

Pacific Biocontrol Strategic Action Plan

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Balloon vine (*Cardiospermum grandiflorum*) was one of eight weeds prioritized for biological control by the Cook Islands because of its quick growth and ability to smother forests, as shown in the photo on the left taken in Rarotonga in December 2017. The photo on the right shows the same forest in December 2018 after the release of the host-specific natural enemy, *Puccinia arechavaletae*, which is a rust fungus that damages the leaves (photo inset) and reduces the health and vigor of the plant. Balloon vine is still present in the Cook Islands, but its ability to be invasive is being controlled by the rust fungus. The project was funded by the New Zealand government and managed by Manaaki Whenua – Landcare Research. Photos by Quentin Paynter, Manaaki Whenua – Landcare Research NZ.

Executive Summary

Climate change and invasive non-native species have direct and indirect negative impacts, and can combine to have synergistic effects that cause major harm and seriously threaten food security and trade, ecosystem function, public health and wellbeing, natural and cultural resources, development, and economies^{1,6,7,1,12}. In Pacific Island Countries and Territories (PICTs), invasive non-native plants (weeds), invertebrates (pests), and plant pathogens (plant diseases) already increase the cost of food production by one-third, and without management actions can result in total crop loss. With climate change, crops and forests are more prone to invasive species^{4,5,6,7,14}.

This plan has been jointly developed by participants of the first Pacific Ecological Security Conference (2022), representatives of Pacific Island Countries and Territories, and members of the Pacific Invasives Partnership including New Zealand, Australia and the USA. This SAP is aligned with Decision XIII/13 paragraph 14 on Biological Control of Invasive Alien Species, adopted at the thirteenth meeting of the Conference of the Parties to the Convention on Biological Diversity, and CBD Technical Series No. 91 which facilitates effective scientific and technical cooperation among countries for the use of modern biological control techniques.

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Invasive species are also the greatest driver of native biodiversity loss on islands⁴, and pests, weeds, and diseases degrade the resilience of forests and their ability to store carbon, buffer severe weather, keep soil moist and accelerate water infiltration, and hold topsoil^{4,5,6,7,8,10}. Conversely, protecting forests from invasion is an important climate resilience strategy^{6,7,9}. When a pest or weed becomes established and widespread, it may become a management priority because its abundance causes unacceptable levels of harm. Chemical and mechanical control methods may be appropriate tools in some cases, while other situations call for a more cost-effective and sustainable approach^{11,14}, which is why many PICTs have added modern biological control—the use of natural enemies—as one of their invasive species management and climate resilience strategies^{1,2,3,8}.

Unlike the use of generalist predators that can have unwanted impacts, modern biological control practices involve rigorous research in the invasive pest or weed's native range to identify co-evolved, host-specific natural enemies of the target pest or weed^{1,2,8,15}. Researchers look for a natural enemy that cannot complete its life cycle on any species other than the target species. After careful testing in a specialized high-security quarantine research facility and upon receiving regulatory approvals, that natural enemy can be used as a biological control by “reuniting” it with its weed or pest host, thereby brining that weed or pest under control. The aim of biological control is not to eradicate the invasive species, but to control it in a way that reduces its negative impacts. A host-specific biological control agent can provide long-term, non-chemical control services in perpetuity, with little or no additional interventions or inputs^{1,2,3,8,13,14}.

Seventeen PICTs have deliberately introduced at least one natural enemy to target their priority weed/s and every PICT has deliberately introduced at least one natural enemy to manage priority pest/s. In addition, New Zealand, Australia, and Hawai'i have researched, tested, and introduced natural enemies to target more than 100 weed and 220 pest species. In the PICTs, of the 350 host-specific natural enemies deliberately introduced to manage weeds and pests, *no biological control agent has shifted from their weed or pest host or negatively impacted other species or the environment*¹. In addition to the need for nature-based solutions to manage existing pests and weeds, recent research predicts significant increases in the establishment of new species, including disease vectors and pathogens through the coming decades due to increased trade and climate change^{4,11,14}.

Biological control has produced huge returns on investment, up to \$4,000 USD for every dollar spent³. The biological control of cactus species to reclaim and protect range land in Australia delivered a benefit:cost ratio of 300:1³, and in Hawai'i, a biological control agent brought the endemic wiliwili tree (*Erythrina sandwicensis*) back from the brink of extinction by providing ongoing control of invasive gall wasps since 2008⁸. A summary of biological control efforts in the Pacific Islands region can be seen in Table 1.

These are just two of the hundreds of case studies that show the value and importance of modern biological control as a tool for managing the invasive species that are an existential threat to island resilience, ecological security, and the perpetuation of island peoples' livelihoods and cultures. With the dual and synergistic drivers of climate change and invasive species, there is a critical need to increase the capacity, scope, and output of biological control work in the PICTs.

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Table 1. Summary of biological control efforts in the Pacific region targeting weeds and pests using insects, pathogens, and mites.

Type of target species, type of natural enemy	No. of target species	No. of natural enemies released	No. of natural enemies established	No. of target species at least partially controlled	% of target species at least partially controlled
Weeds	103	337	233	71	68.9
Pests using insects	232	891	353	101	43.5
Pests using pathogens	10	20	17	7	70.0
Pests using mites	8	11	8	6	75.0
Source: Day et al. 2021					

Scope of the Plan

This Pacific Biocontrol Strategic Action Plan (SAP) is intended for use by all island nations, states, and jurisdictions within the Pacific region: American Samoa, Australia, Cook Islands, Federated States of Micronesia (FSM), Fiji, French Polynesia, Guam, Hawaii, Kiribati, Marshall Islands, Nauru, New Caledonia, Niue, Northern Mariana Islands (CNMI), New Zealand, Palau, Papua New Guinea (PNG), Pitcairn Islands, Samoa, Solomon Islands, Tokelau, Tonga, Tuvalu, Vanuatu, and Wallis and Futuna.

This SAP is focused on modern biological control practices and uses this working definition, modified slightly from the SPREP Guidelines for Invasive Species Management in the Pacific: biological control, classical biological control, or biocontrol: Controlling an invasive species by researching, testing, and introducing a natural enemy, such as an insect, mite, or fungus, that co-evolved with and specifically attacks the target pest or weed species and does not attack other native or economically important species. The practice of using generalist species that can have negative impacts on a range of species is wholly outside of this SAP.

This SAP details the objectives and the subsequent actions required to support the needs of PICTs for managing priority pests and weeds using modern biological control. It is focused on identifying and filling key local to regional gaps and needs in the areas of communications, policy, capacity, and the coordination and collaboration mechanisms that will be necessary for sustained effort to implement this SAP. The plan does not set priorities for specific pests and weeds, rather, it acknowledges that the prioritization of pest and weed species must be conducted at the local level, and that there are existing priorities and processes in place, including, among others, the work of the Pacific Regional Invasive Species Management Support Service (PRISMSS) “Natural Enemies – Natural Solutions” regional programme (<https://www.sprep.org/prismss/natural-enemies-natural-solutions>).

Goal

To enhance climate resilience by raising the capacity of Pacific Island Countries, Territories, and States to mitigate the biophysical, social, and economic impacts of priority weeds, pests, and plant diseases through the use of host-specific, effective natural enemies and modern biological control techniques.

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Objectives and Actions

Objective 1. Communications: Build government and public awareness and support

Increase awareness of the impacts of invasive species to agriculture and the environment, the synergistic effects of invasive species and climate change, and how biological control can provide resilience, and other benefits. Communications is necessary to overcome barriers to the implementation of the SAP. A communications contractor or staff is estimated at \$70,000 USD.

- a) Design and provide shared informational and communications resources for building internal support in governments, primarily for executive level use. Resources should include editable and ready-to-use facts, graphics, photos, case studies, and PowerPoints which can be accessed and used to build internal support which is needed to advance all other aspects of this SAP.
- b) Design and provide shared informational and communications resources that can be modified or used for use by different PICTs for the purpose of increasing public awareness and support.
- c) Use current information garnered from meetings and workshops described in *Objective 5, Coordination, Collaboration, and Information Sharing* to update both internal and public communications resources.

Objective 2. Policy and Regulatory support: Assess and enact protective regulatory frameworks for biocontrol projects as required

These may be done by PICTs, or possibly by a legal fellow that would provide draft model language and consultative assistance. The annual salary of a legal fellow is estimated at \$60,000 USD.

- a) Draft policy language to enact protective biological control regulations as required. Alternately, a paid legal fellow could draft model policy language that may be used by PICTs to enact local regulations.
- b) Provide legal assistance where requested to assist PICTs in reviewing or updating relevant policies.
- c) Develop criteria for regulatory applications and a framework for peer review.
- d) Gather and provide current best practices for standardized biological control import risk assessments protocols, pre- and post-release monitoring, and other resources. These can be gathered from existing programs and from *Objective 4, Training and Educational Support* workshops.

Objective 3. Capacity: Assess and advance the facilities infrastructure, staffing, and operational needs of the region

These include High-Security Quarantine Research Facilities, Post-Entry Quarantine (PEQ) and Rearing Facilities, and the staffing and operational costs of facilities. An assessment should include a clear strategy for documenting the capacity of existing high-security facilities in the Pacific region and the needs based on the needs of the PICTs and the provision or sharing of regional and international facilities institutions between PICTs (see more in *Objective 5, Coordination, Collaboration, and Information Sharing*). Based on planning and construction costs of a high-security quarantine research facility in the US, such a facility today is estimated to cost \$63,150,000 USD, although the inclusion of modular design components might reduce this cost. Operating and staffing costs would be additional.

- a) High-security quarantine research facilities:
 - a. Costs of construction/expansion facilities to meet the needs of the region.

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- b. Staffing costs of facilities (annual salaries)
 - c. Operation costs of facilities including equipment and annual operating costs, and exploratory research.
- b) Post Entry Quarantine (PEQ) facilities: Assess and continue to refine needs for regional quarantine research capacity to fill existing and anticipated needs (note that appropriate scientific and regulatory requirements mean that it takes several years to bring a biological control project/ program to fruition). This includes:
 - a. Costs of construction/ expansion of local and national PEQs and host plant and biological control agent rearing facilities.
 - b. Staffing costs of PEQs and rearing facilities (annual salaries)
 - c. PEQ and rearing facility operation costs (of facilities including equipment and annual operating costs.

Objective 4. Training and Educational Support: Assess workforce and training needs

Increase the availability of technical training for staff planning and implementing biological control projects in the PICTs, and identify educational pathways for students in biological control and related disciplines to meet the needs of the region.

- a) Workshops, courses, and learning exchanges: Support for conducting or participation in new or existing learning opportunities focused on biological control project work topics.
- b) Educate the next generation of Pacific biological control practitioners: Identify Pacific region degree programs in relevant sciences; and post-doc programs in biological control, and provide support through scholarships or other mechanism, including exchange visits.
- c) Pre-emptive planning and research to develop capacity for rapid biological control response for pests and weeds that are highly likely to arrive.

Objective 5. Coordination, Collaboration, and Information Sharing: Identify and fill this central capacity role

Coordination salary and support is estimated at \$150,000 USD.

- a) Support existing biological control programs in the Pacific. Document and highlight success stories and lessons for sharing.
- b) Identify and agree on a regional coordinating body or agency, or subregional coordinators to coordinate advances on these objectives and facilitate information sharing.
- c) Set and support regular (suggested every 3 years) conferences and ad hoc meetings to share information, assess progress, refine needs, set next steps for this SAP.
 - a. Identify and implement a mechanism/s to communicate with and among the Pacific biological control/resource management community.
 - b. Organize and host meetings to discuss and assess the capacity of high-security quarantine research facilities and the ability of the existing facilities in meeting the biological control output needs of PICTs. A number of priority weed and pest targets have passed through high-security quarantine research facilities but would still require quarantine testing specific to the requesting PICT, while others will require exploration and extensive research in one of the high-security quarantine facilities that serve the region. Therefore, coordination would (in part) is aimed at efficient and collaborative planning, and a more realistic assessment of capacity needs in the region.
 - c. Organize and host conferences every three years (as a suggestion) to share relevant information and network, review progress towards SAP objectives, assess regional and subregional gaps, needs, and next steps.

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Appendix 1: Summary of Status and Needs for Implementing the Pacific Biocontrol Strategic Action Plan

Pacific Biocontrol Strategic Action Plan Goal – *To enhance climate resilience by raising the capacity of Pacific Island countries, territories, and states to mitigate the biophysical, social, and economic impacts of priority weeds, pests, and plant diseases through the use of host-specific, effective natural enemies, and modern biological control techniques.*

Background

In the months leading up to the Pacific Ecological Security Conference in Palau (3-5 October 2022), researchers from 16 PICTs and Hawai'i provided input that resulted in the draft Pacific Biocontrol Strategic Action Plan (SAP). During and immediately after the PESC, attendees and invitees provided input on the draft Strategy and their local and regional needs relating to the use of biological control. The results to-date are summarized here, and reflect the input of 20 PICTs. The results are applicable for individual PICTs to identify their priority Actions relating to the Strategy, and for external parties to identify how they can assist PICTs to achieve such progress. Note that results are summarised but individual PICT responses are available upon request.

Brief summary

Regional Objectives – Coordination to Achieve the Objectives (Objective 5)

- Regional coordination and a coordinating body for this SAP to bring together related efforts under umbrella organizations are needed, and regular regional conferences or workshops would help advance the Pacific Regional Biocontrol Strategic Action Plan.
- Regional coordination can better advance the PESC Strategies under the 2050 Strategy for the Blue Pacific Continent and find synergies with existing invasive species and resilience-related plans, e.g. the Regional Biosecurity Plan, the Micronesia Challenge 2030, and others.
- The establishment of a regional communications network to facilitate biological control information sharing is needed and the NENS framework could be a model for national engagement with partners. (New Zealand provides biological control support to PICT partners through project coordination, High-Security Quarantine Research and Testing capacity, and regulatory support, with the Queensland Government's assistance, and through SPREP).
- Regional coordination and communications are also needed to better assess the ability of existing High-Security Quarantine Research facilities to meet the current and impending needs of the PICTs, and if expansions or new facilities are required, qualified and experienced staff, and capacity are needed.

Objective 1 – Communications Objectives

- The vast majority of responses (14 of 15 countries) indicated that they need help with internal communication messaging, prepared communications resources, and capacity to build internal support for the use of biological control.
- Some (9) needed assistance with external/community communication tools and informational resources, while (6) reported that this work was underway.
- Personnel and capacity to develop and conduct outreach was a priority for most (12), and underway by some (3), and most (13) need funding to achieve this Action.

Note that the SAP provides some ideas for providing some of the communication tools but not outreach capacity at the local level. Several PICTs rely on partners for assistance, many through the NENS program, which can serve as a model for how other nations can support the region in this and other Objectives.

Objective 2– Policy and Regulatory Support Objectives

- More than half the countries (9) either need to enact specific regulations or need to revise regulations to conduct biological control projects and most (8) need help to do this, while some (6) have regulations in place.
- Some (6) need a framework for regulatory applications and local environmental review for planning and conducting biological control projects, and some (7) need help setting up or implementing regulatory compliance work locally, while (8) have this in place either themselves or with partners.
- The majority (13) need easy-access to biological control best management practices, risk assessment protocols, monitoring procedures, etc.
- Many (11) need personnel and funding capacity to achieve this Objective.

Objective 3 – Facilities Infrastructure, Staffing, and Operational Objectives

- Many (10 countries) need to establish research and testing collaborations with one or more High Security Quarantine Research Facilities in the region while others (5) either have facilities or have relationships established.
- Many (9) need Post Entry Quarantine facilities for receiving natural enemies from High-Security Quarantine Research Facilities and need help and funding for facilities (10).
- Many (10) need help and funding for new or expanded rearing facilities.

Objective 4 – Professional Development Objectives

- Many (10 countries) need professional development opportunities for practitioners, and they need help, funding, and partners to make this happen.
- Some (8) need to identify educational pathways and provide support for students to build the workforce, and they need help (9), funding (8), and partners (7) to achieve this. Several (5) said that this was underway.