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Project Description

Three new strategies for improving biosecurity and invasive species management to build resilience in Pacific Islands

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Abstract

The inaugural Pacific Ecological Security Conference (PESC) was held in October 2022, bringing together over 100 island leaders, policy-makers, natural resource managers and global and regional invasive species experts to prioritise the critical issue of invasive species in the Pacific Islands Region. Participants confirmed that invasive species are a major threat to building and maintaining climate resilience and adaptability of Pacific Island ecosystems, as well as food security, biodiversity, sustainable livelihoods and the protection of cultural resources and way of life. Three region-wide strategic action plans were developed to guide interventions focused on the topics of invasive ants, coconut rhinoceros beetle and the use of biological control as a pest and weed management tool. These plans were the major outcome of the PESC and, when implemented, will result in coordinated activities that take a "whole-of-Pacific" approach to invasive species biosecurity and management. Here, we briefly describe the background, planning and engagement process for the three plans, summarise any country- and territory-level data obtained through the process and detail what is planned to occur over the next few years. In addition to the adoption and implementation of the strategies as a result of this inaugural PESC, we anticipate that the PESC will become the premier regional conference aimed at reducing the entry and impacts of invasive species to improve sustainability of environments and peoples of the Pacific.

Key words: Ants, biological invasions, biological control, border security, climate change, coconut rhinoceros beetle, costs, impacts

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Introduction

The Islands of the tropical Pacific are made up of 22 countries, territories and the U.S. State of Hawai'i, within three sub-regions of Micronesia, Melanesia and Polynesia. Thousands of high (mountainous, volcanic) and low (atoll, limestone) islands comprise this vast oceanic region where over 14 million inhabitants reside

on a total land area of approximately 600,000 km^2 (The World Bank 2022). The Pacific Islands are home to over 1,000 languages and dialects, strong native and indigenous cultural heritage and numerous terrestrial and marine protected areas and biodiversity hotspots (Lynch 1998; Myers et al. 2000).

Islands worldwide are particularly noteworthy for global conservation efforts because they host more than 20% of the world's terrestrial plant and vertebrate species within less than five percent of global terrestrial area (Kier et al. 2009). Given their geographic isolation, high levels of endemism and population centres that are concentrated close to the coast, tropical islands are also uniquely vulnerable to global threats, such as climate change and invasive species (Fordham and Brook 2010; Bellard et al. 2013; Nurse et al. 2014; Taylor and Kumar 2016; IPBES 2019). Pacific Island ecosystems and communities are particularly vulnerable to climate-induced threats to water resources (Keener et al. 2018; Clilverd et al. 2019; Frauendorf et al. 2019), natural or green/blue infrastructure (Kane and Fletcher 2020; Buffington et al. 2021; Reguero et al. 2021), coral reefs and fisheries (Lehodey et al. 2013; McManus et al. 2021) and agricultural and subsistence activities (Kurashima et al. 2019).

Much of the conservation threat on islands, as well as on mainland ecosystems, arises from invasive species, which are considered to be the second largest driver of extinction globally (Bellard et al. 2016). In the tropical Pacific Islands, however, invasive species are much more than just a primary driver of biodiversity loss (IPBES 2019). Invasive plants and animals can completely alter ecosystems and, consequently, the cultural and ecosystem services they provide (Cordell et al. 2009; Holmes et al. 2019). They also threaten food and water security in the region, especially for subsistence farming, through productivity losses and changing hydrological dynamics, especially by increasing water loss (Vargas et al. 2016; Kappes et al. 2021). The negative impacts of invasive species also reduce environmental and human resilience to climate change. Protecting island ecosystems from the effects of invasive species not only alleviates these effects, but is also an important climate resilience strategy (IPCC 2007; Lawler et al. 2010; IPBES 2019).

Given the impacts that invasive species have on Pacific Island ecosystems and nearly every aspect of life in the region, the Pacific has become a leader in regional approaches for their prevention, control and eradication. One of the first Pacific-wide frameworks for national and regional management efforts was the Regional Invasive Species Strategy (RISS), produced in 2000 by the Secretariat of the Pacific Regional Environment Program (SPREP), a regional multilateral organisation representing its member Pacific Island Countries and Territories (PICTs). A review of this strategy resulted in the development in 2004 of the Guidelines for Invasive Species Management in the Pacific. The subsequent establishment of the Pacific Regional Invasive Species Management Support Service (PRISMSS) has further strengthened SPREP's supporting infrastructure for technical assistance and advice. Whereas SPREP focuses primarily on the ecological impacts of invasive species, a fellow Pacific regional organisation, the Pacific Community (SPC; formerly the South Pacific Commission) provides scientific and technical resources for sustainable Pacific Island economies and food systems in the face of the dual threats of invasive species and climate change. International conservation NGOs, such as Island Conservation, Birdlife International Pacific Secretariat and The Nature Conservancy, have substantial invasive species programmes within the region. Other coordinating groups and networks, including the Pacific Invasives Partnership (PIP), the Regional Invasive Species Council for Micronesia (RISC),

the Pacific Regional Invasive Species and Climate Change management network (Pacific RISCC) and the Asian Pacific Forest Invasive Species Network (APFISN) support international planning, research, training, networking and assistance at the regional or sub-regional scales.

The First Pacific ecological security conference

Despite increased awareness of the importance and seriousness of invasive species, there continues to be an urgent need for increased and coordinated action at the local, national and regional levels to address the Pacific's most urgent problems. In response, an international organising committee initiated preparations for the first Pacific-wide invasive species conference in 2020. The inaugural Pacific Ecological Security Conference (PESC) was held in the Republic of Palau, 3–5 October 2022, hosted by the Government of Palau, the East-West Center, SPC and The Nature Conservancy. The PESC convened over 100 island leaders, policy-makers, natural resource managers and global and regional invasive species experts to address the impact of invasive species on critical issues for the Pacific, including ecosystem sustainability, island livelihoods, cultures, food security and resilience to climate change. The conference focused on developing region-wide plans for action for the priority areas of invasive ants, coconut rhinoceros beetle (CRB) and biological control.

As a forum for regional decision-making, strategic planning, knowledge exchange and networking, it was crucial to the success of the PESC to ensure that the PICTs were well-represented to enhance partnerships and coordination with the United States, Australia and New Zealand. Funding provided by conference sponsors (East-West Center, U.S. Office of Insular Affairs, U.S. Forest Service, Australian Embassy to Palau and Sasakawa Peace Foundation) supported participant travel for representatives from 14 PICTs (Fig. 4), including four Minister-level delegations. Additionally, high-level delegations attended from regional organisations (SPREP, SPC) and regional partner countries (the United States, Australia, New Zealand, Japan, Taiwan). Timing for the PESC was opportune as it was held three months after the 51st Pacific Island Forum Leaders Meeting in Fiji, during which the 2050 Strategy for the Blue Pacific Continent (Pacific Islands Forum Secretariat 2022) was endorsed. As the Strategy serves as a blueprint for sustainable development, climate resilience and healthy people and environments amongst the 18 member countries and territories of the Pacific Islands Forum, motivation for regional collective action was high.

To ensure the goals of the conference were both manageable and achievable, the first PESC focused on developing or updating Strategic Action Plans for two of the most significant and rising invasive species issues in the Pacific Islands (invasive ants and CRB), as well as the underutilised use of biological control as a management tool for particularly damaging and widespread pests and weeds. Over two years leading up to the PESC, working groups engaged PICT representatives and subject-matter experts in the process of developing draft plans. As a result, the bulk of the conference was built around multiple breakout sessions in which participants provided input and direction on the three draft plans. These plans were envisaged to be the major outcome of the PESC, increasing coordinated activities that would take a "whole-of-Pacific" approach to invasive species biosecurity and management. Participants also heard stories from Pacific Islanders about the lived, everyday impacts of invasive species and statements by regional organisations and partners that highlighted potential research, capacity-building or funding capa-

bilities. Following, we provide some of the information presented at the PESC detailing the basis of the need for attention of the three topics of invasive ants, CRB and biological control.

Invasive Ants

Amongst globally significant invasive taxa, ants are particularly notable for their many serious environmental, social and economic impacts (Angulo et al. 2022; Gruber et al. 2022) contributing to extinctions (Banko and Banko 1976; Lumsden 2009; Emery et al. 2021), collapse of ecosystem functioning (O'Dowd et al. 2003; Olds 2008), farm abandonment (multiple PESC participant personal communications) and human deaths (Xu et al. 2012). Notably, some species are predicted to have economically unsustainable consequences if allowed to establish in many places globally, especially on islands (Angulo et al. 2022; Gruber et al. 2022). Given the severity of these impacts and the low prospects of eradication if incursions are not discovered and acted upon early (Hoffmann 2011; Hoffmann et al. 2016), ants are increasingly becoming a priority target of biosecurity measures to prevent their arrival (HAG 2001; PIAG 2004; Environment and Invasives Committee 2019).

Despite the knowledge of invasive ant impacts, surprisingly few data are available about ant incursion rates within the PICTs. However, inferences can be derived from some locations with quantified data. Australia, which now has a strong biosecurity system to prevent incursions, found 17 incursions between 2000 and 2021 (0.8 incursions per year) (Fig. 1; Suppl. material 1: table S1). This incursion rate is almost half that of Lord Howe Island (1.4 incursions per year between 2000 and 2012), which, during that timeframe, had few biosecurity protocols to prevent incursions (Hoffmann et al. 2017) and as such could be representative of most islands throughout the Pacific. Hawai'i, which arguably has a less stringent biosecurity system and significantly smaller volumes of trade than Australia, has found 14 new ant species since 2000 (0.6 incursions per year), bringing the total number of exotic ant species established in the State to almost 70 (Krushelnycky et al. 2005).

Few ant eradication programmes exist in the Pacific (Angulo et al. 2022), so the costs of running such programmes must also be inferred. Australia has been attempting to eradicate almost every exotic ant incursion found in the past two decades and, not surprisingly, the cost of attempting to eradicate the Australian mainland incursions is rising as more and more eradication programmes are being conducted simultaneously, despite five already being completed. Excluding the largest eradi-

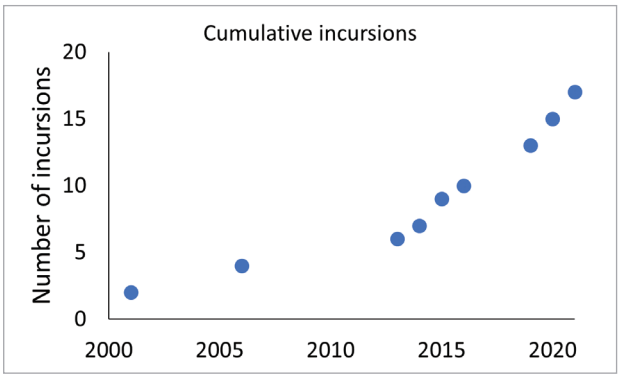

Figure 1. Cumulative number of exotic ant incursions found in Australia since the year 2000. (Data sourced from Department of Agriculture, Fisheries and Forestry Consultative Committees Secretariat).

cation programme, targeting the red imported fire ant (*Solenopsis invicta*) in southeast Queensland, the cost of all other eradication programmes in 2019 had reached AUD$14.3 million (Fig. 2a). When the southeast Queensland *S. invicta* programme is included, that cost in 2019 rises to AUD$53.6 million (Fig. 2b). Given that the average per capita gross domestic product of Pacific nations is approximately one tenth of the developed world (IMF 2020), it is unlikely that PICTs would have the financial capacity to deal with incursions as Australia is attempting. Additionally, local regulations may limit access to and use of pesticides used during eradication efforts and delay rapid response efforts when a new species detection is made. Clearly, preventing such incursions is far more economical than attempting eradication after they arrive (Leung et al. 2002; Muller et al. 2021; Angulo et al. 2022).

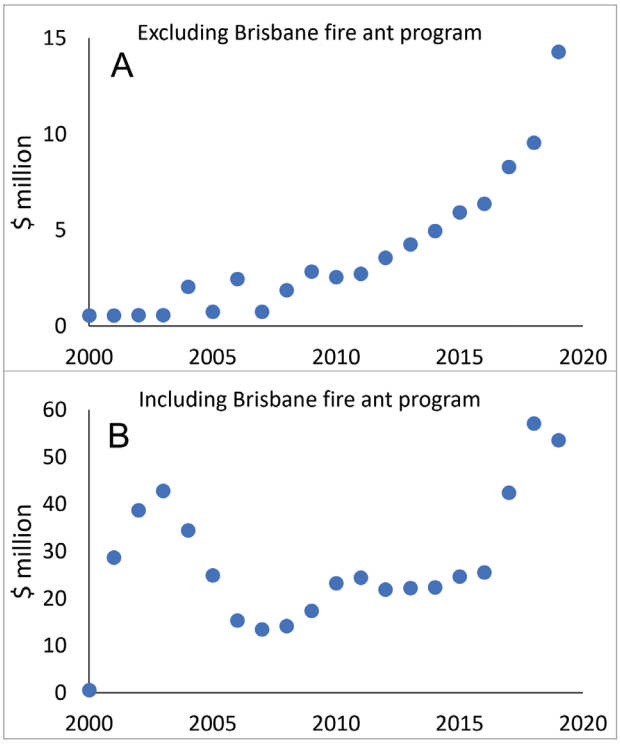

Figure 2. Annual cost of exotic ant eradication programmes within Australia since the year 2000 both excluding (**A**) and including (**B**) the costs of the red imported fire ant eradication programme in south east Queensland. Data sourced from the Invacost database (Diagne et al. 2020).

Coconut Rhinoceros beetle

Known regionally as the "tree of life", the coconut palm (*Cocos nucifera*) has vast utility for PICTs. Over thousands of years, voyaging Pacific Islanders brought varieties of *C. nucifera* to various islands where the palms provide income, food, medicine, cultural and household materials, shade for communities and shade-tolerant crops and are an attraction for tourism (Harries 1978; Foale 2003). At the last census in 2020, 61.5 M tonnes of coconuts were harvested commercially worldwide and much of that production and trade occurred within the Pacific (FAOSTAT 2018). The species is ecologically important because of the vast areas that plantations cover and coastal shorelines it inhabits where, in particular, the plants are highly resistant to wind from storms, withstand erosion and may tolerate salinity in the face of rising sea levels (Parrotta 1993; Labouisse et al. 2007).

The CRB is native to the Asian Region, but has spread to many parts of the world including the Pacific where it is a key pest of coconut and oil palm (Bedford 1980). CRB feed on the palms causing damage that reduces palm health and, in severe cases, kills the palms (Fig. 3). These impacts negatively affect all of the utilities provided by the coconut palm and greatly threaten the economy provided

Figure 3. Coconut palms severely damaged by Coconut Rhinoceros Beetle on Guam (Photo courtesy of Laura Brewington).

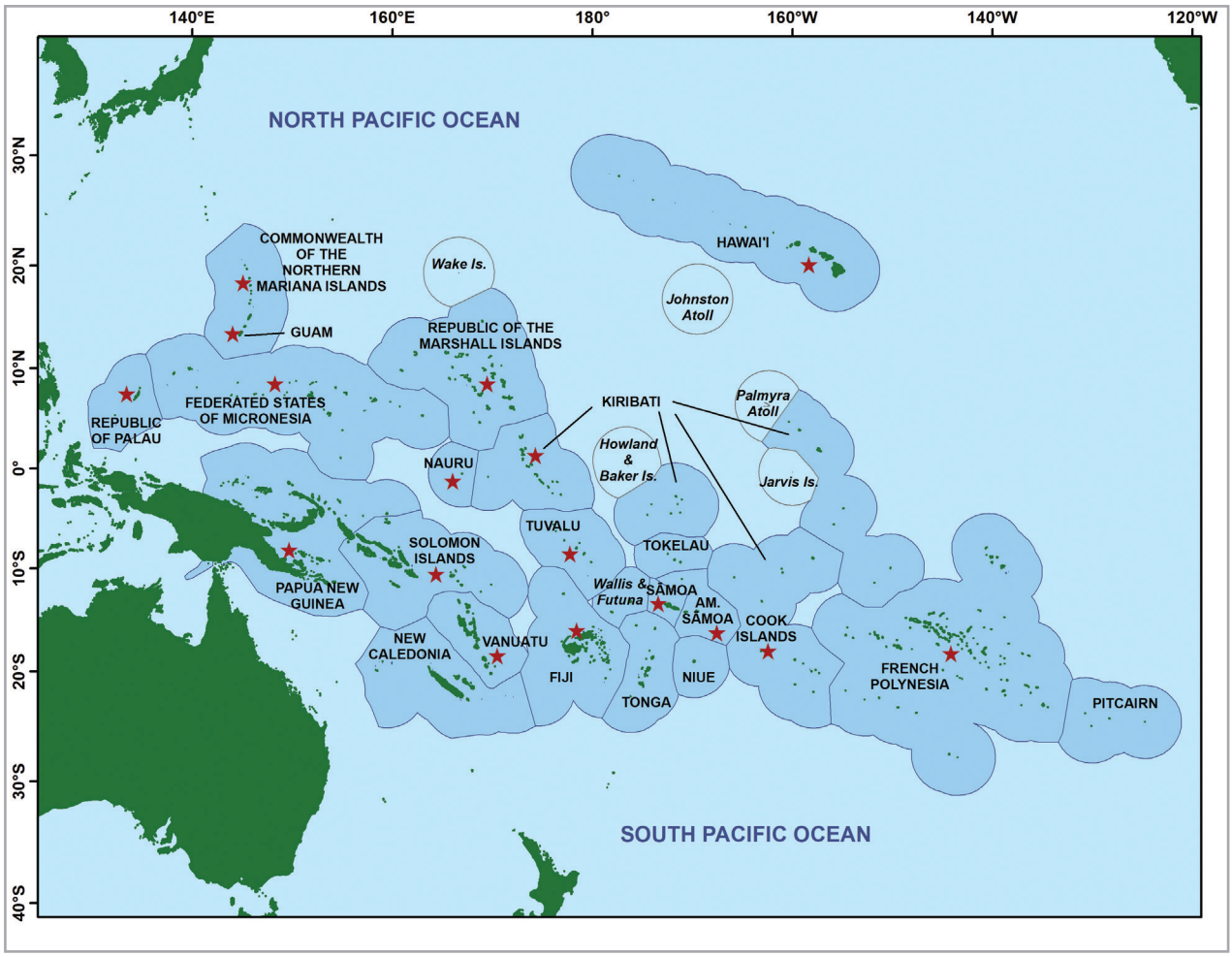

Figure 4. Map of the Pacific Region with red stars indicating PICTs that were represented at the PESC.

by the coconut trade. The beetle was first reported in the Pacific Region in Samoa in 1909 and the only PICTs that now remain free of CRB are the Cook Islands, French Polynesia, Federated States of Micronesia, Kiribati, Marshall Islands, Nauru, Niue, Pitcairn Islands and Tuvalu (Paudel et al. 2021).

The impacts of CRB within the Pacific are mostly undocumented, despite being visually prominent and are detailed here from personal experience. Coconut death in Guam from CRB damage has been severe such that few tall palms remain, which has greatly detracted the environment for the locals and tourist industry alike. In places within PNG where CRB has established, there are now localised shortages of coconuts for local consumption. In the Solomon Islands, CRB has devastated coconuts and young, replanted oil palm seedlings in plantations along the Guadalcanal plains. The relatively recent incursion into Vanuatu has spread across almost half of Efate inducing very severe damage (> 80% palms killed) in some areas. If uncontrolled, on-going spread of the CRB is projected to cause the loss of more than half of the country's coconut palms. The *Oryctes* nudivirus (OrNV) has been used successfully as a biological control agent against CRB for over 40 years (Bedford 1980; Huger 2005). However, in recent years, control efficacies have apparently been decreasing across CRB's invasive range.

Biological control

Modern classical biological control is the natural regulation of a pest species by re-uniting the pest with a co-evolved and host-specific natural enemy (biological control agent) collected from the native range of the pest species (van Driesche et al. 2016; Mason 2021). To date, all 22 PICTs have intentionally released at least one natural enemy to control arthropod pests, while 17 PICTs have deliberately released at least one weed biological control agent. In fact, more than 900 species of natural enemies have been intentionally released to control over 250 pest arthropod species in the region (Day et al. 2021). Notably absent to date has been the use of natural enemies to control plant diseases. Most importantly, none of the host-specific natural enemies has shifted from their weed or pest host or negatively impacted other species or the environment. Instead, they have remained intricately linked to their invasive species host, thereby confirming the adequacy of modern risk assessments for the safe release of natural enemies in new locations.

The successful and extremely low-risk use of natural enemies to control weeds in the tropical Pacific has a long history (> 100 years), with 66 natural enemies intentionally released to control over 26 weed species (Day and Winston 2016). Surprisingly, given the many success stories of using biological control in the Pacific Islands (e.g. control of the floating weed *Salvinia molesta* in PNG and the herbaceous shrub *Chromolaena odorata* in PNG and Micronesia) and elsewhere, this technique is still an underutilised tool in most PICTs. This is even more surprising given that using biological control agents has produced huge returns on investment, up to $4,000 USD for every dollar spent (van Wilgen and De Lange 2011) through reduced control costs and increased productivity. For example, the biological control of cactus species to reclaim and protect range lands in Australia delivered a benefit-cost ratio of 300:1 (Page and Lacey 2006) 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 2008. Currently, biological control is the only widely available tool

that can control many widespread pests and weeds that are an existential threat to island resilience, ecological security and the perpetuation of island people's livelihoods and cultures.

Strategic action plans

To drive the invasive species agenda, three Strategic Action Plans, focused on the three themes detailed above, were drafted prior to the meeting. The plans were intended to enhance overall coordination amongst the PICTs, regional multilateral entities and research and funding partners around identified gaps and needs at multiple scales (local to regional).

Invasive ant plan

The Biosecurity Plan for Invasive Ants in the Pacific (BPIAP) was an update to the 2004 Pacific Ant Prevention Plan (PAPP) by the Invasive Species Specialist Group of the International Union for the Conservation of Nature (PIAG 2004). The PAPP was endorsed at the 2004 meeting of the Pacific Plant Protection Organization (PPPO) and the SPC agreed to be the lead agency in implementing the plan. Over the subsequent years, some of the PAPP's elements were addressed, but the plan was in need of updating even well before 2022 (Vanderwoude et al. 2021). The PESC was an opportunity to re-invigorate the original plan and align it with the current status and needs in the Pacific. The plan contains biosecurity and management actions at three levels: regional, country and intra-country. The greatest difference from the prior version is that it contained a dedicated science strategy. In addition, it was notable that many actions influence biosecurity generally, not just for ants.

Before, during and immediately after the PESC, attendees and invitees of all PICTs were requested to complete a survey of their completion status, as well as their expertise and financial assistance needs, relative to the highest-priority actions drafted within the updated version of the BPIAP. Responses were received from 14 PICTs (Suppl. material 1: tables S2–S4). Key findings included the following: none of the PICTs had emergency response plans for any invasive ant species, with the exception of Hawai'i, which had a single plan for the red imported fire ant. Approximately half of the PICTs had no awareness activities for invasive ants. Only one third of PICTs indicated that some form of proactive surveillance was being conducted. There were very few completed pest risk analyses or pathway analyses. Most (64%) PICTs that responded stated that they currently do not have professional development opportunities for people responsible for invasive ant biosecurity. More than 82% indicated that expert assistance was needed to conduct actions. Finally, 97% of PICTs indicated that external financial assistance was needed to conduct actions. Notably, the results are just as relevant for both individual PICTs identifying priority actions to progress ant biosecurity and external parties identifying how they can assist PICTs to achieve such progress (Pacific Ecological Security Conference 2022a).

Coconut Rhinoceros beetle plan

Prior to the PESC, researchers and practitioners from throughout the world drafted the Strategic Action Plan for CRB management and containment across PICTs (CRB Plan). The plan focused on biosecurity measures preventing CRB spreading

to the few remaining PICTs that remain CRB-free, improving management and limiting spread where CRB is already present and developing a strong research plan supporting these two biosecurity and management objectives. During and immediately after the PESC, attendees and invitees also completed a survey evaluating awareness of CRB and jurisdictional needs to contain and control the pest. PICTs were divided into three groups of incursion status: those having a recent damaging outbreak (Outbreak), those where CRB has been established for a period longer than 50 years (Established) and those yet to be infested by CRB (CRB-Free). Responses were obtained from 23 PICTs and Hawai'i.

The survey found that the countries without CRB are ill-prepared for incursions and that those with high levels of CRB infestation do not have the resources for a sustained response (Suppl. material 1: table S5). Awareness and response capability were also generally higher where CRB was well established. The following three key points were identified from the responses as well as from discussions at the PESC: 1) There is an urgent need for CRB-free PICTs to establish surveillance and response plans to be able to respond quickly and effectively to a CRB incursion; 2) PICTs with CRB need to reduce their populations, especially around ports and transport hubs, to limit further spread of CRB; and 3) Better tools (new strains of biological control agents, improved traps, rapid detection systems) are needed to provide PICTs with the technologies they need to effectively manage or even eradicate CRB (Pacific Ecological Security Conference 2022b).

Pacific Biological control plan

Prior to the PESC, researchers from 16 PICTs and the State of Hawai'i provided input that resulted in the draft Pacific Biological control Strategic Action Plan (PBSAP) which aimed to expand the use of natural enemies for invasive species management in the Pacific at local, country and regional levels. Notably, the plan does not set priorities for specific pests and weeds, rather, it acknowledges that the prioritisation of pest and weed species must be conducted at the local level.

During and immediately after the PESC, attendees and invitees also provided input on their jurisdictional needs for using biological control, especially for filling key local to regional gaps and needs in the areas of communications, policy, capacity and determining the coordination and collaboration mechanisms that will be necessary for sustained effort to implement the plan. Responses were received from 15 PICTs. More than 86% of the PICTs indicated that they still had to, and needed help to, develop internal communication messaging, preparing communications resources and capacity to build internal support for the use of biological control. Only 14% were already developing such protocols. Developing external communication messaging and resources to increase the public support for biological control was a priority for all PICTs that responded. Just 40% indicated that this was already underway and more than 73% stated that they need assistance to complete this activity. None of the PICTs stated that they had the personnel or the capacity to develop internal and external communication resources, although 13% stated that this was underway. More than 73% stated that they needed assistance and 93% stated that they would require funding to achieve this.

Less than half (40%) of the PICTs had regulations in place to conduct biological control projects, while just over half still had to put regulations in place. Half of the PICTs indicated that they would need assistance to develop such regulations. Less than half (40%) had developed a framework for regulatory applications and local

environmental review for planning and conducting biological control projects, while the remaining PICTs still needed to do this and indicated they would need help setting up or implementing regulatory compliance work locally. More than 86% of PICTs indicated that they still needed to develop or gain access to current best practices, risk assessment protocols, pre- and post-release monitoring procedures for conducting biological control projects and that they would need assistance, partners and funding. Eighty percent reported needing assistance and funding to develop policy and regulatory actions (Pacific Ecological Security Conference 2022c).

There are very few existing high security quarantine facilities in the region, with 80% of PICTs indicating that they would need help and funding to assess needs and construct, if necessary. More than 26% of PICTs had Post Entry Quarantine facilities for receiving natural enemies from other high-security quarantine research facilities, with 73% needing assistance and funding to upgrade or construct new facilities. More than 26% had facilities to rearing natural enemies with the remaining PICTs indicating that they needed assistance and funding to expand current facilities or construct new insect-rearing facilities. Nearly all (93%) respondents indicated they needed professional development opportunities for practitioners and that they needed help, funding and partners to make this happen.

Implementing the plans

All three plans are intended for use by all Island Nations, States and jurisdictions within the Pacific Region, including Australia, New Zealand and the United States. Likewise, the plans can also be used to guide investments by funding agencies, donors and development partners. Inherently, there are many actions that can be taken by individual PICTs, but there are also numerous regional biosecurity initiatives that are beyond the remit of individual jurisdictions. These fall within the perceived roles of regional multilateral entities, amongst which the two primary environmental representatives are SPC and SPREP. Specifically, within SPREP is the PRISMSS, with SPC as a founding partner, but which welcomes participation by all parties with the common goal of practical action to prevent and manage invasive species throughout the Pacific. Such multi-dimensional and multi-entity work is not novel in the Pacific. The Pacific Regional Fruit Fly Program, which ran from 1989 for more than a decade is just one example of a highly successful Pacific regional programme (Allwood and Drew 1997).

Notably, the plans can be used in parallel with, or continue on from, other plans and current programmes. The BPIAP can also be used with the only other known equivalent plan in the world, Australia's National Invasive Ant Biosecurity Plan (Environment and Invasives Committee 2019). The Australian plan has an approach agreed to by all Australian States and Territories to enhance Australia's capacity to prevent exotic ants establishing in Australia and reduce the impacts of those already established. Equally to the BPIAP, the Australian plan also includes actions that are to be implemented offshore (preventing ants arriving), at ports-of-entry and post-entry throughout the continent. The CRB plan can extend from the New Zealand Ministry of Foreign Affairs and Trade Aid Programme "Pacific Awareness and Response to the Coconut Rhinoceros Beetle" (PARC) programme, which is coordinated by SPC and currently covers parts of a Melanesia sub-region (PNG, Solomon Islands, Vanuatu). The PARC programme focuses on limiting the spread within established areas through increased awareness and management efforts.

One of the first actions for all three plans is to determine which entity will be the administrator for each plan. The mechanism to determine this will be a combination of discussions between the likely entities (i.e. SPC and SPREP), as well as voting by PICTs through the Pacific Plant Protection Officer network. Regardless, anybody or any entity can do any work on these topics anywhere and anytime and funders can also provide money outside of the bounds of these plans. These plans are just guidance documents to help illuminate gaps and needs and aid the prioritisation and impetus for such work. While these administrative details are being determined, the plans can be accessed from the locations detailed with the reference for each plan (Pacific Ecological Security Conference 2022a, 2022b, 2022c). The plans are living documents and are intended to be updated regularly as management technology improves, as local and regional capacity is increased, as key understandings of target species improve or change and as on-ground statuses change thereby changing priorities. Administrators will also be expected to lead the future refinements of these living documents.

Moving beyond the first PESC

Momentum from the PESC quickly translated into legislative and programmatic achievements for the region. At the 2022 Association of Pacific Island Legislatures (APIL) meeting held immediately following the PESC, participants passed Resolution 39-GA-15 to endorse and support invasive species management, control and eradication in Micronesia. The Strategic Action Plan priorities were featured prominently at the 2023 Micronesian Islands Forum meeting in Pohnpei, Federated States of Micronesia, where island leaders committed to implementing recommendations from the PESC and enhancing inter-island biosecurity measures against CRB and the little fire ant. The latest update to the Regional Biosecurity Plan for Micronesia and Hawai'i (United States Department of the Navy 2015), a process that is scheduled for every five years, has also been re-invigorated as a result of the PESC. At the PESC, the U.S. Forest Service committed to providing funding to support a new Micronesia RISC coordinator position that will ensure all jurisdictions in Micronesia and Hawai'i finalise their respective updates to the Plan.

The PESC also called for increased research, capacity building and technical assistance for addressing invasive species in the region, needs that are subsequently being met by multiple partner entities. In late 2023, in response to recommendations in the CRB Strategic Action Plan, the Micronesia Conservation Trust hired a Regional Research Coordinator to assist in CRB preparation and response throughout Micronesia. The Coordinator also joins the Pacific RISCC Core Team, conducting needed research and coordination support to natural resource managers in the Pacific Islands, while strengthening regional partnerships and awareness around the interactions/synergistic effects of invasive species and climate change. The US Indo-Pacific Command committed during the PESC to improving research and development activities for the detection, surveillance, mitigation and eradication of invasive species in the Indo-Pacific Region and hosted an Invasive Species Forum in 2023 that has ultimately provided information for the next generation of financial investments by the U.S. Department of Defense in research and development. Finally, in late 2023, the U.S. Office of Insular Affairs held a multi-island biosecurity training in Guam for all U.S. insular territories, the Freely Associated States and the nation of Kiribati. Nearly 100 frontline biosecurity

personnel and government administrators were in attendance at this technical assistance workshop, which was requested by participants at the PESC and featured CRB and fire ant detection, as well as high risk invasive plants.

Subsequent to the PESC, the Convention of the Parties (COP15) in Montreal, Canada adopted the Kunming-Montreal Global Biodiversity Framework (GBF) which has a specific target (target 6) focused on mitigating the spread and impacts of invasive species, especially in priority sites, such as islands (GBF 2022). This achievement was in no small part due to SPREP's high level engagement at COP15 with input and outcome summaries provided by PESC participants. The International Union for Conservation of Nature (IUCN) Invasive Species Specialist Group (ISSG) was further called upon to ensure a global platform for sharing data and information, continuing compiling policy response indicators and calling states, organisations and experts to support the Global Register of Introduced and Invasive Species (GRIIS). In addition to the GBF, COP15 approved a series of related agreements on its implementation, including a resource mobilisation plan and requesting the Global Environment Facility to establish, as soon as possible, a Special Trust Fund (GBF Fund) to support implementation — for which PICTs would be eligible to apply.

Lastly, it was determined at the inaugural PESC that another similarly-themed conference was desired and that two years would be a suitable interval to allow sufficient time for implementing Strategic Action Plans to the extent that they could be reviewed and refreshed. Additionally, it was recognised that rodents are a significant and comparable invasive species issue within the Pacific. As rodents have already received considerable attention over the past few decades, with many successful eradications achieved on islands and subsequent ecological recoveries (Russell and Holmes 2015), as well as other conferences dedicated to rodent management, this topic was not included as a priority for the first conference. However, it is envisaged that future PESCs will incorporate vertebrate biosecurity and management.

There are numerous sustainability issues in the Pacific Region, such as invasive species and climate change, that cannot be effectively dealt with by individual jurisdictions. Indeed, the 2050 Strategy for the Blue Pacific Continent, endorsed by Pacific Island leaders in 2022, specifically reinforced the commitment to working as a regional collective in pursuit of sustainability, resilience and security (Pacific Islands Forum Secretariat 2022). The PESC brought together international and multidisciplinary participants to foster collaborative networks and increase action on invasive species in the region. It is now up to all jurisdictions and interested parties (i.e. funders, researchers, managers) to rise to the challenge and initiate on-the-ground actions and progress that utilise the Strategic Action Plans. Nevertheless, much more work remains to be initiated. We anticipate that the PESC will grow to be the premier regional conference addressing the interplay of invasive species with other critical factors affecting the sustainability of environments and peoples of the Pacific.

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Additional information

Conflict of interest

The authors have declared that no competing interests exist.

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Data availability

The datasets generated during and/or analysed during the current study are available from the corresponding author on reasonable request.

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Supplementary material 1

Supplementary data

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Data type: docx

Explanation note: **table S1.** Details of exotic ant incursions found within Australia since 2000. Information sourced from Department of Agriculture, Fisheries and Forestry Consultative Committees Secretariat). **table S2.** Number of PICTs in the three Pacific Regions relative to their completion of highest priority Actions for invasive ant biosecurity. **table S3.** Number of PICTs in the three Pacific Regions relative to their need for personnel assistance to complete highest priority Actions for invasive ant biosecurity. **table S4.** Number of PICTs in the three Pacific Regions relative to their need for financial assistance to complete highest priority Actions for invasive ant biosecurity. **table S5.** Mean scores of PICT responses to questions about CRB biosecurity. PICTs were divided into the three categories, being those having a recent damaging CRB outbreak (Outbreak), those where CRB has been established for a long period > 50 years (Established) and those yet to be infested by CRB (CRB-Free). Responses were provided using a five-point scale of increasing knowledge, preparation, resources and/or self-ability: 0 = No/nothing; 1 = almost nothing; 2 = partly; 3 = moderately so; 4 = yes/fully/completed.

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