WR Committee

From: Eva Blumenstein <Eva.Blumenstein@co.maui.hi.us>
Sent: Friday, September 22, 2017 11:41 AM
To: WR Committee
Cc: Agnes Nolan; Dave Taylor
Subject: Requested FY19 grant proposal
Attachments: BIO ECONOMICS.pdf

Aloha,

Please find requested FY19 grant proposal relating to bio-economic modeling to DWS.

Mahalo,

Eva

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COUNTY OF MAUI DEPARTMENT OF WATER SUPPLY

WATERSHED PROTECTION GRANT PROGRAM

(FORM A) APPLICANT INFORMATION

Fiscal Year 2019

Date of Application	August 23, 2017
Organization	University of Hawaii for Bio Economics Model Project
Mailing Address	2440 Campus Road, Box 368 **City** Honolulu **State** HI **Zip Code** 96822-2234
Physical Address	2425 Campus Road, Room 1 **City** Honolulu **State** HI **Zip Code** 96822-2247
Field Operations Address	Maui Agricultural Research Center, PO Box 269 **City** Kula **State** HI **Zip Code** 96790-0269

Executive Director	Darcie Yoshinaga	**Phone**	808-956-7800
		Email	aorcontact@ors.hawaii.edu
Authorized Administrator	Nozomi Kanoho	**Phone**	808-932-7755
		Email	nkanoho@hawaii.edu
Grant Project Manager	James Leary	**Phone**	808-878-1213, ext. 24
		Email	learyj@hawaii.edu
Grant Project Coodinator	James Leary	**Phone**	808-878-1213, ext. 24
		Email	learyj@hawaii.edu

Fiscal Year 2018 Grant Funding Received	$0.00
Fiscal Year 2018 Grant Funding Spent	$0.00

The County of Maui Department of Water Supply
WATERSHED PROTECTION GRANTS PROGRAM FISCAL YEAR 2019

Bio-Economic Models Prioritizing Mauka Catchment Basins of the East Maui Watershed for Protection Against Miconia Invasion.

4.1.1 Project Background

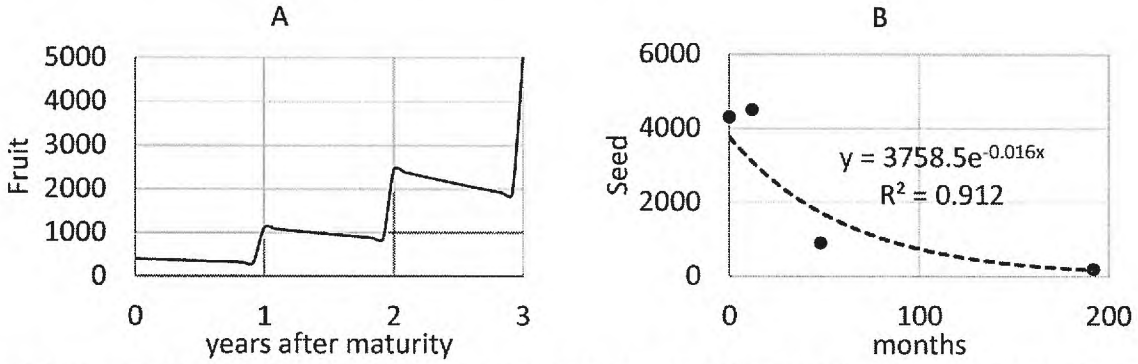
Describe how your proposed work will benefit and/or improve the drinking water supply of Maui County. How is your proposed work important and relevant to the mission of the Maui County DWS – To Provide Clean Water Efficiently? What are the consequences of not doing this work in the context of preserving, protecting and sustaining Maui County's drinking water supply?

The mission of this project is to design cost-effective management decisions to protect the mauka catchment basins in the East Maui Watershed (EMW) against incipient miconia incursions. Miconia is highly adapted to the climatic conditions of the EMW and left unchecked will displace all other naturalized and endemic vegetation communities with expanding monotypic infestations; ultimately disrupting known stream flow characteristics of the watershed. This is a pre-emptive approach, deploying a state-of-the-art surgical "weed-ectomy" intervention system to efficiently maintain the long-term health of Haleakala.

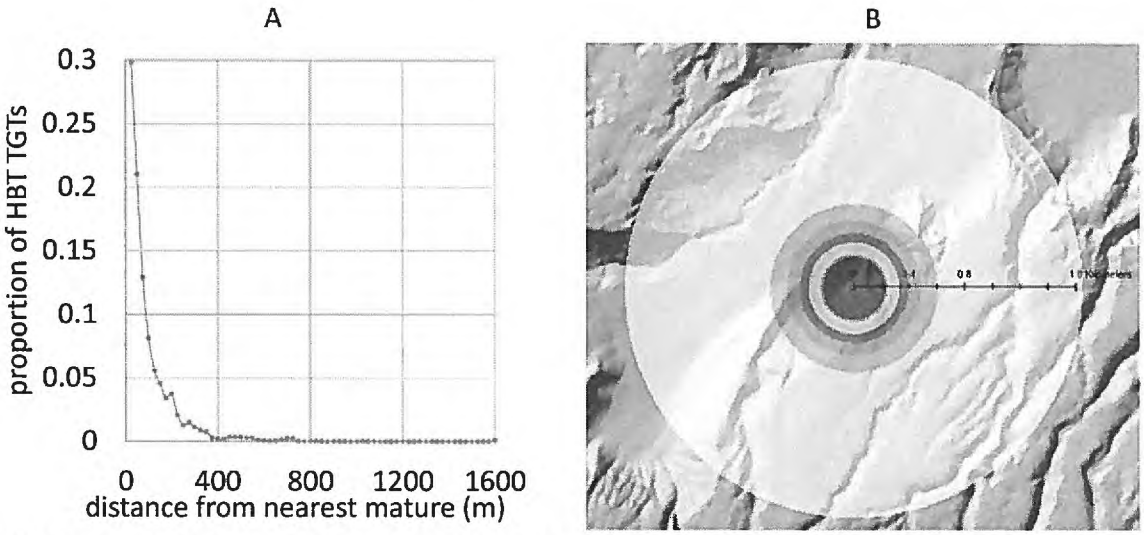
The EMW stretching from Maliko to Makapipi Gulch measures over 96,000 acres reaching the summit of Haleakala Volcano at over 10,000 ft. above sea level (a.s.l.) providing critical water resources to East Maui, Upcountry and Central Valley residents and agriculture. For over a century, surface-water diversion systems have been maintained with several miles of ditches and tunnels, tapped by hundreds of intakes, dams, pipes, and flumes (Wilcox, 1996). This diversion system is established along ~1300 ft. a.s.l. on the contour with over 30 different mauka catchment basins encompassing over 56,000 acres that produce on average 163 Mgal day^{-1} of fresh water (Gingerich, 1999). This phenomenal resource is vital to sustaining life and viability on Maui.

Miconia (*Miconia calvescens*) is dubiously recognized among *"100 of the World's Worst Invaders"* (Lowe et al. 2000). This mid-canopy species is native to South and Central America and invasive to many other tropical regions of the Pacific Rim, including Tahiti and Australia. This species is highly competitive to island, endemic vegetation communities and known for destabilizing functional forest ecosystems with catastrophic consequences (Gagne et al. 1992, Nanko et al. 2015). It was introduced to Hana, Maui as a botanical specimen in the early 1970s and realized as a major forest weed problem twenty years later, when active management commenced. Today, there are over 2000 acres of infestations in Hana and Nahiku naturalized below 1300 ft. a.s.l. with an incipient invasion spread across over 50% of the entire watershed from Honomanu to Kipahulu. Since 1991, there have been over 300K miconia plants removed from the EMW with ground and aerial strategies led by the Maui Invasive Species Committee (MISC) in collaboration with many other local, state and federal partners.

The invasive biology of miconia is driven by fecundity, dispersal, seed bank longevity and recruitment. Miconia is autogamous (self-fertile) with reproduction reported in the millions of seed propagules (Meyer 1998). Miconia fruit are edible to a broad range of frugivores, particularly avifauna; facilitating dispersal of seed propagules to establish beyond its maternal source (Hardesty et al 2011, Spotswood et al. 2013, Fletcher and Westcott 2013). We recently discovered the range of miconia dispersal in the EMW to exceed one mile (i.e., 1644 m). Meyer (2009) verified survival of a soil seed bank at the end of a 16-year study with the fitted decay function putting extinction well beyond four decades. Based on these biological features, one mature (self-fertile) plant will independently impact up 2100 acres of the watershed for several decades. Thus, miconia occupying the mauka catchment basins above the diversion system must become the highest priority targets for elimination.

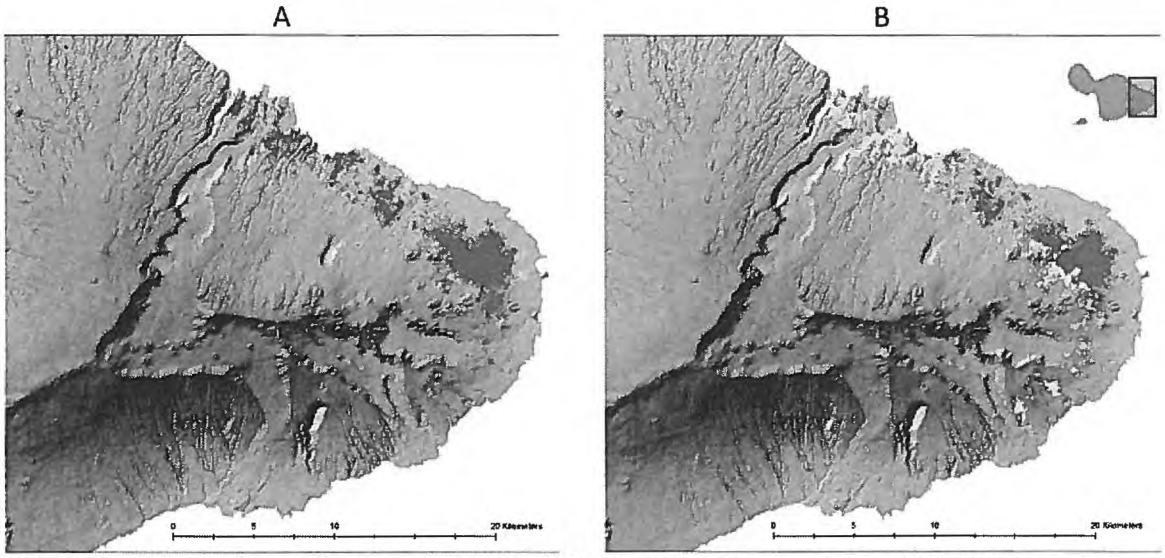


(A) Miconia produces 1000s of fruit in several years of early maturity, (B) seed bank survival was measured at the end of a 16-year trial with a fitted decay function showing recruitment lasting over four decades (Meyer 2009).



(A) The dispersal kernel of miconia in the EMW extending to 1644 m (i.e., beyond one mile) creating (B) an impact area greater than 2100 acres

Herbicide Ballistic Technology (HBT) is a novel application system developed by the University of Hawaii and registered as a FIFRA 24c Special Local Need (SLN) pesticide to treat Miconia in natural areas of Hawaii. The concept of HBT is to surgically administer a lethal pesticide dose directly to individual weed targets with no collateral impact to the surrounding vegetation (Leary et al. 2013). The platform pneumatically delivers an herbicide-filled gelatin capsule with high accuracy and effective range up to 100 ft. The HBT system demonstrated the utility to treat miconia colonizing extreme, inaccessible terrain, where many of the most critical incipient populations reside (Leary et al. 2014). Thus, greatly expanding the opportunity to focus management efforts on eradicating incipient populations and containing the core infestation. Since 2012, in collaboration with the MISC, we have conducted over 100 HBT missions, eliminating over 25,000 incipient miconia targets, protecting over 43,000 acres of the EMW.



(A) Historical miconia points recorded 1991-2012 (n=270,591; purple) and (B) HBT target points recorded 2012-2016 (n=20,363; yellow)

With an operations research approach, we have studied aerial management tactics with the HBT platform to generate robust estimates of efficiency and cost effectiveness. With a Hughes 500 helicopter, we are effectively searching one acre of the watershed in 11 sec of flight time and administering an average dose of ~22 projectiles to each target detected. With the known price points for purchasing helicopter services and HBT inventories we have estimated the variable costs to survey and treat at \$3.67 acre^{-1} and \$6.82 target^{-1}, respectively. We've further determined management costs to positively correlate with target density where the most economical strategies focus on eliminating isolated, incipient targets in the most remote areas of the watershed (i.e., lowest target density).

In spite of our tactical successes, miconia is not strategically eradicable from Maui. Major efforts are now focused on developing long-term biological control strategies of the larger infested areas (Badenes-Perez and Johnson 2007, Johnson 2010). In our most recent report to the Hawaii Invasive Species Committee, we predict that current investments to contain the

miconia infestation are only 55% of levels calculated to be successful. Being short of this level, should trigger decisions to localize protection efforts on prioritized assets (Auld and Johnson 2014). Effective management, regardless of strategy, is achieved when target mortality outpaces biological recruitment. Models interpreting the spatial and temporal dynamics of an invasion are critical to developing cost-effective counter tactics integrating with the larger biocontrol effort to produce complementary outcomes (Johnson 2010).

Bioeconomic modeling originates from fisheries research looking at dynamic population trends dictated by management (harvest) intensity, in concert with the biological constraints of the species and habitat (Seijo et al. 1998). In the original context, the goal was to maintain a sustainable harvest of an economic resource. Bioeconomic modeling, in the context of miconia management, deploys the same concepts, but with a goal to tip the balance with management outpacing the biology, forcing population extinction. There is good science published on the biology of miconia (as described above) to predict how populations migrate over space and time; that can be used to determine how to optimize deployment of management resources (e.g., helicopter time and projectiles) with counter interventions suppressing the invasion (Büyüktahtakın et al 2015). This project will customize bioeconomic intervention models for optimal mitigation of miconia encroaching the EMW mauka catchment basins informed by: (i) species biology, (ii) empirically-derived operational (cost) metrics and (iii) suitable habitat models correlating presence/absence data to climate layers of the region. These models will present probability density functions of an invasion impact radiating from known target locations, with counter-management imposing measurable reduction. Environmental correlations of suitability will also determine likelihood of impact relative to optimal, where, e.g., higher elevations present less suitable habitat. These model parameters will also interpret the consequential tradeoffs resulting from not managing below the diversion system (i.e., dispersal into mauka catchment basins).

a. *Please provide background information about your organization, including an organizational chart.*

Dr. James Leary is an Associate Research and Extension Specialist Faculty with the Maui County Cooperative Extension Service, in the College of Tropical Agriculture and Human Resources, at the University of Hawaii at Manoa, with an academic appointment in the Department of Natural Resources and Environmental Management. His specialization is in Invasive Plant Species Science and Management. He has been stationed on Maui since 2009. He actively collaborates with the Maui Invasive Species Committee, West Maui Mountain Watershed Partnership, Leeward Haleakala Watershed Partnership and The Nature Conservancy. Over these past eight years, he has secured over $664K in extramural grant awards from state and federal programs and dedicated over 80% annual FTE serving Maui County with a real investment of over $914K, for a total direct contribution to Maui County exceeding $1.5M and another $417K in new extramural grant funds pending in 2018.

Contributions to Maui County from 2009-2016	
Total matching extramural funds (13 grant awards)	$ 664,066

In-kind match (conservative estimate 0.8 FTE)	$ 913,642
Grand Total	$ 1,577,690

He has produced five peer reviewed, scientific publications (one receiving the award for outstanding paper of the year in 2015), along with 15 international and national conference presentations, two of which were invited. All of these outputs have the Maui Invasive Species Committee listed as co-author and acknowledge the Maui County Office of Economic Development and Department of Water Supply for their contributions (to the MISC).

From 2012-2016, the collaboration with the MISC has invested over $800K, sponsored in part by Maui County DWS, conducting over 100 HBT aerial missions containing the miconia invasion in the EMW. As a result, they have eliminated 20,363 incipient miconia targets, protecting 18,336 ha of this vital watershed.

b. Please provide maps, figures, and photos as appropriate.
See above

4.1.2 Project Goals and Objectives
How will your project address the need to provide future drinking water source and supply for the Maui County DWS? a. What are the benefits of your work? Does your existing watershed management plan have clear objectives and goals to address specific threats and problems recognized and approved by DWS? b. Please clearly define your methodological approach to achieve desired results which contribute to DWS's objectives to conserve Maui's County's water sources and to provide clean water efficiently? c. If possible, quantify the value of what you are proposing. d. Please explain how you will implement best management practices, foster innovation, and exemplify efficient execution of a program management plan to produce quantifiable results.

The mission of this project is to design cost effective management decisions to protect high-priority mauka catchment basins of the East Maui Watershed (EMW) against incipient miconia incursions. Pre-emptive, maintenance interventions present the lightest footprint on the landscape (i.e., surgical weedectomy) with long-term health benefits preserving the ecosystem functions of Haleakala.

Project Objectives:

1. Initiate scaled tactics eliminating incipient miconia targets occupying mauka catchment basins above the diversion system with the deployment of aerial HBT operations
2. Develop a custom bioeconomic map layer with spatio-temporal resolution depicting optimal management strategies

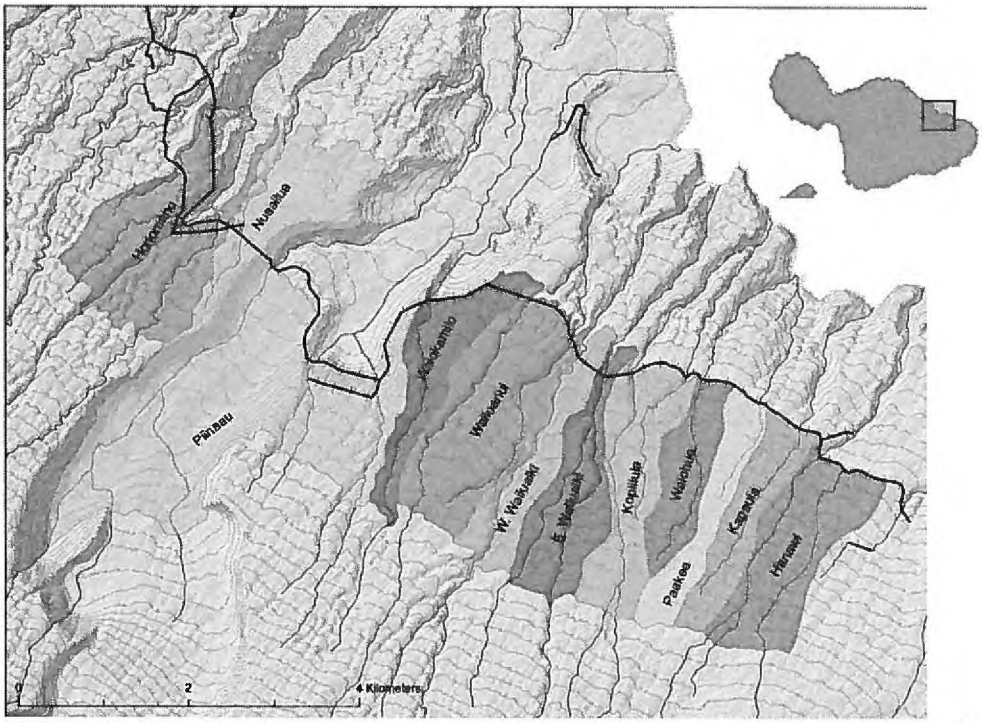
This is an action research approach in collaboration with the MISC designed to generate novel management data analytics to improve watershed protection against miconia incursions. To date, less than 2% of the incipient targets eliminated were occupying the EMW catchment

basins above 1300 ft. a.s.l. with the highest target recorded at 2100 ft. a.s.l. Research in Tahiti has found Miconia to occupy similar climates at elevations exceeding 3500 ft. a.s.l. (Pouteau et al 2010). This project gives us the opportunity to update the intelligence on these mauka watersheds where surveillance is infrequent. Every miconia plant detected and eliminated before reaching maturity will save an estimated minimum of $170K USD in future management costs. This is based on our knowledge of the fecundity, dispersal, seed bank longevity of miconia and the costs to search and treat every target progeny dispersed by a plant allowed to achieve reproductive maturity.

4.1.3 Location and Size of Project Area

a. Provide quantifiable information, such as where you will be conducting your work and the size of the area you plan to address through your proposal. b. Provide maps, aerial and other photos, and graphics as necessary. c. Show the proximity of your proposed work to the nearest DWS water source(s). d. Explain how your efforts in the location and project area may enhance available and clean water supply.

Aerial HBT operations will be coordinated for all mauka catchment basins from Hanawi to Honomanu (n=13) above the diversion system from 1300 ft. a.s.l., up to 2500 ft. a.s.l. The total area to be protected is 6721 acres. This selected area encompasses the highest 2% of known target locations, with much of the area having inadequate intelligence.



Depiction of the size and location of the proposed management location showing the twelve mauka catchment basins from Hanawi to Honomanu established mauka of the Koolau ditch system (black line with cross hatches) running along the 1300 ft. a.s.l. elevation contour and extending up to 2500 ft. a.s.l., well above the highest known point recorded, but also within

what is expected to be habitat susceptible to miconia invasion. The total area is measured at 6721 acres.

4.1.4 Scope of Work

Describe the work you are proposing (as if to someone who has never heard of your organization or the work you have done in the past), and answer the following: a. Is your project scope of work well-organized, practical, and cost-effective? b. What are your integrated measures to prevent further watershed or water supply degradation and to help restore and preserve Maui County's watersheds? c. What are your project's scientific and technical merits, and how will they help continually produce useful results to enhance Maui County's water supply and advance the watershed conservation field? d. Does your scope of work include public outreach and education?

This scope of work has two objectives towards modernizing the miconia management strategy in the EMW with a re-prioritization of the mauka catchment basins feeding into the diversion system at 1300 ft. a.s.l. This is an action research approach defined as a simultaneous complementation of science and management with a mission to improve the system, which in this case is a collaboration between Dr. Leary (research) and the MISC (management) actively managing the mauka catchment basins to eliminate high-priority incipient targets and simultaneously generating new intelligence towards the development of a bioeconomic model optimizing future management actions. We propose to systematically search a total of thirteen catchment basins from Hanawi to Honomanu starting at 1300 ft. a.s.l. and up to 2500 ft. a.s.l., exceeding the elevation of the highest known target in this area. We anticipate detection and treatment of less than 100 targets established below 2000 ft. a.s.l. This will require an estimated 25 hours of contracted flight time to accomplish. Surveillance intelligence collected in the areas where targets are not found will contribute towards the statistical probability of that area being protected from incursion based on concepts in search theory used by the military to track adversary movements (Koopman 1946, Cacho et al. 2006). In this case, the occupation and dispersal of miconia within the mauka catchment basins will serve as inputs into the bioeconomic model that can track where and how often management will need to be deployed based on intelligence of when and where targets have been located. For practical purposes, areas determined to be "free" of miconia and beyond 1644 m of the nearest recorded mature plant would be reasonably classified as protected for a minimum of four years, i.e., the maximum known dispersal distance and the estimated time for miconia to reach maturity, respectively. Moreover, we will develop a suitable habitat model for miconia in the EMW using scientifically proven methods (Crall et al. 2013), with the main climatic drivers likely to be temperature and precipitation (Pouteau et al. 2011). This will greatly enhance our expectations of miconia performance, where the likelihood of miconia viability is severely diminished by elevation further extending the management outcomes of eliminating high priority targets with longer term protection imposed, translating into a greater return on the investment. The models to be developed will produce high-resolution maps easily interpreted of where miconia is most impactful and how management resources can be most optimally deployed.

4.1.5 Timeline

Applicant proposals should contain a detailed timeline to provide accurate work dates that outline deliverable activities and when they are planned for completion. The timeline must start and end within the given performance period. Proposal timelines take into account Deliverables Reporting Form (Form C) Refer to Grant Performance Period (Section 2.3) and the General Terms and Conditions (Section 3.0) for guidance.

This project will be accomplished within a 12-month period. Aerial surveillance and elimination of all detected miconia will be accomplished within the first two quarters. Bioeconomic and suitable habitat modeling will be accomplished within the last two quarters utilizing the intelligence gathered in the first two quarters.

Literature Cited:

1. Auld, B.A. and Johnson, S.B., 2014. Invasive alien plant management. *CAB Rev. doi*, *10*, p.1079.
2. Badenes-Perez, F.R. and Johnson, M.T., 2007. Ecology, host specificity and impact of Atomacera petroa Smith (Hymenoptera: Argidae) on Miconia calvescens DC (Melastomataceae). *Biological Control*, *43*(1), pp.95-101.
3. Büyüktahtakın, İ.E., Kıbış, E.Y., Cobuloglu, H.I., Houseman, G.R. and Lampe, J.T., 2015. An age-structured bio-economic model of invasive species management: insights and strategies for optimal control. *Biological invasions*, *17*(9), pp.2545-2563.
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7. Gingerich, S.B., 1999. *Ground-water occurrence and contribution to streamflow, Northeast Maui, Hawaii* (No. 99-4090). Geological Survey (US).
8. Hardesty, B.D., Metcalfe, S.S. and Westcott, D.A., 2011. Persistence and spread in a new landscape: dispersal ecology and genetics of Miconia invasions in Australia. *Acta Oecologica*, *37*(6), pp.657-665.
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12. Lowe, S., Browne, M., Boudjelas, S. and De Poorter, M., 2000. *100 of the world's worst invasive alien species: a selection from the global invasive species database* (Vol. 12). Auckland: Invasive Species Specialist Group.
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14. Meyer, J.Y., 1998. Observations on the reproductive biology of Miconia calvescens DC (Melastomataceae), an alien invasive tree on the island of Tahiti (South Pacific Ocean). *Biotropica*, *30*(4), pp.609-624.
15. Meyer, J.Y., 2009, May. The Miconia saga: 20 years of study and control in French Polynesia (1988–2008). In *Proceedings of the international miconia conference, Keanae, Maui, Hawaii.*

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Attachment E

Direct costs are estimated at $82,608 and Indirect Administrative & Overhead costs are estimated at $14,578 which is 15% of final grant expenditure amount per page 5 of County of Maui's Watershed Protection Grants Program Fiscal Year 2019 Grant Application Guide.

Direct cost administrator: Gayle Yamashita, yamashitag@ctahr.hawaii.edu, 808-956-4151.
Indirect cost administrator: Kevin Hanaoka, hanaokak@hawaii.edu, 808-956-7874.

COUNTY OF MAUI DEPARTMENT OF WATER SUPPLY

WATERSHED PROTECTION GRANT PROGRAM

(FORM C) DELIVERABLES REPORTING FORM **FISCAL YEAR** 2019

Applicant/Grantee:	Included	Target	Performance Period = 4 Quarters (4 Qtrs = 100%)								Percent Completed Final Report	
			1st Quarter		2nd Quarter		3rd Quarter		4th Quarter			
University of Hawaii - Protection Against Miconia Invasion	(yes/no)	Goal	Goal Amount 1st Qtr	% 1st Qtr	Goal Amount 2nd Qtr	% 2nd Qtr	Goal Amount 3rd Qtr	% 3rd Qtr	Goal Amount 4th Qtr	% 4th Qtr	Total %	Target Goal Reached
UNGULATE CONTROL	o Yes ● No											o Yes o No
Fence construction (ft)	o Yes ● No											o Yes o No
Fence inspection (ft)	o Yes ● No											o Yes o No
Surveyed transects (number)	o Yes ● No											o Yes o No
Install traps (number)	o Yes ● No											o Yes o No
Maintain traps (number)	o Yes ● No											o Yes o No
Ungulate removal (number)	o Yes ● No											o Yes o No
Other (please describe)	o Yes ● No											o Yes o No
WEED CONTROL AND ERADICATION	● Yes o No											o Yes o No
Survey sites (numer of acres)	● Yes o No	6720										o Yes o No
Weed removal (number of acres)	o Yes ● No	<1										o Yes o No
Apply herbicide - HBT (number of applications or acres)	● Yes o No	100										o Yes o No
Other (please describe)	o Yes ● No											o Yes o No
INVASIVE PLANT CONTROL	● Yes o No											o Yes o No
Ground Surveys (number of acres)	o Yes ● No											o Yes o No
Aerial Surveys (number of acres)	● Yes o No	6720										o Yes o No
Invastive plant(s) controlled (combined acres)	o Yes ● No											o Yes o No
Miconia (acres)	● Yes o No	<1										o Yes o No
Pampas grass (acres)	o Yes ● No											o Yes o No
Fountain grass (acres)	o Yes ● No											o Yes o No
Himalayan ginger (acres)	o Yes ● No											o Yes o No
Gorse (acres)	o Yes ● No											o Yes o No
Ivy gourd (acres)	o Yes ● No											o Yes o No
Strawberry guava (acres)	o Yes ● No											o Yes o No
Other plant (please describe)	o Yes ● No											o Yes o No
Other (please describe)	o Yes ● No											o Yes o No
RESOURCE MONITORING/RESEARCH	o Yes ● No											o Yes o No
Monitor rain gauges (number)	o Yes ● No											o Yes o No
Other (please describe)	o Yes ● No											o Yes o No
COMMUNITY OUTREACH (#/hrs)	o Yes ● No											o Yes o No
Educational hikes (number)	o Yes ● No											o Yes o No
Volunteer trips (number)	o Yes ● No											o Yes o No
Outreach events (number)	o Yes ● No											o Yes o No
Public presentations (number)	o Yes ● No											o Yes o No
Volunteer recruitment (number)	o Yes ● No											o Yes o No
Volunteer outplanting (number)	o Yes ● No											o Yes o No
Other (please desribe)	o Yes ● No											o Yes o No
RESEARCH, GERMINATION, AND PLANTING	o Yes ● No											o Yes o No
Collect native seeds for revegetation - attach species (lbs/kg)	o Yes ● No											o Yes o No
Locate seed sites for planting (number in watershed)	o Yes ● No											o Yes o No
Collect wilt resistant koa seeds (lbs/kg)	o Yes ● No											o Yes o No
Distribute wilt resistant koa seeds (to watershed partners)	o Yes ● No											o Yes o No
Outplanting for reforestation and management (number)	o Yes ● No											o Yes o No
Other (please describe)	o Yes ● No											o Yes o No

• Careful consideration should be given to your Target Goal. Reaching your Target Goal may be obtained incrementally over 4 quarters until the deliverable is 100% complete. Be sure to provide justification if you do not attain your Target Goal due to unexpected technical and personnel issues or weather related delays. Your proposal and updated quarterly reports will be used as reference, if more detail about your planned project activities to complete deliverables is needed.

*Please attach narrative justifications or additional descriptions behind this form.

COUNTY OF MAUI DEPARTMENT OF WATER SUPPLY

WATERSHED PROTECTION GRANT PROGRAM

(FORM D) PROJECT BUDGET SUMMARY

- Applicants should exercise caution and responsibility when requesting funds. Awards are considered based on applications with clear justification concerning the costs and activities to achieve contracted deliverables.
- Awarded funds are limited. Only request amounts that you are prepared to spend in a given performance period. Plan and follow project eligibility requirements under number one of Part VI, Eligible Projects, in the RFP.
- See Budget Instructions (Section 1.5), Grant Performace Period (Section 2.3), Gen. T&C's (Section 3.0), and Request for Reimbursements (Section 4.2.7) for guidance, limitations, and restrictions that may prohibit the reimbursement for your expenses.
- Grantees should ensure that totals for each expense categories are reconciled accordingly. Requesting budget changes after the submission of your Project Budget Summary can result is long delays in reimbursement.
- Grantees should not attempt to spend down remaining funds close to their project closeout date that alters your initial Scope of Work under Payments of the T&C without ample justification.
- Vehicles, equipment, supplies, and materials are for project-based work only and personal or recreational use is strictly prohibited.
- Please provide narratives for large unspent amounts if they were included in your initial grant proposal.

FISCAL YEAR: 2019 | GRANT NUMBER: | NTP Start Date: | NTP End Date:

PROJECT BUDGET SUMMARY - APPLICANT/GRANTEE University of Hawaii - Protection Against Miconia Invasion	Requested Budget Amount	Matching Funds	Award Amount	1st Qtr Drawdown Amount	2nd Qtr Drawdown Amount	3rd Qtr Drawdown Amount	4th Qtr Drawdown Amount	Grant Award Remaining Balance
EXPENSES								
A. Personnel (payroll taxes & fringes)	45308	0	0	0	0	0	0	0
B. Transportation (e.g. fuel, etc)	500	0	0	0	0	0	0	0
C. Contractual (e.g. helicopter, consultant, contractor, etc)	30300	0	0	0	0	0	0	0
D. Facility Rental	0	0	0	0	0	0	0	0
E. Utilities (e.g. telephone, mobile, water, electricity)	500	0	0	0	0	0	0	0
F. Travel	4000	0	0	0	0	0	0	0
G. Field Crew (e.g. equipment, training)	0	0	0	0	0	0	0	0
H. Supplies & Materials	2000	0	0	0	0	0	0	0
I. Administrative & Overhead	14578	0	0	0	0	0	0	0
J. Other Expenses	0	0	0	0	0	0	0	0
TOTALS	**$ 97,186.00**	**$ 0.00**	**$ 0.00**	**$ 0.00**	**$ 0.00**	**$ 0.00**	**$ 0.00**	**$ 0.00**

PLEASE ATTACH BUDGET NARRATIVE/JUSTIFICATIONS BEHIND THIS FORM IF NECESSARY

Personnel covers 0.1 FTE for an RCUH research economist with 36.13% fringe estimate and a graduate assistant (step-16) with 12% fringe.
Transportation covers truck fuel consumption on the island.
Contractual is helicopter service for a total of 25 hours estimated at $1200 per hour.
Utilities covers cellular service data plan during the project.
Travel budgeted from $4000 to cover the cost for GIS collaborator and student.
Supplies cover the replacement and repair of HBT hardware during the project.
Indirect A&O costs are calculated as 15% of total funded.

*Comments/Notes Section Below

COUNTY OF MAUI DEPARTMENT OF WATER SUPPLY

WATERSHED PROTECTION GRANT PROGRAM

(FORM E) PAYROLL

FISCAL YEAR 2019

Applicant/Grantee: University of Hawaii - Protection Against Miconia Invasion	INDIVIDUAL TOTAL SALARY ($)	REQUESTED DWS SALARY CONTRIBUTION ($)	Performance Period Drawdowns NTP start date NTP end date 1st Quarter SALARY ($)	2nd Quarter SALARY ($)	3rd Quarter SALARY ($)	4th Quarter SALARY ($)	Remaining Balance ($)
POSITION NAME/TITLE AND FTE%			* All included expense invoices must be dated within NTP start and end dates				
RCUH Research Economist	83440	8344					
Step-16 Graduate Assistant	30312	30312					
Salaries (Subtotal)	113,752.00	38,656.00					
Payroll Taxes	0.00	0.00					
Fringes and Benefits	33,784.00	6,652.00					
TOTALS	$ 147,536.00	$ 45,308.00					

*Comments/notes section below

PLEASE ATTACH PROJECT JOB DESCRIPTION BY POSITION/TITLE BEHIND THIS FORM

Research Economist will have a minimum PhD in an economics field with preferences in natural resources and familiarity with Hawaii's ecosystems and landscapes. The Economist will perform high level cost valuations of spatial data for management level interpretations in cost effective management decisions.

The Graduate Assistant will have a minimum BS in natural resource management or geographical information systems. theThe GA will develop custom suitable habitat models for Miconia calvescens in the East Maui Watershed by associating spatial climate with presence/absence data

COUNTY OF MAUI DEPARTMENT OF WATER SUPPLY

WATERSHED PROTECTION GRANT PROGRAM

(FORM F) TRANSPORTATION

FISCAL YEAR 2019

Applicant/Grantee: University of Hawaii - Protection Against Miconia Invasion			REQUESTED BUDGET AMOUNT ($)	PURPOSE	Performance Period Drawdowns NTP start date NTP end date 1st Quarter ACTUAL EXPENSES ($)	2nd Quarter ACTUAL EXPENSES ($)	3rd Quarter ACTUAL EXPENSES ($)	4th Quarter ACTUAL EXPENSES ($)	Remaining Balance ($)
ITEM	Vehicle	VIN #			* All included expense invoices must be dated within NTP start and end dates				
State Vehicle	F150		500						
TOTALS			$ 500.00						

*Comments/notes section below

PLEASE ATTACH ADDITIONAL NARRATIVE/BREAKDOWN BEHIND THIS FORM IF NECESSARY

Transportation covers truck fuel consumption on the island.

COUNTY OF MAUI DEPARTMENT OF WATER SUPPLY

WATERSHED PROTECTION GRANT PROGRAM

(FORM G) CONTRACTUAL SERVICES

FISCAL YEAR 2019

Applicant/Grantee: University of Hawaii - Protection Against Miconia Invasion	HOURS	COST ($)	PURPOSE	Performance Period Drawdowns NTP start date NTP end date 1st Quarter ACTUAL EXPENSES ($)	2nd Quarter ACTUAL EXPENSES ($)	3rd Quarter ACTUAL EXPENSES ($)	4th Quarter ACTUAL EXPENSES ($)	Remaining Balance ($)
ITEM				* All included expense invoices must be dated within NTP start and end dates				
Helicopter service		30300						
Helicopter Operations				HRS: $	HRS: $	HRS: $	HRS: $	
TOTALS		$ 30,300.00						

*Comments/notes section below

PLEASE ATTACH ADDITIONAL NARRATIVE/BREAKDOWN BEHIND THIS FORM IF NECESSARY

Contractual is helicopter service for a total of 25 hours estimated at $1200 per hour.

COUNTY OF MAUI DEPARTMENT OF WATER SUPPLY

WATERSHED PROTECTION GRANT PROGRAM

(FORM H) FACILITIES

FISCAL YEAR 2019

Applicant/Grantee: University of Hawaii - Protection Against Miconia Invasion			Performance Period Drawdowns NTP start date NTP end date				
	COST ($)	PURPOSE	1st Quarter ACTUAL EXPENSES ($)	2nd Quarter ACTUAL EXPENSES ($)	3rd Quarter ACTUAL EXPENSES ($)	4th Quarter ACTUAL EXPENSES ($)	Remaining Balance ($)
ITEM			* All included expense invoices must be dated within NTP start and end dates				
TOTALS							

*Comments/notes section below

PLEASE ATTACH ADDITIONAL NARRATIVE/BREAKDOWN BEHIND THIS FORM IF NECESSARY

COUNTY OF MAUI DEPARTMENT OF WATER SUPPLY

WATERSHED PROTECTION GRANT PROGRAM

(FORM I) UTILITIES

FISCAL YEAR 2019

Applicant/Grantee: University of Hawaii - Protection Against Miconia Invasion	COST ($)	PURPOSE	Performance Period Drawdowns NTP start date NTP end date 1st Quarter ACTUAL EXPENSES ($)	2nd Quarter ACTUAL EXPENSES ($)	3rd Quarter ACTUAL EXPENSES ($)	4th Quarter ACTUAL EXPENSES ($)	Remaining Balance ($)
ITEM			* All included expense invoices must be dated within NTP start and end dates				
Cellular data plan	500						
TOTALS	$ 500.00						

*Comments/notes section below

PLEASE ATTACH ADDITIONAL NARRATIVE/BREAKDOWN BEHIND THIS FORM IF NECESSARY

Utilities covers cellular service data plan during the project.

COUNTY OF MAUI DEPARTMENT OF WATER SUPPLY

WATERSHED PROTECTION GRANT PROGRAM

(FORM J) TRAVEL

FISCAL YEAR 2019

Applicant/Grantee: University of Hawaii - Protection Against Miconia Invasion	COST ($)	PURPOSE	Performance Period Drawdowns NTP start date NTP end date 1st Quarter ACTUAL EXPENSES ($)	2nd Quarter ACTUAL EXPENSES ($)	3rd Quarter ACTUAL EXPENSES ($)	4th Quarter ACTUAL EXPENSES ($)	Remaining Balance ($)
ITEM			* All included expense invoices must be dated within NTP start and end dates				
Mainland Travel	4000						
TOTALS	$ 4,000.00						

*Comments/notes section below

PLEASE ATTACH ADDITIONAL NARRATIVE/BREAKDOWN BEHIND THIS FORM IF NECESSARY

Travel budgeted from $4000 to cover the cost for GIS collaborator and student.

COUNTY OF MAUI DEPARTMENT OF WATER SUPPLY

WATERSHED PROTECTION GRANT PROGRAM

(FORM K) FIELD CREW

FISCAL YEAR 2019

Applicant/Grantee: University of Hawaii - Protection Against Miconia Invasion			Performance Period Drawdowns NTP start date NTP end date				
	COST ($)	PURPOSE	1st Quarter ACTUAL EXPENSES ($)	2nd Quarter ACTUAL EXPENSES ($)	3rd Quarter ACTUAL EXPENSES ($)	4th Quarter ACTUAL EXPENSES ($)	Remaining Balance ($)
ITEM			* All included expense invoices must be dated within NTP start and end dates				
TOTALS							

*Comments/notes section below

PLEASE ATTACH ADDITIONAL NARRATIVE/BREAKDOWN BEHIND THIS FORM IF NECESSARY

COUNTY OF MAUI DEPARTMENT OF WATER SUPPLY

WATERSHED PROTECTION GRANT PROGRAM

(FORM L) SUPPLIES & MATERIALS

FISCAL YEAR 2019

Applicant/Grantee: University of Hawaii - Protection Against Miconia Invasion	COST ($)	PURPOSE	Performance Period Drawdowns NTP start date NTP end date 1st Quarter ACTUAL EXPENSES ($)	2nd Quarter ACTUAL EXPENSES ($)	3rd Quarter ACTUAL EXPENSES ($)	4th Quarter ACTUAL EXPENSES ($)	Remaining Balance ($)
ITEM			* All included expense invoices must be dated within NTP start and end dates				
Hardware replacement and repair	2000						
TOTALS	$ 2,000.00						

*Comments/notes section below

PLEASE ATTACH ADDITIONAL NARRATIVE/BREAKDOWN BEHIND THIS FORM IF NECESSARY

Supplies cover the replacement and repair of HBT hardware during the project.

COUNTY OF MAUI DEPARTMENT OF WATER SUPPLY

WATERSHED PROTECTION GRANT PROGRAM

(FORM M) ADMINISTRATIVE & OVERHEAD

FISCAL YEAR 2019

Applicant/Grantee: University of Hawaii - Protection Against Miconia Invasion			Performance Period Drawdowns NTP start date NTP end date				
	COST ($)	PURPOSE	1st Quarter ACTUAL EXPENSES ($)	2nd Quarter ACTUAL EXPENSES ($)	3rd Quarter ACTUAL EXPENSES ($)	4th Quarter ACTUAL EXPENSES ($)	Remaining Balance ($)
ITEM			* All included expense invoices must be dated within NTP start and end dates				
Indirect Administrative & Overhead Cost	14578						
TOTALS	$ 14,578.00						

*Comments/notes section below

PLEASE ATTACH ADDITIONAL NARRATIVE/BREAKDOWN BEHIND THIS FORM IF NECESSARY

Direct costs are estimated at $82,608 and Indirect Administrative & Overhead costs are estimated at $14,578 which is 15% of final grant expenditure amount per page 5 of County of Maui's Watershed Protection Grants Program Fiscal Year 2019 Grant Application Guide. Direct cost administrator: Gayle Yamashita, yamashitag@ctahr.hawaii.edu, 808-956-4151. Indirect cost administrator: Kevin Hanaoka, hanaokak@hawaii.edu, 808-956-7874.

COUNTY OF MAUI DEPARTMENT OF WATER SUPPLY

WATERSHED PROTECTION GRANT PROGRAM

(FORM N) OTHER EXPENSES

FISCAL YEAR 2019

Applicant/Grantee: University of Hawaii - Protection Against Miconia Invasion	COST ($)	PURPOSE	Performance Period Drawdowns NTP start date NTP end date 1st Quarter EXPENSES	2nd Quarter EXPENSES	3rd Quarter EXPENSES	4th Quarter EXPENSES	Remaining Balance
ITEM			* All included expense invoices must be dated within NTP start and end dates				
TOTALS							

*Comments/notes section below

PLEASE ATTACH ADDITIONAL NARRATIVE/BREAKDOWN BEHIND THIS FORM IF NECESSARY

COUNTY OF MAUI DEPARTMENT OF WATER SUPPLY

WATERSHED PROTECTION GRANT PROGRAM

(FORM O) EQUIPMENT & SUPPLIES INVENTORY

*Include Invoices/Receipts

FISCAL YEAR 2019

Applicant/Grantee: University of Hawaii - Protection Against Miconia Invasion	DATE OF PURCHASE	QUANTITY	UNIT COST ($)	TOTAL COST ($)	PURPOSE	ANTICIPATED USEFUL LIFE
ITEM						
TOTALS						

PLEASE ATTACH ADDITIONAL NARRATIVE/BREAKDOWN BEHIND THIS FORM IF NECESSARY

COUNTY OF MAUI DEPARTMENT OF WATER SUPPLY

WATERSHED PROTECTION GRANT PROGRAM

(FORM P) OTHER FUNDERS & GRANTS

FISCAL YEAR 2019

Applicant/Grantee: University of Hawaii - Protection Against Miconia Invasion	DELIVERABLE ACTIVITY	AMOUNT ($)
FUNDER OR GRANT		
TOTALS		

PLEASE ATTACH ADDITIONAL NARRATIVE/BREAKDOWN BEHIND THIS FORM IF NECESSARY

COUNTY OF MAUI DEPARTMENT OF WATER SUPPLY

WATERSHED PROTECTION GRANT PROGRAM

(FORM B) REQUIRED DOCUMENTS & FORMS CHECKLIST

FISCAL YEAR 2019

Applicant/Grantee: University of Hawaii - Protection Against Miconia Invasion	ATTACHED
DOCUMENT AND FORM	
A. Tax Clearance Certificate or Certification of Vendor Compliance (certified and dated within the last six (6) months).	☑
B. Annual Financial Statements: Current financial statements for the past three (3) years. One (1) year must be audited.	☑
C. DWS Grants General Terms and Conditions signed by the authorized grant administrator and its executive director.	☑
D. The names of other funders and grants for the proposed project with DWS, including their individual contribution amount.	☑
E. An administration and overhead (A&O) breakdown of direct and indirect cost rates not exceeding the allowable percentage of the total grant amount. The direct and indirect administrators must also be identified. [The expenditure functions for both direct and indirect A&O will be outlined in the General Terms & Conditions]	☑
F. All fillable forms included in the Watershed Protection Grants Program Application (Forms C through P)	☑