CGAPS is led by a Steering Committee of 12 partner representatives, and all partners are encouraged to participate in quarterly meetings to share information, foster collaborations, flag challenges, and coordinate public awareness initiatives. HISC is first among CGAPS leading partners, working together seamlessly to mobilize and leverage government, NGO and private sector efforts for maximum impact and sustainability. CGAPS often provides statewide leadership and expertise on targeted communications to ensure strong public and political support for invasive species actions. Since 2012, CGAPS has focused particularly on prevention and early detection/rapid response supported by a special ten-year partnership with the Hau'oli Mau Loa Foundation, which will be revisited in 2021.

"Gaps" constitute priority issues that no agency has authority or resources to accomplish within its own purview. For example, aquatic biosecurity is a critical gap that was identified in the last five years and is being addressed through legislation, policy, new programs and staffing.



Over the last five years, CGAPS spearheaded significant outcomes on almost all the priorities in its 2015-2019 strategic plan. Highlights include:

- » Led statewide outreach and coordinated planning to prevent spread of **Rapid ōhi'a Death (ROD)**; reached approximately 750,000 people statewide with Emmy award-winning documentary *Saving ōhi'a*.
- » Launched multi-agency collaboration to understand and address **marine biosecurity threats**, including successful input to key policies (federal, state and international) on ballast water, biofouling and in-water vessel hull cleaning.
- » Initiated scoping for a new **Pacific Regional Biocontrol Facility** with key state and federal partners, including Hawaii's Congressional delegation.
- » Helped HDOA reinstate and expand the **detector dog program**.
- » Supported HDOA and APHIS initiatives to **strengthen quarantine and inspection**, including e-manifest system and landmark Myrtle restriction package for federal protection.
- » Assisted ISC and others to **limit the spread of priority pests**, such as little fire ant (LFA), coqui frog, coconut rhinoceros beetle (CRB) and ROD, including five joint annual Stop the Ant Month statewide campaigns.
- » Helped DLNR and USFWS launch a new statewide **Mosquito Working Group** to pursue expanded control options.
- » Spearheaded **risk assessments** for hundreds of species and contracted research on priority species not known to occur (NKO) in Hawai'i to guide prevention and ED/RR preparation.
- » Guided the **CGAPS Legal Fellows** program to provide expertise to state agencies on regulations and policies for harmful plant and animal imports, emergency declarations, marine biosecurity and other issues.
- » Partnered with HISC and others to launch the first **Hawai'i Interagency Biosecurity Plan** at the 2016 World Conservation Congress and begin implementing and tracking progress.

More significant achievements can be found in the Progress Report on the 2015 – 2019 CGAPS Strategic Plan (Appendix D).

All of this was accomplished by two professional staff coordinating all CGAPS projects and deliverables. All CGAPS positions are fully or partially grant-funded each year, so building a more secure financial foundation for the Group is a priority in this plan.

Reflecting on CGAPS' last five years, some important lessons emerged:

1. CGAPS' best role is to identify critical needs/gaps and initiate action/scoping/ research to help partner agencies update policy and build capacity for ongoing action.
2. Hawaii's Invasive Species Committees (ISC), Watershed Partnerships (WP), Hawai'i Ant Lab (HAL) and other NGOs play critical roles in this work. Government agencies cannot do this work alone, nor can NGOs do this work without agencies.
3. The 2013 Tabletop After Action Report and informal ED/RR evaluations revealed key gaps in authorities, policy, procedure, emergency funding & leadership-level decision support tools/structures to guide effective responses to new invasions.
4. All new initiatives and many existing programs need significantly more capacity and policy actions to be effective. All must have data and risk management-driven targets that support a SMART long-term goal. We could also benefit from more capacity in data and risk manage.



Stakeholders gather to provide input on the draft HISC & CGAPS 2025 Strategy
Photo Credit: Randy Bartlett

■ Taking Action & Measuring Success

This HISC/CGAPS 2025 Joint Strategy: In Support of the Hawai'i Interagency Biosecurity Plan reflects the ongoing, effective collaboration of state, federal, NGO, business and community partners to achieve the shared vision of "Hawai'i's natural environment, agriculture, economy, and the health, lifestyle, and culture of its people are protected from the impacts of invasive species."

It builds on CGAPS' 25-year track record for effective action, successful network-building, and lessons learned and 17 years of state leadership and coordination through the HISC.

Already, many of the joint strategies are being implemented by committed partners across the archipelago. Leadership for this work is strong, and ten agencies and organizations stepped up to co-lead the ten Strategy Teams. Each team will implement and adapt the workplan for their strategy (Appendix G), including identifying and tracking practical measures to assess their effectiveness and progress. As much as possible, this monitoring will use data and protocols already in place to avoid new data gathering, which can be difficult and costly to maintain.

HISC and CGAPS will continue to meet, make decisions and manage their operations independently, according to their unique mandates and protocols. Each will also focus on the different organizational development needs and strategies identified through this planning process. However, HISC/CGAPS 2025 will help both networks restructure and energize their working groups, bringing them together and recruiting new partners where appropriate.

Finally, HISC/CGAPS 2025 provides a clear roadmap to guide invasive species priorities and partners statewide. Together, our two networks will assess progress, identify critical gaps, and adapt workplans annually. We will also actively capture and share lessons learned to continually improve our collective impact.

Key Contacts

Christy Martin
CGAPS Public Info Officer
christym@rocketmail.com
www.cgaps.org

Josh Atwood
HISC Program Supervisor
Joshua.P.Atwood@hawaii.gov
<http://hisc.hawaii.gov>

Chelsea Arnott
HISC Planner
Chelsea.L.Arnott@hawaii.gov
<http://hisc.hawaii.gov>

Acknowledgements

Invasive species work in Hawai'i requires a complex but highly functional set of stakeholders and partners working together across different organizational and geographic boundaries.

The HIBP demonstrated the importance and value of prioritizing biosecurity needs and working together to implement those priorities. This HISC/CGAPS 2025 strategy builds on this successful HIBP collaboration by engaging a broad and diverse coalition of stakeholders engaged in invasive species work across Hawai'i, to again prioritize our collective energy, action, and voices to implement the highest HIBP priorities.

HISC and CGAPS wish to acknowledge the many partners and stakeholders who helped develop this strategy, coming together through a variety of forums (Appendix C). We are especially grateful for the HISC Planning Team and CGAPS Steering Committee members for sharing their expertise during the statewide and special planning meetings (Table 1). HISC's six Council members also provided critical political support and guidance for this collaborative process, committing their agencies to take leadership and action on the strategies core to their mandates.

This strategic planning process was made possible by CGAPS' long-term partnership with the Hau'oli Mau Loa Foundation (HMLF). In addition to their generous support, HMLF Senior Program Officer Brant Chillingworth and Executive Director Janis Reischmann shared valuable insights and history to help strengthen the plan and the statewide partnership.

For the priority strategies developed at the statewide meeting, knowledgeable partners volunteered to review early drafts and provide critical input. Our sincere thanks to:

- » Kevin Hoffman (HDOA) & Gen Devine (DAR) for Prevention & Early Detection/Rapid Response
- » Jules Kuo (DAR) & Jon Sprague (Pūlama Lāna'i) for Inter/Intra-island Movement
- » Will Weaver (KMWP) & Emma Anders (HCA) for Landscape-scale Eradication
- » Darcy Oishi (HDOA) & Rob Hauff (DOFAW) for Biocontrol
- » Mark Fox (TNC) & Brant Chillingworth (HMLF) for Diversified Funding

The Core Team for this strategic planning effort was led by Christy Martin (CGAPS) and Josh Atwood (HISC) with outstanding staff support by Chelsea Arnott (HISC) and Lara Reynolds (CGAPS). Audrey Newman, Conservation & Sustainability Advisor, led the process design, facilitation and drafting of this plan. This strategy reflects their deep expertise, seamless teamwork and clear commitment to collaboration. Sheila Sarhangi from Cause Consulting was a special Core Team member to provide early input on strategic communications. Sincere thanks also are due to HISC support staff - Randy Bartlett, Leyla Kaufman, and Elizabeth Speith – for their facilitation and logistics assistance at the statewide meeting.

We are deeply grateful for the outstanding, active engagement by so many invasive species stakeholders to develop these shared strategies for our next five years of collaborative work. Most of all, we are thankful for the partners who are leading action on these strategies and their commitment to implementing the Hawai'i Interagency Biosecurity Plan.

Table 1. CGAPS & HISC Planning Team Partners & Leaders

Name	Agency	Role
Adam Radford	MISC	CGAPS Steering Committee
Angela Kieran-Vast	NAVFA	CGAPS Steering Committee
Audrey Newman	Strategy Advisor	Core Team
Becky Azama	HDOA	CGAPS Steering Committee
Benton Pang	USFWS	CGAPS Steering Committee
Brian J. Neilson	DLNR - DAR	CGAPS Steering Committee
Bryan Harry	HCAF	CGAPS Steering Committee
Chelsea Arnott	HISC	Core Team
Christy Martin	CGAPS	Core Team
Chuck Chimera	HP-WRA	HISC Planning Team

Table 1. CGAPS & HISC Planning Team Partners & Leaders

Name	Agency	Role
Dave Smith	DLNR - DOFAW	CGAPS Steering Committee
David Rodriguez	HDOT	HI Invasive Species Council & HISC Planning Team
Dorothy S. Alontaga	USDA – APHIS	CGAPS Steering Committee
Nicholas Comerford	UH-CTAHR	HI Invasive Species Council
Elizabeth Speith	643-PEST	HISC Planning Team
Gen Devine	DLNR-DAR	HISC Planning Team
Grace Simmons	HDOH	HISC Planning Team
Jodi S. Chew	USDA – Forest Service	CGAPS Steering Committee
Jonathan Ho	HDOA-PQ	HISC Planning Team
Josh Fisher	USFWS	CGAPS Steering Committee
Joshua Atwood	HISC	Core Team
Jules Kuo	DLNR-DAR	HISC Planning Team
Keith Kawaoka	HDOH	HI Invasive Species Council
Kevin Hoffman	HDOA	HISC Planning Team & CGAPS Steering Committee
Kimberly Fuller	DLNR – DAR	CGAPS Steering Committee
Lara Reynolds	Former CGAPS	Core Team
Leyla Kauffman	Māmalu Poepoe	HISC Planning Team
Mark Fox	TNC – Hawai'i Program	CGAPS Steering Committee
Mary Alice Evans	DBEDT	HI Invasive Species Council
Michael Melzer	UH – CTAHR	HISC Planning Team & CGAPS Steering Committee
Nate Dube	OISC	CGAPS Steering Committee
Patrick Chee	DLNR-DOFAW	HISC Planning Team
Phyllis Shimabukuro-Geiser	HDOA	HI Invasive Species Council
Rachel Neville	OISC	CGAPS Steering Committee
Randy Bartlett	HISC	HISC Planning Team & CGAPS Steering Committee
Rebecca Chong	DHS – CBP	CGAPS Steering Committee
Rob Hauff	DLNR – DOFAW	HISC Planning Team & CGAPS Steering Committee
Sheila Sarhangi	Cause Consulting LLC	Core Team
Suzanne Case	DLNR	HI Invasive Species Council

■ Keyterms

Key Term	Definition
Aquatic Non-native Species (or Aquatic Invasive Species)	Sometimes called exotic, invasive, nonindigenous or non-native, these are aquatic organisms that invade ecosystems beyond their natural, historic range. Their presence may harm native ecosystems or commercial, agricultural, or recreational activities dependent on these ecosystems
Biocontrol	Refers to classical biocontrol or classical biological control, which is the use of natural enemies to reduce an invasive species population.
Biofouling	The accumulation of microorganisms, plants, algae, or small animals on wetted surfaces that have a mechanical function, causing structural or other functional deficiencies.
Biosecurity	The set of measures taken to manage the risk from invasive species to the economy, environment, and health and lifestyle of the people.
Border	<p>“Border” is about facilities, regulations and inspection. It encompasses all the policies, protocols, and processes put in place to detect and respond to the arrival of an invasive species at the ports of entry (into the state) or at the regulated place of entry (into the state). The border is the area bounded either by the inspection areas (inside the walls or inside the fence) at ports of entry from mainland or foreign countries or by the extent of regulations governing importation from mainland or foreign countries. It is a very confined physical area/area of responsibility. Anything that is not covered by import regulations or is found outside the physical boundary of the port is “post-border.”</p> <p>“Border” would include facilities that are mandated (by border regulations) to deal with goods as if they are at the border, including off-site inspection facilities, containment facilities, plant quarantine facilities.</p>
Domestic Imports	Commodities imported into Hawai‘i from other US states.
E-manifest	Electronic manifesting system managed by HDOA to track imported shipments of agricultural commodities.
Emergency Containment Facility	A “backup” facility capable of housing potential biocontrol species and similar research in the event of a natural disaster or other emergency that threatens the originating facility.
Inter-island	Refers to the movement of goods and people between islands.
Intra-island	Refers to the movement of goods and people on a single Bisland.
Invasive species	An alien species whose introduction does or is likely to cause economic or environmental harm or harm to human health. This is the federal definition of invasive species from Executive Order 13112. Invasive species is a nonregulatory term, and the state has several regulatory designations that are related to but not synonymous with the term, including pest, noxious weed, and injurious wildlife.
Pathway	How a pest gets to Hawai‘i, especially the mode of transportation.
Pest	As defined by Hawai‘i Revised Statutes Chapter 150A, “any animal, insect, disease agent or other organism in any stage of development that is detrimental or potentially harmful to agriculture, or horticulture, or animal or public health, or natural resources including native biota or has an adverse effect on the environment.”
Post-border	The area that a pest is found in once it has passed the point or opportunity of border inspection, whether it was or was not detected. Post-border encompasses all the policies, protocols, and processes put in place to eradicate or control an invasive species beyond the ports of entry and inspection process. The issue of interisland biosecurity and transport of species within an island is covered under the theme of post-border security.

Key Term	Definition
Pre-border	Encompasses all the policies, processes, and protocols put in place to prevent transportation of an invasive species to Hawai'i (e.g. protocols for shaking Christmas trees prior to shipment to Hawai'i, and law restricting the import and possession of snakes).
Resilience	The ability of a system to maintain key functions and processes in the face of stresses or pressures by resisting and then recovering or adapting to change. It can be applied to ecological and social systems (e.g. human communities).
Risk	Discussed in this document in many contexts, including pest risk analysis; pest risk assessment; biosecurity risk; and high-risk species or pathway. Risk is the chance of an adverse event happening and the consequences if it happens. Risk analysis is a systematic way of gathering, evaluating, and recording information leading to recommendations for action in response to an identified hazard. Pest risk analysis is conducted by regulatory plant health authorities (e.g. USDA APHIS or IPPC) as a systematic approach to decide whether a pest should be allowed to enter a country, region, and/or state or managed using legislation. IPPC defines pest risk analysis as "the process of evaluating biological or other scientific and economic evidence to determine whether a pest should be regulated and the strength of any phytosanitary measures to be taken against it."
Risk assessments	Scientific studies that measure and identify risk.
Social Marketing	The use of commercial marketing principles and techniques to improve the welfare of people and the physical, social and economic environment in which they live.
Transitional inspection facilities	Third-party inspection facilities built by freight forwarders or commodity companies, in agreement with and to biosecurity standards set by HDOA. For the relevant commodities, these facilities provide a secure location away from the port where HDOA inspections can occur.

HIBP Abbreviations

Abbreviation	Definition
BorPol	Border Policy
BorPro	Border Process
BorTifs	Border Technology, Infrastructure, Funding, and Staffing
PosPol	Postborder Policy
PosBor	Postborder Process
PosTifs	Postborder Technology, Infrastructure, Funding, and Staffing
PrePol	Preborder Policy
PrePro	Preborder Process
PreTifs	Preborder Technology, Infrastructure, Funding, and Staffing
PwsPol	Public Awareness and Support Policy
PwsPro	Public Awareness and Support Process
PwsTifs	Public Awareness and Support Technology, Infrastructure, Funding, and Staffing

References

Burnett, K., B. Kaiser, and J.A. Roumasset. 2007. Economic lessons from control efforts for an invasive species: *Miconia calvenscens* in Hawai'i. *Journal of Forest Economics* 13: 151-167.

Burnett, K. and M Coffman. 2014. *2015-2019 CGAPS Strategic Plan*. Unpublished, 23pp.

Courtney, C. 2018. *Making Conservation Climate-Smart* (ppt) & *Climate-Smart Design for Conservation for Coastal Ecosystems in South Kohala*. Unpublished, 5pp, including relevant reference list.

Dawson, Wayne, et al. 2017. "Global hotspots and correlates of alien species richness across taxonomic groups." *Nature Ecology & Evolution* 1.7 (2017): 0186.

Duffy, D. C., and C. Martin. 2019. Cooperative natural resource and invasive species management in Hawai'i. *Island invasives: scaling up to meet the challenge* 62: 497.

DLNR. 2010. Hawai'i Statewide Assessment of Forest Conditions and Trends: 2010 An Assessment of the State of Our 'Aina. Honolulu, Hawai'i. <https://dlnr.hawaii.gov/forestry/files/2013/09/SWARS-Entire-Assessment-and-Strategy.pdf>

DLNR. 2017. Budgetary and other issues regarding invasive species. Honolulu, Hawai'i. <https://dlnr.hawaii.gov/wp-content/uploads/2017/10/FW18-Invasive-Species-Report-Chapter-194-Act-213-SLH08-FY17.pdf>

Grace, J.K., R.J. Woodrow, and J.R. Yates. 2002. Distribution and management of termites in Hawai'i. *Sociobiology* 40: 87-93.

Gutrich, J.J., E. VanGelder, and L. Loope. 2007. Potential economic impact of introduction and spread of the red imported fire ant, *Solenopsis invicta*, in Hawai'i. *Environmental Science & Policy* 10: 685–696.

HDOA. 2002. Kahului Airport Pest Risk Assessment. Plant Quarantine Branch, Honolulu, Hawai'i. <https://www.cgaps.org/wp-content/uploads/Kahului-Airport-Pest-Risk-Assessment-2002.pdf>

HDOT. 2018. Media Kit, Harbors Division. Honolulu, Hawai'i. <https://hidot.hawaii.gov/wp-content/uploads/2018/01/HDOT-Harbors-Division-Media-Kit-2018-1.pdf>

HDOT. 2019. The State of Hawai'i Airport Activity Statistics by Calendar Year. <https://hidot.hawaii.gov/airports/files/2013/01/annual-air-traffic-statistics-20190715.pdf>

Holman, L. E., de Bruyn, M., Creer, S., Carvalho, G., Robidart, J., & Rius, M. 2019. Detection of introduced and resident marine species using environmental DNA metabarcoding of sediment and water. *Scientific Reports*, 9(1), 1-10.

HTA. 2017. Annual Visitor Research Report. <https://www.hawaiitourismauthority.org/media/2766/2017-annual-visitor-research-report.pdf>

Kirch, P.V. 2011. When did the Polynesians settle Hawai'i? A review of 150 years of scholarly inquiry and a tentative answer. *Hawaiian Archaeology* 12: 3–26.

Laney, L. 2007. The Impact of Hawaii's Harbors on the Local Economy. Hawai'i Pacific University. Technical report. <http://hidot.hawaii.gov/harbors/files/2014/04/Impact-of-Harbors.pdf>

Lee, D.J., M. Motoki, C. Vanderwoude, S.T. Nakamoto, and P.S. Leung. 2015. Taking the sting out of Little Fire Ant in Hawai'i. *Ecological Economics* 111:100-110

Legislative Reference Bureau (LRB). 2015. Can't see the forest for the (albizia) trees: an invasive species update. - Honolulu, Hawai'i. - xi, 416 pages. tables ; 28 cm. - Report ; no. 15-3. - Report (Hawai'i. Legislative Reference Bureau) no. 15-3.

Liao, W., C.T. Atkinson, D.A. LaPoint, M.D. Samuel. 2017. Mitigating Future Avian Malaria Threats to Hawaiian Forest Birds from Climate Change. *PlosOne* DOI:10.1371/journal.pone.0168880

Loope, L. L. 1998. Hawai'i and the Pacific Islands. Status and Trends of the Nation's Biological Resources. 747-774 pp., U.S. Department of the Interior, U.S. Geological Survey, National Wetlands Research Center, Washington, D.C

Macdonald, G. A., A. T. Abbott, and F. L. Peterson. 1983. Volcanoes in the Sea: The Geology of Hawai'i, 2nd edition. University of Hawai'i Press, Honolulu. 517 pp.

Messing, R.H., M.G. Wright. 2006. Biological Control of Invasive Species: Solution or Pollution? *Frontiers in Ecology and the Environment* 4:132-140

Motoki, M., D.J. Lee, C. Vanderwoude, S.T. Nakamoto, P.S. Leung. 2013. A bioeconomic model of Little Fire Ant (*Wasmannia auropunctata*) in Hawai'i. Technical Report No. 186. Pacific Cooperative Studies Unit, University of Hawai'i, Honolulu, Hawaii. p.89.

National Institute of Water and Atmospheric (NIWA) Research, for possible development of an aquatic weed risk assessment: <https://www.niwa.co.nz/freshwater-and-estuaries/tools/biosecurity/weed-risk-assessment>

OTA. 1993. Harmful non-indigenous species in the United States. Washington (DC): Office of Technology Assessment, US Congress.

Shwiff, S.A. K. Gebhardt, K.N. Kirkpatrick, and S.S. Shwiff. 2010. Potential economic damage from introduction of brown tree snakes, *Boiga irregularis* (Reptilia: Colubridae), to the Islands of Hawai'i. *Pacific Science*, 64: 1-10

State of Hawai'i. 2016. Hawai'i Interagency Biosecurity Plan. <https://dlnr.hawaii.gov/hisc/plans/hibp/>.

USDA. 2017. USDA/NASS QuickStats Ad-Hoc-Query Tool, quickstats.nass.usda.gov/results/2ECCB77F-4189-3CAA-92F9-57966AFE4042.

USGCRP. 2018. *Impacts, Risks, and Adaptation in the United States: Fourth National Climate Assessment, Volume II* [Reidmiller, D.R., C.W. Avery, D.R. Easterling, K.E. Kunkel, K.L.M. Lewis, T.K. Maycock, and B.C. Stewart (eds.)]. U.S. Global Change Research Program, Washington, DC, USA, 1515 pp. doi: 10.7930/NCA4.2018.

Wagner, Warren L., et al. 2012. "Hawaiian vascular plant updates: a supplement to the Manual of the Flowering Plants of Hawai'i and Hawai'i's ferns and fern allies." *Washington, DC: Smithsonian National Museum of Natural History*.

West, J. M., C.A. Courtney, A.T. Hamilton, B.A. Parker, S.H. Julius, S. H., J. Hoffman, & P. MacGowan. 2016. Climate-Smart Design for Ecosystem Management: A Test Application for Coral Reefs. *Environmental Management*, 59(1), 102-117. doi:10.1007/s00267-016-0774-3

Western Governors' Association (WGA). 2019. Special Report: Biosecurity and Invasive Species Initiative. http://westgov.org/images/editor/2019_WGA_BISI_REPORTvF.pdf.

Ziegler, A.C. 2002. Hawaiian Natural History, Ecology, and Evolution. Honolulu: University of Hawai'i Press.

