

AQUATIC INVASIVE SPECIES PROGRAM

Strategic Plan 2019 - 2024

Hawai'i State Motto:
"Ua Mau ke Ea o ka 'Āina i ka Pono"
"The life of the land is perpetuated in righteousness"

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Executive Summary

The Department of Land and Natural Resources, Division of Aquatic Resources' Aquatic Invasive Species (AIS) Program works to prevent, manage, and control invasive species in marine and inland waters of Hawai'i that are causing or could cause environmental, economic, or human health impacts. The Program focuses its efforts specifically on AIS because they pose significant threats to Hawai'i's native ecosystems as well as residents and visitors. The need for a coordinated statewide approach to address AIS issues was identified in the 2003 AIS Management Plan, which is revisited and updated in this document (SOH, 2003). The current strategy is composed of four central pillars to achieve this goal: Pre-Border Prevention, Border Protection, and Post-Border Management, and Outreach and Education. Within each pillar, there are specific objectives and associated actions to take to effectively manage the impacts of invasive species on Hawai'i's native ecosystems. These objectives have been prioritized by program staff and participants in the 2018 AIS Steering Committee Workshop. The focus of this document is intended to identify the current efforts of the AIS Program and the actions that need to be undertaken to meet these objectives over the next five-years.

Cover Photograph Information:

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1) AIS team members collect suspected non-native species from Japanese Tsunami Debris. 2) Coral reef showing before and after the invasive algae was manually removed. 3) DAR Urchin hatchery analyzing egg morphology during a spawn. 4) Autonomous Reef Monitoring Structure deployed to allow colonization of marine invertebrates. 5) AIS Team members conducting coral bleaching rapid response surveys. 6) Vessel hull showing excessive biofouling. All photographs are courtesy of the DAR AIS Team or XL Catlin Seaview Survey.



Acknowledgements

The AIS Program recognizes that partnerships are a vital component to an effective management strategy given the size and scope of AIS issues in Hawai'i and the Division's limited resources. I would like to express my greatest appreciation to all former and current AIS Program staff first and foremost whom have either laid the foundation for the work we are privileged to perform or who are currently working diligently to achieve our next success. Next, I would like to thank the Division staff members behind the scenes who have worked tirelessly through the years to create and support the AIS team staff. I would like to acknowledge DAR's Acting Administrator, Brian Neilson, for having the foresight to initiate the creation of this strategic plan and Brian Kanenaka for all his support and guidance throughout this process. Page | 2

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Acronyms List

AIS – Aquatic Invasive Species
ANS – Aquatic Nuisance Species
BW/BF – Ballast Water/Bio-Fouling
BMPs – Best Management Practices
CGAPS – Coordinating Group on Alien Pest Species
DAR – Division of Aquatic Resources
DLNR – Department of Land and Natural Resources
eDNA – Environmental DNA
EOR – Eyes of The Reef
HDOA – Hawai’i Department of Agriculture
HDOH – Hawai’i Department of Health
HIBP – Hawai’i Interagency Biosecurity Plan
HIMB – Hawai’i Institute of Marine Biology
HISC – Hawai’i Invasive Species Council
JTMD – Japanese Tsunami Marine Debris
KISC – Kaua’i Invasive Species Committee
KUA – Kua’aina Ulu 'Auamo
LOR – Letter of Reciprocity
NOAA – National Oceanic and Atmospheric Administration
RCUH – Research Corporation of The University of Hawai’i
TNC – The Nature Conservancy
UH – University of Hawai’i
USFWS – United States Fish and Wildlife Service
USGS – United States Geological Survey



Introduction

As one of the most geographically remote archipelagoes in the world, Hawai'i is home to organisms that have evolved in isolation for millions of years. As a result, the Hawaiian Islands have a high percentage of endemic species and unique ecosystems that are susceptible to invasive species. Due to the island's biogeographical isolation evolutionary processes that created this beautiful landscape also prevented the coevolution of natural predator-prey relationships that would allow native species to defend themselves. This absence of coevolution has resulted in increased vulnerabilities to invasive species (Denslow, 2003; Dawson et al., 2017; Reaser et al., 2007). Hawai'i is estimated to have 463 non-native aquatic species overall (333 introduced species and 130 cryptogenic species) (Carlton and Eldredge, 2015), and an overwhelmingly higher density of non-native species richness when compared to the other 49 states combined (Figure 1) (Simpson et al., 2018).

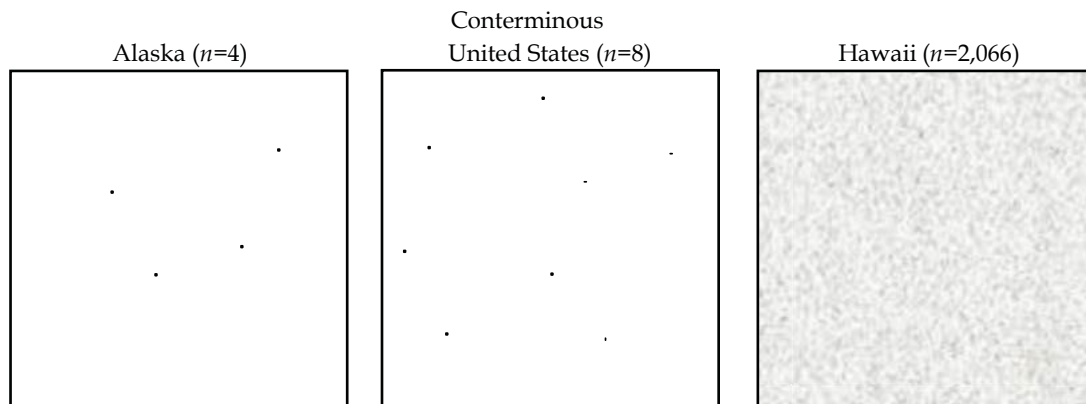


Figure 1. Comparison of non-native species richness densities in three United States regions (n = number of species per 10,000 km²) (Stimpson et al., 2018).

Not all introduced species are invasive; a species that is introduced to a new region, may or may not become established, and grow or spread in other regions. The establishment of many non-native species result in little to no impact. There are certain characteristics that may predispose a species to become invasive such as high fecundity and growth rates, generalist diet and habitat, and ability to out-compete native species. An organism with these characteristics has the potential to negatively impact the native ecosystem (Sakai et al., 2001). The State of Hawai'i Division of Aquatic Resources (DAR) therefore defines an invasive species as a non-indigenous aquatic species that, if introduced into an ecosystem, may cause harm to Hawai'i's economy, environment, human health, or public safety and welfare.



Invasive species are a leading cause of native species extinctions in Pacific islands (SPREP, 2016), and can lead to habitat degradation, loss of natural resources and biodiversity, and economic loss (Charles and Dukes, 2006; Lovell et al., 2006). The large extent and diverse nature of AIS issues facing Hawai'i pose a challenging task for one team with limited staff and resources. A prioritized action strategy is essential to efficiently address Hawai'i's AIS issues to effectively preserve and restore the native aquatic ecosystem.

The AIS Program's vision and mission statements are:

Vision

- A healthy and sustainable native aquatic ecosystem absent of uncontrolled aquatic invasive species and supported by a collaborative management strategy.

Mission

- To preserve, restore, and protect Hawai'i's native aquatic ecosystems for present and future generations through the effective management of aquatic invasive species.

DAR published its first AIS Management Plan in 2003 which documented all currently known AIS issues in the state and identified goals and objectives that could be implemented by the Division and its partners (SOH, 2003). This update reflects the Program's ongoing mission to fulfill the objectives of the 2003 plan and describes future projects and needs of the Program to manage the negative impacts of AIS in Hawai'i. The purpose of the 2019 - 2024 AIS Strategic Plan is to outline the current status of the Program, future direction, and framework for implementing the new action strategy.

Timeline of Significant Events

- 1997/2000 - DLNR authorized to form the Alien Aquatic Organism Task Force (AAOTF) and manage Ballast Water and Biofouling
- 2003 - Hawai'i Invasive Species Council formed
- 2003 - State of Hawai'i AIS Management plan published
- 2003 - AIS Advisory Group formed
- 2003 - Lake Wilson, O'ahu cleared of *Salvinia molesta*
- 2004/2005/2006 - State legislature funded HISC and strongly supported new initiatives for AIS management
- 2005 - Super Sucker built
- 2005 - Port Allen, Kaua'i, Snowflake Coral, *Carijoa riisei* remediation project



- 2006 – Super Sucker used to clear reef at Coconut Island
- 2006-2009 – AIS surveys/mapping of alien invasive algae distributions
- 2008 – First clearing of Reef 16 using Super Sucker
- 2008 – Ballast Water/Biofouling continues its efforts
- 2009 – Second clearing of Reef 16; added collector urchins as biocontrol
- 2008/2009 – Invasive Algae Regrowth Experiment demonstrates manual removal alone as ineffective
- 2009 – Molokaʻi Community-Based Invasive Species Control
- 2009 – Chemical Toolbox developed
- 2009 – Sea Urchin Hatchery built at Ānuenuē Fisheries Research Center, Sand Island, Oʻahu
- 2009/2010 – Biocontrol Pilot Project demonstrated that urchins are effective at keeping invasive algae densities at less than 5% areal coverage
- 2010 – First successful larval run and transplant of juvenile urchins
- 2011 – First hatchery raised urchins released into Kāneʻohe Bay, Oʻahu
- 2012 – Released over 60,000 hatchery raised urchins
- 2013 – Released over 90,000 hatchery raised urchins
- 2014 – State-Funded Civil Service AIS Program Staff Hired
- 2014 – Released over 110,000 hatchery raised urchins
- 2014 – Began JTMD response efforts
- 2014 – Completed an 18-month Ballast Water and Biofouling Study
- 2015 – Surveyed Oʻahu harbors for established species in collaboration with the Smithsonian Environmental Research Center and Bishop Museum
- 2015 – Molokaʻi Community Based South Shore Invasive Algae Mapping Project
- 2016 – First Statewide Marine Debris Assessment of Main Hawaiian Islands
- 2016 – Ballast Water Compliance Testing began
- 2016 – Completed Hull Fouling In-water Cleaning Study
- 2017 – Hawaiʻi Interagency Biosecurity Plan 2017 – 2027
- 2017 – Heʻeia, Oʻahu National Estuarine Research Reserve Watershed Restoration began
- 2017 – *Salvinia molesta* Kauaʻi Steams Project began
- 2017 – First internal AIS Program Strategic Planning Meeting
- 2018 – Completed stocking all priority patch reefs in Kāneʻohe Bay with initial urchin target release numbers (21 patch and barrier reefs, ~45 acres)
- 2018 – Began targeting invasive algae on fringing and barrier reefs in Kāneʻohe Bay
- 2018 – Released over 470,000 urchins to date
- 2018 – Began Benthic Harbor Monitoring Study
- 2018 – Passage of Commercial Vessel Incidental Discharge Act



- 2018 – Held first external AIS Program Steering Committee Workshop
- 2019 – AIS Strategic Plan completed

Structure of the AIS Program

The State’s first large scale AIS effort occurred during 2002 – 2003 on a *Salvinia molesta* removal project on Lake Wilson, O’ahu. This project required the help of countless staff underscoring the need for a full-time AIS dedicated team. Contracted staff through RCUH were eventually hired to devote full-time efforts towards AIS issues, especially the algae removal from coral reefs in Kāne’ohe Bay, O’ahu. In 2014, the legislature approved funding to establish six full-time civil service staff marking the beginning of a permanently staffed State AIS Program contributing to the effective management of the State’s aquatic resources.

The AIS Program is comprised of three distinct units working in coordination but each with a unique focus and area of expertise. The three units are the AIS Field Team, the Urchin Hatchery Team, and the Ballast Water and Biofouling Team. Positions are provided by State Civil Service General Funds, or contracted through RCUH/PCSU, RCUH/SSRI, KUPU, and CGAPS. Currently the AIS Program is comprised of the following:

- 1 Aquatic Biologist IV, Program Coordinator- Civil Service
- AIS Field Team Staff:
 - 1 Aquatic Biologist III, Field Supervisor – Civil Service
 - 3 Fisheries Technicians IV – Civil Service
 - 1 Marine Resource Specialist – Contractor
 - 1 Habitat Monitoring Technician - Contractor
- Urchin Hatchery Staff:
 - 1 AIS Biocontrol Specialist (Hatchery Manager) – Contractor
 - 1 Senior Technician – Contractor
 - 3 Hatchery Technicians – Contractor
 - 1 Kupu AmeriCorps Intern
- Ballast Water and Biofouling Staff:
 - 1 Coordinator – Contractor
 - 1 Fisheries Technician IV – Civil Service
 - 1 Legal Fellow – Contractor
 - 1 Kupu AmeriCorps Intern

Structure of the AIS Management Strategy



The AIS Program classifies AIS management into four separate pillars. Three of these pillars, Pre-border, Border, and Post-border management, align with the Hawai'i Interagency Biosecurity Plan 2017 – 2027 (Figure 2) (SOH, 2017) and a fourth, Outreach and Education, has been added as its own separate category. The pillars are not autonomous and many components of each pillar are interrelated. For example, monitoring is essential to determining if a new species has breached Hawai'i's border and to document the post-border spread.

Outreach and Education is a component of each pillar but it is separated since it has a common objective shared by each management category. For instance, educating the shipping industry on vessel husbandry aids in preventing species from being brought to Hawai'i (Pre-border), identifying potentially new occurrences of species (Border), and minimizing the chance of spreading of an invasive species between harbors (Post-border).

This categorization system provides a way to organize similar management objectives to guide and streamline future actions. Pillar descriptions are listed below:

- **Pre-Border Protection (Prevention)**
 - *To prevent aquatic invasive species (AIS) introductions and spread to the State of Hawai'i through all possible vectors of transfer.*
- **Border Protection (Early Detection & Rapid Response)**
 - *To detect newly introduced species, the distribution of previously established species and their impacts, and to eliminate and contain AIS to minimize negative effects in a native ecosystem.*
- **Post-Border Management (Monitoring & Control)**
 - *To minimize negative impacts caused by AIS to Hawai'i's native aquatic ecosystems, economy, and culture.*
- **Community Outreach and Support**
 - *To raise awareness of AIS issues within the State and foster support and involvement from community members, groups, and various stakeholders.*

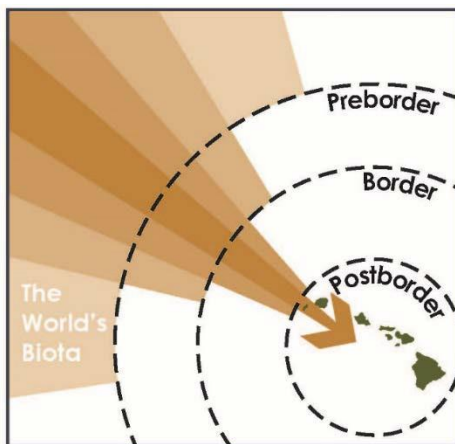


Figure 2. Graphical representation of the three levels of biosecurity management (SOH, 2017).



For additional background details on Pre-border, Border, and Post-border biosecurity prevention and protection please refer to the Hawai'i Interagency Biosecurity Plan 2017 - 2027.

Funding

Current available funding for the AIS Program is derived from State General Funds, CGAPS, Coral Reef Damage Mitigation Trust Funds, HISC Grants, and USFWS ANS Grants. State General Funds currently only pay for civil service staff salaries while grants and trust funds sustain all other salaries and operating budgets. These various funding avenues not only spotlight current collaborations between agencies but also emphasize the Program's reliance on and necessity for continued partnerships and increased commitment from the legislature.

The 2018 steering committee participants made valuable suggestions for obtaining future funding. The central theme was to be creative with funding such as writing proposals with a broader view of ANS mitigation goals rather than species specific projects. Other examples could include training workshops to encourage community reporting of invasive species, water quality concerns such as cesspool to septic tank conversions, or holistic nearshore environmental projects.

Pre-existing intergovernmental plans, such as the Hawai'i Interagency Biosecurity Plan, The Aloha Challenge, and the Sustainable Hawai'i Initiative, will be used as a vehicle for future funding and staffing requests.

Current funding gaps include but are not limited to the following:

- Pre-Border
 - BW/BF database infrastructure
 - Analytic lab equipment
 - Staffing to conduct vessel hull and ballast water inspections
- Border
 - Rapid response operating budget (i.e. travel/equipment)
 - Training budget (i.e. EOR field training workshops)
- Post-Border
 - Operating funds for mitigation projects outside of Kāne'ohē Bay
 - Travel funds to neighbor islands
 - Training funds (i.e. for herbicide application course)
 - Permitting funds (i.e. NPDES Notice of Intent applications)
- All Pillars
 - Neighbor island AIS staffing and operating budget
 - Species specific Risk Assessment staffing



- Taxonomic and DNA Analysis
- Rapid response funding

Partnerships and Collaboration

Building capacity through collaboration and community involvement is a critical component of successfully managing AIS in Hawai'i. As an example, the AIS field team was able to map the distribution of invasive algae on 22 miles of Moloka'i's south shore through the direct contributions of over 40 community members. Maintaining and increasing partnerships is a priority for the Program. Current partners that are vital to our ongoing efforts include but are not limited to: CGAPS, EOR, HDOA, HDOH, Hawai'i Department of Planning, Hawai'i Department of Transportation, Hawai'i Division of Boating and Ocean Recreation, HIMB, HISC, Kua'aina Ulu 'Auamo, KISC, Mālama Maunalua, NOAA, UH Botany Department, USFWS, USGS, and the Western Regional Panel on ANS.

The Program plans to engage more partners and Division staff for increased flexibility and support across the islands. To increase capacity for early detection, the Program will provide cross-training for DAR staff in AIS identification and sample collection techniques and support for programs such as EOR and iNaturalist. Collaborations on future projects with partners will also help to reduce competition for grants and increase likelihood of award.

Workplan Prioritization

The 2003 AIS Management Plan identified eight objectives with over forty action strategies (SOH, 2003). Since then even more AIS issues and capacity gaps have been identified. The continual expansion of AIS issues creates a high propensity for the Program's focus to become perceptually narrowed while tackling long-term AIS issues that may not be as beneficial to State resource protection as another potential project which has not yet been identified. The need for standardized, methodical, and science-based project prioritization system is a critical component in organizing pragmatic objectives and establishing achievable outcomes. Given the size and scope of AIS issues in Hawai'i and the Division's limited resources the 2018 Steering Committee Workshop was formed with members from DAR, DOFAW, KUA, UH CGAPS, UH Botany Department, NOAA, TNC, and USFWS to revisit the AIS management strategy, identify current capacity gaps and Program needs, and prioritize objectives to minimize the negative impacts of AIS in the State over the next five years.



Decision trees are used to focus a discussion and illustrate possible outcome scenarios of a decision. They can be used to programmatically assign values (e.g. staff time, funding) to a potential project and automate the decision-making process. The creation and adoption of a decision tree would help determine if a project fits within the scope and operational limits of the Program and guide a cost-benefit analysis. The different approaches to developing a decision tree could include creating one for each pillar, type of threat (i.e. species specific or environmental quality threats), habitat, species niche, or one for species generalists vs. specialists.

At the writing of this plan, no official decision tree has been adopted by the AIS Program, and prioritization of projects is currently made on a case-by-case basis. Projects that address the following guiding principles are given a higher priority:

- Prevention of new introductions
- AIS that pose the largest threat to the environment, native species, and human health
- Projects that have the greatest opportunity for success, both new introductions and established AIS
- Availability of funding

Rapid response efforts pose unique challenges to State. Numerous reports are received annually for new species siting's that may require immediate attention, such as JTMD. The AIS Field Team and other Division staff have ongoing projects that must be considered in determining if a response assessment is warranted which subsequently postpones an ongoing project. A rapid response decision making tool has not yet been developed, however the questions below will be used in determining if a rapid response investigation should be conducted on newly reported non-native species, crown of thorns outbreaks, or coral disease and bleaching.

- Is it an incipient population?
- Is it an established population?
- Is eradication feasible?
- Are there human health concerns?
- Is there potential for negative economic/ecological/cultural impact?
- Is there a high probability of impacting keystone species, high valued habitats, or threatened/endangered species?
- Is spread to other areas likely?
- Is there strong community support?

Objectives, Actions, and Implementation Tasks



Based on the current knowledge of AIS issues in Hawai'i, prioritized objectives, and action items are outlined in the Table 1. These objectives, actions, and tasks are intended to be consistent and complementary to the 2003 AIS Management Plan and existing governmental and partner organizations' strategic plans such as the 2017 – 2027 HIBP.

Objectives and associated actions are arranged by the four organizational pillars as described above. Ten objectives and sixty-two individual actions have been identified and prioritized over the four pillars and an additional four objectives with thirteen actions are currently ongoing (Table 1). Each pillar has a supplementary list of actions that the AIS program will attempt to achieve as capacity increases in the future.

The following is an overview of Table 1 organization structure:

- Objectives Column
 - Lists the specific results the AIS Program aims to achieve within the next five years.
- 2003 Strategy Column
 - References the associated strategy items from the 2003 AIS Management Plan. This was provided for ease of cross referencing.
- Actions Column
 - Refers to prioritized activities need to achieve each objective.
 - Actions written in type bold font were previously ranked by AIS program staff as high priority.
- Project Status Column
 - Intended to track progress of the implementation of this plan.
 - Status descriptions include:
 - 'In Progress: Working Towards Completion' – used for action items that have been started and have a tentative end date.
 - 'Ongoing' – used for action items that are in perpetual progress with no known end date.
 - 'Not Started Yet' – denotes projects that have not commenced.
 - 'On Standby' – signifies that the AIS field team is prepared and awaiting to conduct this action as needed.
- Priority Rank Column
 - Refers to the importance of each action item as identified by the December 2018 Steering Committee, with 1 as the highest priority.
- Outreach and Education section has two unique columns:
 - 'Location' – encompasses the intended geographical extent to disseminate information.
 - 'Target Audience' – includes the persons which the AIS awareness information is intended to reach.



Pre-Border Prevention				
Objectives	2003 Strategy	Actions	Project Status	Priority Rank

Table 1. Pre-Border, Border, Post-Border, & Outreach Objective and Actions Strategy. Bold font text is previously identified priorities.

Minimize species introductions via ballast water and biofouling	2G 7A-7C	Develop criteria for risk assessment of vessel arrivals using reporting forms and impending online database	In Progress: Working Towards Completion	1
		Develop biofouling regulations and amend ballast water regulations	In Progress: Working Towards Completion	2
		Develop criteria to evaluate effectiveness of in-water cleaning capture systems	Not Started Yet	3
		Develop best management practices for ballast water and biofouling for Hawai`i shipping industry	Ongoing	4
		Conduct In-water Cleaning Pilot Study to inform rule making	Not Started Yet	
		Develop hull husbandry reporting (e.g. protocols, rules, database)	Ongoing	
		Develop pre-border preventative techniques for streams species	Not Started Yet	

Pre-Border Prevention

Objectives	2003 Strategy	Actions	Project Status	Priority Rank
Minimize the introduction of new nonnative species based on the HDOA Species Import Rules	3	Review current HDOA Animal Import Rules to determine if it is working and potential gaps	Ongoing	1
	1	Provide well researched recommendations and testimony to HDOA for Import Applications	Ongoing	2
		Develop basic criteria of high-risk species using risk assessment tools and literature reviews	Not Started Yet	
		Develop a decision tree for Import Permits	Not Started Yet	
Pre-Border Supplementary List		Create a species import database which houses all import applications and Agriculture Board determinations		1
		Support HDOA capacity for inspections, outreach & education		
		Proactively review climate matching areas to determine which species are restricted in other regions		
		Proactively add potentially invasive species to the HDOA prohibited list		
		Research policy actions needed		
		Research all HDOA permits - research, commercial		
		Assess loophole species, quasi-black market (i.e. hobbyists trading among friends, FedEx shipments not DOA related, species transported from one place to another with Hawai'i holding in transit, shipping industry liability)		

Border Protection

Objectives	2003 Strategy	Actions	Project Status	Priority Rank
Early Detection monitoring for new species introductions and inventory of spatial and temporal distributions of established AIS	3A	Obtain DNA sequences of present species that have been established in Hawai'i's harbors	Ongoing	
		Finalize Taxonomic and DNA Database results from 2015 O'ahu Harbor Monitoring Settlement Plates Survey	In Progress: Working Towards Completion	
		Conduct periodic settlement plate monitoring surveys to monitor the of continued presence of established and occurrences of new species (e.g. at 5 year intervals)	Ongoing	
		Conduct plankton surveys in harbors	Ongoing	
		Build eDNA baseline repository	Ongoing	
	2G 3A, 3B	Develop ballast water and biofouling inspection protocols and identify / employ technologies for rapid assessment	Ongoing	
	Implement ballast water and biofouling inspections	Not Started Yet		
Build Capacity for Early Detection	1A-1D 3B, 3C 5D	Identify gaps in current monitoring efforts and partner with universities, Federal agencies (NOAA, USFWS), non-profit organizations (TNC), and other teams within DAR especially neighbor islands	In Progress: Working Towards Completion	1
		Build capacity for neighbor island AIS surveys: <ul style="list-style-type: none"> • Assess current field teams' AIS awareness and documentation that may be already occurring • Cross train staff in AIS identification • Distribute SOP for sample collection and preservation 	Ongoing	

Border Protection

Objectives	2003 Strategy	Actions	Project Status	Priority Rank
Build Capacity for Early Detection (cont.)	1A-1D 3B, 3C 5D	Develop new tools for AIS early detection and rapid response	Ongoing	
		Increase communication between DAR teams	Ongoing	
		Utilize multi-agency AIS databases	Ongoing	
		Identify opportunities for community involvement	Ongoing	
		Increase participation in schools to engage youth in identifying and reporting AIS	Not Started Yet	
	Participate in more EOR Training and develop AIS focused training to emphasize current species of highest interest	Ongoing		
Rapid Response to AIS threats		Respond to new AIS reports (i.e. EOR and iNaturalist)	Ongoing	1
		Develop protocols for site inspections, standard follow-up surveys, and data dissemination for each type of rapid response report	In Progress: Working Towards Completion	
		Respond to JTMD and other high-risk marine debris	Ongoing	
		Develop response protocols to unmanaged ballast water/biofouling	Not Started Yet	
Build Capacity for Rapid Response	1E	Increase rapid response funding (e.g. state legislator) <ul style="list-style-type: none"> • Prove relevance by evaluating examples of current established species and their economic impacts, and examples of successful rapid response mitigation efforts • Quantify cost of AIS impacts to Hawai'i 	Not Started Yet	1

Border Protection

Objectives	2003 Strategy	Actions	Project Status	Priority Rank
Build Capacity for Rapid Response (cont.)		Create a response plan based on the Incident Command System structure for rapid response events <ul style="list-style-type: none"> • Pre-establish logistics to maximize effectiveness/streamline response (include emergency call list for partners, pre-submitted dive plan approvals and required LORs) 	Not Started Yet	2
	1A-1D	Build capacity for other aquatic habitats: <ul style="list-style-type: none"> • Estuary, Anchialine pools, Streams, deep water, Papahānaumokuākea National Marine Monument 	Not Started Yet	3
		Partner with NOAA for reports on deep water AIS and monument AIS database maintenance	Not Started Yet	
	4B, 4H	Create rapid response decision tree and identify projects with high likelihood of success across aquatic habitats	Not Started Yet	
		Identify gaps to increase capacity to respond	Not Started Yet	
Border Supplementary List		Inventory pet store's freshwater and marine species		
		Monitor soft bottom species		
		Increase monitoring of species movement from harbors to outer reefs and more pristine areas		
		Assess whole habitats (including nocturnal) and not just one component in areas that are already surveyed		
		Assess implementing fines to mitigate AIS impacts from known introductions		

Border Protection

Objectives	2003 Strategy	Actions	Project Status	Priority Rank
Border Supplementary List (cont.)		Hire a planner to develop/update AIS Program Plan		
		Update 2008 Rapid Response Plan to include input from partner agencies/groups and increase capacity beyond AIS team (i.e. MOP students for surveys, TNC boat support, community members' EOR assessments)		
		Table exercise to evaluate effectiveness of Rapid Response Plan and address areas that need improvement		

Post-Border Management

Objectives	2003 Strategy	Actions	Project Status	Priority Rank
Active management and control of AIS to restore native aquatic ecosystem	4D	<p style="text-align: center;">Reduce <i>Eucheuma/Kappaphycus/Acanthophora/Gracilaria</i> biomass and spread through:</p> <ul style="list-style-type: none"> • Benthic habitat mapping surveys to determine extent and expansion (ongoing) • Manual removal of invasive algae using the super sucker (as needed) • Outplanting native sea urchins as a biocontrol and herding (continual) <ul style="list-style-type: none"> • Annual monitoring: habitat mapping, fish transects, photoquads, photoplots, rugosity (ongoing) • Community-based manual removal 	Ongoing	1
		<p style="text-align: center;"><i>Avrainvillea amadelpha</i> management and monitoring:</p> <ul style="list-style-type: none"> • Survey distribution of new sightings on O'ahu • Track change over time using GPS and GIS technology (e.g. Ewa, Kualoa, Maunalua) <ul style="list-style-type: none"> • Develop eradication techniques with researcher from HIMB <ul style="list-style-type: none"> • Test/implement eradication techniques • Manual removal and biocontrol (testing in Maunalua Bay) <ul style="list-style-type: none"> • Develop collaboration with community groups and partners to control Ewa limu restoration area 	Ongoing	2

Post-Border Management

Objectives	2003 Strategy	Actions	Project Status	Priority Rank
Active management and control of AIS to restore native aquatic ecosystem (cont.)	4D	<p style="text-align: center;"><i>Salvinia molesta</i> monitoring and removal on Kaua'i:</p> <ul style="list-style-type: none"> • Identify streams with <i>Salvinia</i> sp. present and determine extent using eDNA and visual surveys • Community-based manual removal of the bulk of biomass • Assess industrial removal techniques (i.e. excavator from shore or on a barge) • Chemical and/or biological treatment for the remaining <i>Salvinia</i> sp. fragments • Follow-up monitoring, removal efforts, and outreach materials 	In Progress: Working Towards Completion	
Build capacity for Post-border management and control of AIS		<p style="text-align: center;">Increase tools/techniques for management of AIS:</p> <ul style="list-style-type: none"> • Review/Update Chemical Tool Box • Develop chemical application capacity by obtaining certification as Class 5 Applicators for field team staff <ul style="list-style-type: none"> • Electrofishing for stream habitat • Develop more species specific genetic markers for additional AIS 	Ongoing	1

Post-Border Management

Objectives	2003 Strategy	Actions	Project Status	Priority Rank
Build capacity for Post-Border management and control of AIS (cont.)	4F	Evaluate potential for control efforts in other habitats (site-specific and species-specific) <ul style="list-style-type: none"> • Habitats: Harbors / Anchialine Pools / Streams / Estuaries • Species: California grass, mangroves, tilapia, etc. 	Not Started Yet	2
		Increase field staff: <ul style="list-style-type: none"> • Enlist MOP students to assist with investigations <ul style="list-style-type: none"> • Teach community to manage AIS threats • Conduct training workshops 	Not Started Yet	
		Upload information on our website for a step by step guide on how to manage AIS	Not Started Yet	
Prioritize management efforts and assess effectiveness of current management strategies		Continue to implement Interagency Biosecurity Plan	Ongoing	1
		Steering committee coordination meetings	Ongoing	
		Pilot studies/research to identify AIS drivers	Not Started Yet	
		Develop control/management prioritization decision tree	In Progress: Working Towards Completion	
		Risk assessment of established non-native species and quantify negative impacts of each on native ecosystem	Ongoing	

Post-Border Management

Objectives	2003 Strategy	Actions	Project Status	Priority Rank
Post-Border Supplementary List		Herbivore fish stock enhancement (i.e. biocontrol feasibility)		
		Develop UV capabilities for aquatic plant management		
		Long term restoration and monitoring, and meetings to share research results, needs, and funding		
		Cryptic diversity baseline assessments (e.g. box jelly fish, limu kohu, etc.) for comparability		
		Overarching planning needs partnerships to fill gaps for nearshore ecosystem		

Current Ongoing Projects

Objectives	2003 Strategy	Actions	Project Status	Priority Rank
Develop proactive strategies to preserve and restore the aquatic ecosystem	4K	Installation of reef markers in Kaneohe Bay to minimize boat strikes	In Progress: Working Towards Completion	
		Holistically restore the He`eia watershed by reducing nutrient and sediment input through watershed restoration and participating in coral monitoring and restoration	In Progress: Working Towards Completion	
		Kapalama coral translocation	Not Started Yet	
		Coral Damage Mitigation Table off Airport Reef	Ongoing	
		Fishing Line Collection Bin Pilot Project (signs from DOBOR) <ul style="list-style-type: none"> • Monitor for use • Pitch an 'Adopt-a-Bin' program to Marine Debris Community Groups 	In Progress: Working Towards Completion	
		"Hatchery" for native limu species - professional implementation	Not Started Yet	

Current Ongoing Projects

Objectives	2003 Strategy	Actions	Project Status	Priority Rank
Rapid response to ship groundings		Following vessel removal: <ul style="list-style-type: none"> • Conduct site inspection to document impact and determine “No Action” or to develop a remediation and restoration plan • Conduct an REA of the grounding site following protocols described in the State of Hawai’i Marine Impact Field Investigation Guide (Gulko and Tun, 2016) 	On Standby	
		Work with other State and Federal partners to: <ul style="list-style-type: none"> • Stabilize the coral and rubble fragments to prevent further damage • Continued monitoring 	Not Started Yet	
		Hazwoper training for staff	Annually	
Rapid response to coral bleaching and disease		Verify reporting of the event	Ongoing	
		Document the extent of bleaching or disease through visual surveys using a modified SNAP survey, noting down descriptive information (locations, species affected, % impacted/mortality)	Ongoing	
		Follow-up monitoring to document recovery efforts	Not Started Yet	
Other	Ship worms study	In Progress: Working Towards Completion		

Outreach & Education

Objectives	2003 Strategy	Actions	Location	Target Audience
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Participate in organized outreach events to increase awareness of AIS issues in the State of Hawai'i for public and targeted audiences	2D, 2E 5A-I 6A, 6B	Expand Stop the Invasion Campaign	Statewide	Community
		Expand Don't Let It Loose Campaign • Emphasize Hawai'i	Statewide Pet Stores	Community
		Build publicly accessible AIS Database • Create internal tracking database • Create online AIS Story map	Statewide	Community
		Learn from community what AIS issues affect them the most to prioritize projects	Statewide	Community
		Use partners to display AIS information to targeted audience	Statewide	Partners
		Participate in conferences/meetings/workshops (e.g. Hawai'i Conservation Conference, Western Regional Panel Conference)	Honolulu	Scientific community
		Developing specific and broad outreach materials (physical and online) with updated information and projects	Western Pacific States	State AIS Program Coordinators
		Increase awareness of reporting methods and monitoring for community: • Community removal of AIS • iNaturalist, Eyes of Reef Training, DOA Pest Hotline, AIS ID training	Statewide	Community, Partners, Colleagues
		Develop "Clean, Drain, Dry" Campaign to stem the spread of <i>Salvinia</i> sp. on Kaua'i	Statewide	Community

Outreach & Education

Objectives	2003 Strategy	Actions	Location	Target Audience
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Participate in organized outreach events to increase awareness of AIS issues in the State of Hawai'i for public and targeted audiences (cont.)	2D, 2E 5A-I 6A, 6B	Develop AIS community focus calendar with rotating spotlight on species of interest (e.g herbivory and urchins, invasive fish in estuary, ballast water and biofouling, AIS in streams, JTMD, vectors of AIS)	Website	Community
		Increase participation in schools to engage youth in reporting AIS	Statewide	Youth
		Spearhead events which raise awareness about the native species which are harmed by AIS	Statewide	Community
		Establish communication with most transited harbors and share information about AIS threats, and learn of any new issues they are facing	Statewide	Stakeholders, vessel operators, neighbor islands
		Outreach for ballast water and biofouling (e.g. BMPs, workshop/meetings for new rule and compliance standards)	Statewide	Stakeholders, vessel operators, neighbor islands

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