Journal for Nature Conservation 18 (2010) 135–141

Contents lists available at ScienceDirect

Journal for Nature Conservation

journal homepage: www.elsevier.de/jnc

A successful model from Hawaii for rapid response to invasive species

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ARTICLE INFO

Article history:
Received 11 February 2009
Accepted 1 July 2009

Keywords:
Biosecurity
Eradication
Invasive-species committees
Partnerships
Pest-control

SUMMARY

We outline a functional management model for the eradication of incipient populations of invasive species that avoids reliance on official governmental response. This model involves formation of informal multi-partner committees that utilise outside funding to achieve pest-management goals. We describe why such a system was needed in Hawaii, how it is structured, how it operates, its achievements, and its advantages and limitations. Fragmented and incomplete governmental authorities are currently the rule for invasive-species management in many parts of the world and typically lead to non-response or an ineffective response. The model we describe serves the useful function of allowing eradication of incipient pests to proceed while comprehensive biosecurity programs are devised through more traditional governmental channels.

Introduction to general problem

Invasive species are major vehicles of ecological alteration, and in many parts of the world – in particular, on oceanic islands – they easily comprise the greatest current threat to native species persistence (Baret et al. 2006; Pimentel 2002; Ziegler 2002). Indeed, in some of these regions, the influx of invasive plants and their ungulate and avian enablers is so great as to blur the distinction between the disturbance categories of "habitat alteration" and "invasive species".

In responding to this threat, it has long been recognised that management can best focus on different aspects of the sequential invasion process: preventing introductions from occurring; detecting incursions at an early stage; and rapidly eradicating them, and/or mitigating the worst effects of well-established invasives (Hobbs & Humphries 1995; Hulme 2006). The first of these can involve screening systems to exclude deliberate importation of species most likely to become invasive, pre-export screening for pests of products intended for import, and/or port-of-entry screening of products thought or known to be at high risk for harbouring pests (Andow 2003; Bomford & Hart 1998; Daehler et al. 2004; Gratz et al. 2000; Pheloung et al. 1999). Rapid-response programs should ideally involve systematic attempts to detect new pest incursions, followed by programs to eradicate (or at least contain) the worst pests so detected (Anderson 2005; Timmis & Braithwaite 2002; Westbrooks et al. 2000). Long-term mitigation is usually focused only on areas having especially high values needing protection (e.g., national parks, wildlife sanctuaries, productive agricultural lands), but will sometimes involve attempts to control a species over much of its invaded range via use of biocontrol organisms (P.A. Rejmánek & Pitcairn 2002; Williams 1997).

A comprehensive program incorporating all of these management facets is often referred to as a "biosecurity" program, but, to date, such comprehensive response to invasive species has only been attempted in a few jurisdictions, such as Australia, New Zealand and Galapagos (Biosecurity New Zealand: http://www.biosecurity.govt.nz/; Australian Biosecurity System for Primary Production and the Environment: http://www.daff.gov.au/animal-plant-health/pests-diseases-weeds/biosecurity/ausbiosec; Galapagos Inspection and Quarantine System: http://www.galapagos.org/2008/index.php?id=110). In the few instances where such an approach has proven effective, two preconditions for success have been met. First, there was broad public and governmental support for such action, sufficient to countermand the desires of those industries and individuals seeking unregulated import; in New Zealand public support originated in the agricultural industry (Warren 2006). Second, governmental responsibility for biosecurity was sufficiently centralised that effective management response could be achieved.

In most jurisdictions (e.g., the United States, China), public and governmental support for responding to invasive species is divided, because strong economic forces and private desires, which are satisfied by a non-responsive status quo (e.g., Ding et al. 2008; Li et al. 2007; Margolis et al. 2005), work to limit governmental action. As well, for some of these jurisdictions, even if public and governmental support were to become more favourable toward stemming biotic invasions, governmental authorities are woefully diffuse. For example, in the United States

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doi:10.1016/j.jnc.2009.07.001

federal government alone, approximately 35–40 agencies have some form of responsibility for invasives management (National Invasive Species Council 2005; C. Dionigi, National Invasive Species Council, pers. comm.). Individual states, counties, and municipalities may contribute additional layers of bureaucracy to this total. This bewilderment of authorities scattered among agencies makes it easy for modest public or governmental opposition to invasive-species control to succeed in maintaining the inertia of inaction. As a result, the United States (and, no doubt, many other jurisdictions) has had a difficult time making progress against the rising tide of invasive species threatening its economy and ecosystems.

In Hawaii, there has been considerable progress in circumventing some of the jurisdictional limitations endemic to the US governmental structure through the development of early detection/rapid-response programs in a series of "Invasive Species Committees" (ISCs). We discuss this ISC model here in the hopes that it may prove useful for other jurisdictions caught in labyrinths of divided authorities, similar to those that characterise American governmental structures.

Management limitations in Hawaii

Hawaii has the largest problem with invasive alien species of any state in the United States, with at least 5311 alien species already established (Eldredge 2006), of which approximately 300–500 are estimated to be invasive, that is, spreading widely and causing significant environmental or economic damage (Loope & Kraus in press). The current introduction rate is approximately 50,000 times the natural background rate, and an average 89 additional alien species were documented to be established in Hawaii each year from 1995–2003 (Loope & Kraus in press). As in many other jurisdictions, the available evidence suggests that the rate of introduction has been rising approximately exponentially over the past several decades (e.g., Kraus 2002 for reptiles and amphibians). These invasions have resulted in extinction of hundreds of native species, endangerment of hundreds more, and large-scale replacement of native vegetation with alien plant communities (cf. Cox 1999; Hobdy 1993; Loope 1998; Stone & Scott 1985; Stone et al. 1992). Economic impacts have also been large and varied (Burnett et al. 2007; CGAPS 1996; Kaiser & Burnett 2006), but rarely measured. Similar damages occur throughout the United States (e.g., Cox 1999; Pimentel 2002), although few areas of the mainland are so heavily impacted by invasives as is Hawaii.

Historically, eradication of new invasive-species incursions has rarely occurred in Hawaii. State responsibilities toward alien invasions have largely been divided between two agencies, although neither has been tasked with a clear mandate to effect eradications generally, and neither has received a sufficient budget to do so in most circumstances. The Hawaii Department of Agriculture (HDOA), which has authority to prevent pest introductions, has in the past not viewed environmental pests as falling under its purview, and it generally lacked authority to operate outside port areas except with the cooperation of a landowner. This effectively limited the department to taking action primarily against agricultural pests, at least two of which (turmeric scale, *Aspidiella hartii*, and an unidentified *Heliconia* wilt) were successfully eradicated (Heu 2004).

The Hawaii Department of Land and Natural Resources is responsible for managing native wildlife and many public, largely upland, forests. It is often pressured to control environmental pests on its lands but has historically not had authority to conduct operations outside those lands. By the time pests reach those areas from the initial loci of invasion, they are so widespread that eradication is usually not an option. Thus, most environmental pests arriving in Hawaii have had an unchallenged opportunity for establishment in the wide jurisdictional gap existing between the ports of entry and the upland forests that serve as the respective foci of activity for these two agencies.

Particularly absent was any authority to compel invasive-species control on private lands, which comprise a majority of the state (Juvik et al. 1999) and the vast majority of new invasion sites. Absent a mandate, clear authorisation from the State Legislature, and adequate resources, agencies have been reluctant to undertake such efforts. Furthermore, as occurs over much of mainland United States (Goldstein 1992; Olson 1980), many landowners in Hawaii distrust government and are not inclined to invite agency staff onto their properties to engage in actions that they do not perceive to benefit them directly.

A further limitation is also common across the United States. As noted above, there are numerous governmental agencies with some involvement in alien-species management, but historically these have communicated and collaborated poorly. In Hawaii, relevant State agencies operated independently and were frequently distrustful of each other, and some relevant agencies denied any responsibility for or involvement with the invasive-species problem (Warren 2006). Federal agencies acted on their own lands but couldn't legally operate outside them. County governments were initially not engaged with the problem at all.

Because of difficulties in achieving agreement on goals and methods between agencies, lack of information sharing, and inefficiencies of scale, only the largest landowners could afford to tackle invasive-species problems by themselves. Effectively, this meant that the National Park Service and Hawaii's Department of Land and Natural Resources controlled some of the more obvious environmental pests on some of their lands, but these usually involved well-entrenched species of widespread distribution. Programs to detect and eradicate incipient populations of new alien species before they became irremediably established and widespread were lacking, even though such efforts were recognised in some circles (e.g., Hobbs & Humphries 1995) as being potentially very cost effective.

Invasive species committees (ISCs)

Structure

The model Hawaii developed to circumvent these assorted limitations involved forming informal, inter-agency partnerships to cooperate in identifying and eradicating several of the most-threatening incipient pests. The impetus for the formation of these partnerships was an initial joint effort begun on Maui in 1991 directed toward controlling *Miconia calvescens* DC, a highly invasive melastome tree from Central and South America that had devastated Tahiti's forests (Meyer 1996) and threatened to do the same if left unchallenged in Hawaii (Conant et al. 1997). This effort has helped contain that species ever since. The personnel involved on Maui were acutely aware that many other species required similar attention, so in December 1997 they expanded their efforts toward eradication of a wider diversity of pests thought to be incipient. Similar efforts were soon adopted on other islands. Each island-based partnership was referred to as an "invasive species committee"; hence, Maui Invasive Species Committee (or MISC), Oahu Invasive Species Committee (OISC), etc. Since 2001, ISCs have operated on all six of the main, non-privately held Hawaiian islands. MISC covers the sparsely populated island of Lanai as well as Maui and is the only ISC to cover more than one island.

The cooperative ISC model is based on the fundamental recognition that invasive species are a problem across landscapes

and that individual landowners cannot successfully defeat the problem if their neighbours are not also involved. These landowners include federal, state, and private entities, each bringing different sets of knowledge, skills, funding opportunities, and (sometimes) governmental authorities to bear on addressing a shared problem. Joint involvement of all relevant landowners places the entire geographic range of a targeted incipient species at risk, which is one requirement needed to successfully achieve eradication (Bomford & O'Brien 1995). By pooling efforts, landowners and managers can also achieve economies of scale and can afford specialised resources that would be unavailable to them as individuals. Finally, united, they can be more effective in lobbying for resources. As a result of this perspective, the intent is for each ISC to operate across all jurisdictions and land ownerships on an island, although all actions are subject to landowner approval.

The ISC structure consists first and foremost of a committee of interested parties, primarily interested individuals from Federal and State agencies and from private organisations, landowners, or business associations. Some of the invasive species committees have attempted to be very inclusive in their membership, actively soliciting participation from as many community groups as possible, while others have simply encouraged agencies/individuals to self-select, with emphasis on land-owning partners and management agencies. The committee elects from its membership a chair who presides over meetings and (usually) supervises the ISC manager (see below). The committees regularly meet to set general policy and action priorities, approve an annual work plan, and review progress in meeting goals. They also have raised the initial funding to hire staff. The committee generally reflects the needs and priorities of each island, but may also reflect State or Federal priorities, since these agencies are major funding sources. One result of this is that some species may be targeted as eradicable on one particular island even though they may be widespread elsewhere in the state. Indeed, experience elsewhere in the state is often a primary impetus for targeting a pest.

The actual pest-control work is carried out by the hired manager and staff of each ISC. Staff positions can vary between ISCs, depending on funding and project needs. The most basic configuration includes a manager to raise funds, set operational goals, hire and supervise staff, determine the budget, and deal with the public; a field leader; and a field crew of varying size (Fig 1). Most ISCs have added an office manager and a data manager to identify target sites and to maintain a GIS record of field operations. ISC's have typically added information officers to work with private landowners to obtain permission to enter properties, to keep the public informed of ISC activities, and to build broad community support. Often a second or third field leader and crew have been added, sometimes focusing on certain taxa because of their specialised control requirements. Some of the ISC's have incorporated volunteer labour into this structure as well.

None of the ISCs was formed with either bilateral or multilateral formal agreements among their membership organisations; consequently, none has a corporate identity that provides non-profit status, and so the ISC's themselves do not have the capacity to receive funds. The "business side" of ISC management (involving accounting, audits, payroll, workmen's compensation, and grant management and compliance) has been consolidated and mostly managed by the Pacific Cooperative Studies Unit (PCSU), an applied-research unit of the University of Hawaii Manoa, although other non-profit organisations have also assisted in fund management. Each ISC began with budgets in the low $100,000s; for the period FY05–FY09, budgets varied from $333,000–$2,604,000, depending on year and particular ISC. Averages across all ISCs varied from $660,000 in FY06 to $1,027,000 in FY08; averages across all five years varied from $487,000 for OISC to $1,787,000 for MISC. The budgetary average across years and ISCs during this period was $833,000.

Operations

Species targeted for control have largely been ecological pests because they were historically ignored in Hawai and were in greatest need of attention, but some ISCs have also assisted the Hawaii Department of Agriculture in controlling incipient agricultural pests, such as banana bunchy-top disease (*Babuvirus* sp.). As stated previously, targeted taxa vary for each ISC; as a result, required field operations also vary. Most targets have been invasive plants (85-95% of targeted taxa, with an equivalent percent devotion of funds), but a few vertebrates (frogs, parrots) have also been the focus of control efforts. Actions taken against

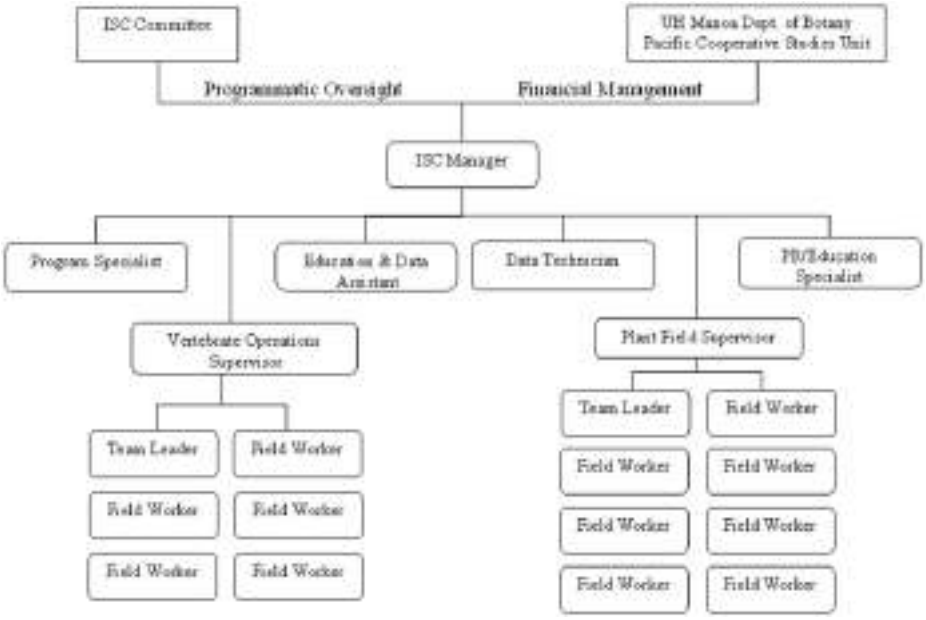

Fig 1. Generalised organisational chart for an ISC showing relationships among the original committee, fiscal management partner, manager, and assorted operational staff.

weeds have involved considerable survey and control work undertaken by ground crews, but the rugged terrain of most Hawaiian islands requires that some work be done by helicopter for species occupying remote or steep upland sites. Flight patterns for survey and control are tracked by GIS to ensure complete coverage of an area. Control actions are undertaken on lands under all types of ownership because of the need to cover all areas hosting incipient invasions. Access to private lands is directly negotiated with owners and is generally granted (~70–100% of landowners approached, depending on target species, island, and ownership). Most upland areas in Hawaii are in public ownership or in the hands of a few large private landowners. Most of these landowners are ISC members; consequently, access to upland properties is usually readily granted. The numerous small landholdings in the residential lowlands, however, make eradications in those areas more complicated because of the need to contact and obtain access approval from a much larger pool of landowners.

As the ISCs have grown in size and taxonomic scope of targets, some specialisation of tasks has occurred, with the most obvious example being the creation of small crews specialising on coqui frog (*Eleutherodactylus coqui* Thomas) control, because of the nocturnal schedule and different techniques required for controlling that species. Some of the ISCs have expended considerable effort informing the public of their goals and activities (8-20% of FY08 budget, mean 11%); this has resulted in a high level of public support for those activities, general landowner willingness to cooperate with ISC efforts, and successful solicitation of volunteer assistance. ISCs have also provided public testimony to the State Legislature, county governments, and US Senate on issues directly related to invasive species.

Table 1
Invasive species successfully eradicated from individual islands by ISCs.

Island	Species
Hawaii	*Cortaderia jubata* (Lemaire) Stapf
Kauai	*Senecio madagascariensis* Poir.
Lanai	*Cryptostegia* sp. R. Brown *Macaranga mappa* (Linnaeus) Muell.-Arg. *Senecio madagascariensis*
Maui	*Acacia retinoides* Schlechtendal *Enchylaena tomentosa* R. Brown *Macaranga mappa* *Melastoma candidum* D. Don *Melastoma sanguineum* Sims *Parkinsonia aculeata* Linnaeus *Rhodomyrtus tomentosa* (Ait.) Wight *Rubus ellipticus* Smith
Molokai	*Arundo donax* *Cortaderia jubata* *Cryptostegia madagascariensis** Bojer ex Dcne *Macaranga mappa* *Pennisetum setaceum* (Forsk.) Chiov. *Cyathea cooperi* (Hook. ex F. Muell.) Domin* *Ulex europaeus* Linnaeus*
Oahu	*Buddleja madagascariensis* Lamarck *Eleutherodactylus coqui*† *Miconia calvescens** *Morella faya* (Ait.) Wilbur* *Rubus ellipticus* *Senecio madagascariensis*

* All adults removed but a seed/spore bank or vegetative sprouts requiring continued follow-up treatment remain.†All naturalised populations eliminated but scattered individuals requiring removal constantly reintroduced via nursery trade.

Achievements

The success of the ISCs can be measured along two axes: the numbers of invasive species controlled or eradicated; and the amount of political support garnered. With respect to the first, it is always difficult to be certain that a species has been entirely eradicated, but evidence suggests that this goal has been met for one species on Kauai, six on Oahu, eight on Maui, seven on Molokai, three on Lanai, and one on Hawaii Island (Table 1). Some of the islands (e.g., Maui, Oahu) have also had success in eradicating populations from one or more of their constituent mountain ranges, although other populations persist elsewhere on the island. Several early target species have taken longer to control than anticipated because they were found to have much larger populations than initially estimated. But even in these instances populations have been severely depressed, and trends in numbers removed and control-hours invested suggest that future eradication, or at least narrow containment, will likely be achieved (Fig 2).

Some of these operations have been successful against extremely difficult-to-control species. *Miconia calvescens*, the original impetus that led to creation of the ISC model, is being successfully contained on Kauai, Oahu, and Maui. Complete eradication seems feasible on Kauai and Oahu, but strategic containment may be the only feasible goal on Maui and the island of Hawaii. Even that would be a considerable achievement for a species scattered over thousands of hectares, with hundreds of thousands of individuals, and for which each mature individual can produce millions of viable seeds in a single year (Meyer 1998). The same results may occur for coqui frogs, which have been eradicated from Oahu and Molokai, and are on the verge of eradication from Kauai. Coquis are expected to be eradicated from 12 of the 14 population centres on Maui, with a single population undergoing continued treatment, and one the site of repeat introductions. But the frogs are probably too widespread on the island of Hawaii for anything but local control without a sustained investment of tens of millions of dollars annually.

The ISCs successfully incorporate new information, allowing them to annually reassess and refocus priorities as needed. In some cases, it became apparent once "eradication" operations began that a number of initial target species – such as *Miconia calvescens* on Hawaii Island or *Arundo donax* Linnaeus on Maui – were already too well established to allow for successful island-wide eradication with available funding. As a result, ISCs have had to accept the need to abandon some early targets and adopt new ones or refocus efforts to protecting limited geographical areas. This experience has served to focus more attention on improved detection of species as early in the invasion process as possible. To this end, in 2000 on Maui, systematic roadside surveys for alien plants were conducted along *all* roads, with the goal of identifying new populations of known or likely invasives planted in adjacent yards before they would spread widely enough to be noticed by land managers (Loope et al. 2004). This program resulted in the discovery of 29 new island species records on Maui, all with extremely small populations; five of these have already been eradicated. With the evident success of this approach at identifying and targeting newly incipient invasions, the program was expanded to other islands in 2004 (Kauai), 2005 (Molokai), 2006 (Hawaii, Oahu), and 2007 (Lanai), resulting in the identification of new island records and the eradication of several island populations. Concomitant with this improved detection, by 2004–2006 the ISCs began increasing effort toward species more likely to prove eradicable because they numbered fewer than one hundred individuals, were present in only a single location, and were easily removed. Applying these more explicit and consistent criteria has increased eradication success and overall efficiency of ISC

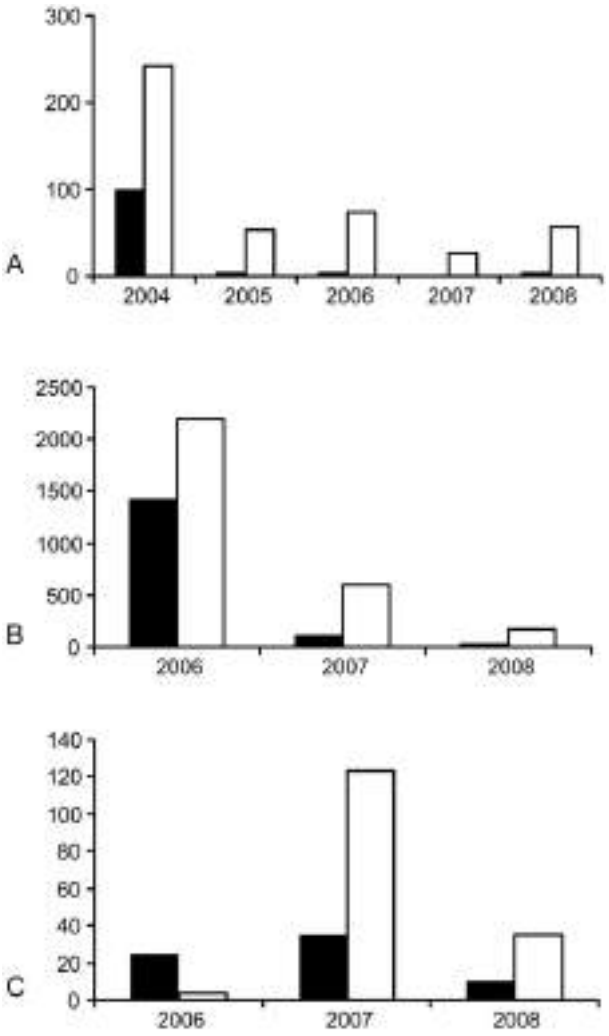

Fig 2. Example results from Molokai of pest-plant-control efforts showing rapid decline of populations with sustained treatment. Solid bars indicate mature, open bars immature, individuals. (A) *Phormium tenax* J.R. & G. Forst., (B) *Cryptostegia madagascariensis*, and (C) *Cyathea cooperi*.

activities. For example, five of eight plant species eradicated from Maui (Table 1) fall into this category, whereas all six of the originally targeted MISC plant species are still undergoing control operations.

The political achievements of the ISCs are also important. One measure of this success has been consistent State funding support for all the ISCs since 2002. The government of Maui County has been supportive with funding virtually since the Maui Invasive Species Committee's field team was first put in place in 1999. Funding or matching control efforts have also been obtained from other sources, including the US National Park Service, US Fish and Wildlife Service, US Forest Service, National Fish and Wildlife Foundation, Hawaii Department of Land and Natural Resources, and the counties of Kauai, Maui, and Oahu. This diversity of support for ISC goals and programs has been critical to their success in suppressing or eradicating targeted species.

Also critical to ISC success has been a proactive approach to keeping the general public, government officials, and agency personnel informed about the problem of invasive species in Hawaii and how ISC actions against incipient invasions help meet state needs to address this threat. These educational activities built on many years of prior efforts by a diversity of agencies and NGOs (Holt 1996; Loope & Kraus in press). Specific ISC efforts have involved publication of newspaper articles, submission of letters to editors, publication of ISC newsletters, public presentations, informational updates to legislators, provision of testimony at relevant legislative hearings, participation in statewide coalitions addressing invasive-species problems, and provision of information about ISC goals, activities, agendas, and meeting minutes on a centralised website (http://www.hawaiiinvasivespecies.org/iscs/). On Maui, additional public awareness has been garnered through less traditional means such as sponsoring innovative parade floats or invasive spear-fishing tournaments. It is the impression among ISC personnel that they have obtained improved land-access rates and heightened friendliness from landowners immediately following periods of television coverage, but these differences have not been quantified. An additional measure of public support is obtaining volunteer assistance from the broader community. As one example, OISC has obtained approximately 4 person-years of volunteer assistance since 2001.

Advantages

We believe the ISC model has proven effective in Hawaii for a number of reasons. First, because targets are jointly decided on by the central committee of each ISC, responsibility for success does not fall on any one participating agency. In any polity lacking comprehensive biosecurity legislation, this helps avoid the authority gaps that occur between agencies having limited jurisdictions because activities unauthorised for any one agency may be covered by another ISC partner, either public or private. Thus, different partners can help achieve shared goals by bringing to bear their organisation's own unique assets. This cooperative structure also avoids making response activities hostage to the particular political limitations that can characterise any single agency's internal focus and priorities.

Second, and central to gaining widespread access to private lands, use of an independent committee structure and non-agency workforce has allowed the ISCs to avoid much of the public distrust that inheres to government agencies. The frequent public fear that government access to land will be followed by government regulation of owners' activities is avoided by reliance on a non-governmental workforce. Public support and private-land access have probably also been high in large part because of ISC efforts to keep the media, public officials, and general public informed about their goals, activities, and achievements, and because of successful branding of the ISC image with identifiable logos. Success in this area is also helped by the fact that ISC staff have the time to persist with landowners, a luxury that many agency officials lack. On some islands, access to private lands has been granted at close to 100% of requests. This can vary depending on the targeted species, however, and Hawaii Island has proven more problematic inasmuch as it contains a larger contingent of absentee landowners who rarely respond to access requests, and growers of *Cannabis sativa* Linnaeus (who contribute a significant portion of that island's economy) rarely welcome access to their lands. ISC offers to replace targeted pests used for landscaping (e.g., *Cortaderia* Stapf spp.) with benign alternatives have also helped achieve high permission rates for removal of some species.

Third, the autonomous nature of the ISCs has served to keep political interference in their activities to a minimum, even though agency representatives participate on the central committees. Activities that could be easily redirected within a single agency are politically more difficult to derail when goals are jointly agreed upon by several different agencies and a variety of private interests. This has provided the programmatic stability necessary for ISCs to meet their eradication goals, which can require many years of focused activity to achieve.

A final advantage is that the ISC model, acting by virtue of prior governmental default in providing rapid-response, has forced a more citizen-oriented approach to solving this problem. In requiring the formation of widely based partnerships among a number of private and public organisations, the ISC approach wrests control away from traditional and often unresponsive governmental structures and disperses it among a broader range of interested parties. Even though individuals from government agencies participate on each of the committees, these representatives are invariably closely networked in their communities and more responsive to them than higher-echelon agency members might be. Decision-making is thus less removed from the community it is intended to serve than are more centrally decided agency actions.

These advantages have allowed the ISCs to attain their control/eradication achievements in a fairly cost-effective manner. The total budget for all ISCs in 2006 was $2,639,000 from State, Federal, and private sources combined. In contrast, all State and federal funding for alien-species activities for 2006 was estimated at $40.8 million, with another $6 million coming from county or non-governmental sources. Approximately $4.2 million of this total was for eradication programs, with another $24.3 million spent on control operations against more widely ranging species; total costs for pest control in Hawaii during 2006 were estimated at $153 million (DLNR 2007). Hence, ISC budgets comprise a small portion of pest-control expenditures in the state. With this money they have achieved 26 island-wide eradications since the first ISC control operations were initiated in 1999 (Table 1); two of these (*Acacia retinoides* Schlechtendal, *Enchylaena tomentosa* R. Brown) currently appear to be statewide eradications. In comparison, in the 50 years since statehood, the State of Hawaii apparently eradicated only the two species of agricultural pests mentioned earlier as well as Polynesian rats (*Rattus exulans* Peale) from Kure Island. Hawaii Department of Agriculture's program for plant pest and disease control received $11 million in FY08 and $10 million in FY09. By the standard of either number of eradications/dollar or prevention of future costs, the ISCs have demonstrated good value compared to other expenditures on alien-pest control in Hawaii.

Limitations/problems encountered

The ISC model has encountered limitations – some inherent to the model itself, and some common to all natural-resource management efforts. The major one is that, not being part of an agency, staff and programs necessarily rely on soft funding. Fortunately, the funding environment for invasive-species management has generally been favorable for much of the past decade, so ISCs were quickly successful in obtaining start-up funds and they have not suffered major funding cutbacks. However, this is currently (mid-2009) changing due to dire global economic conditions (true as well for agency positions in Hawaii).

Priorities within the State Legislature have occasionally redirected State funds away from ISC-identified priorities toward species having greater political cachet. This illustrates a more general issue: inherent in the ISC model is the potential for conflict in priorities between funders and the local members forming the committees. ISCs were explicitly formed to target incipient invasions, but these species are often unknown to most island residents or their elected representatives, who may apply pressure for ISCs to treat better-known invasives, for most of which eradication (or even containment) is not a viable option. As one example, this resulted in a 2006 legislative redirection of $2,000,000 away from the ISCs and toward "eradication" of coqui frogs (mostly on Hawaii Island), even though State agency officials had determined that the amount of money provided was approximately two orders of magnitude insufficient to meet that goal.

One final issue is that the ISCs can only be as good as the legislative matrix within which they operate allows. In particular, absence in Hawaii of meaningful legislative or regulatory restrictions on most alien plant species means that the ISCs lack the ability to access land to eradicate known pests unless landowner cooperation is obtained. In several instances, incipient populations of known pests that could readily be eradicated are instead allowed to spread because of a lack of any legal basis to compel access for eradication. This problem proves as frustrating for interagency partnerships like the ISCs as it does for regular government agencies, and it is a reflection that the ISC model ideally is not an end goal but an innovative approach to address certain management gaps until Hawaii develops and implements a comprehensive biosecurity system.

Conclusions

In providing meaningful protection from invasive alien species, a jurisdiction must have successful programs focused on preventing new incursions, rapidly identifying and eradicating new incursions of known or likely pests, and sustaining control of well-established pests, even if the last element is focused on limited areas of especial ecological or economic importance (Hobbs & Humphries 1995). Prevention and rapid-response programs are poorly developed in the United States and in many other countries. Hawaii has made some progress lately toward improving its prevention programs (Loope & Kraus in press), and we argue here that it has developed a useful rapid-response model as well. We do not mean to argue that such a model should supercede a comprehensive biosecurity approach such as has been developed in New Zealand (Williams 2000); however, most countries (or individual states within the United States) are unlikely to meet that standard in the foreseeable future. Instead, for these jurisdictions the ISC model might be a useful management option, filling a dire need created by the jurisdictional chaos typifying many of these countries' approaches to invasive species.

Needed to achieve this are simply (1) political will among middle- or lower-level agency staff and concerned private interests to work together toward shared goals, and (2) funding to get the programs off the ground. Neither requires direct engagement by legislators or higher administrative officials, although tolerance by the latter for such an approach is helpful. This means that effective rapid-response programs can be implemented before upper governmental strata have become fully engaged, a political process that is traditionally a slow one.

In our limited experience of conditions outside of Hawaii, the benefits of adopting an ISC model are apparent. For example, southern Florida is currently suffering a rash of incipient vertebrate invasions, several of which appear liable to successful eradication if agencies had available a mechanism for routinely working together toward meeting such goals. Currently, cooperation on that front seems desired by many agency personnel but the cooperative organisational structure and attendant change to problem-solving routines seem to be lagging behind the desire. Similarly, post-Olympics Beijing, China faces the potential that species introduced for the games may prove invasive (Ding et al. 2008), but the multitude of local, national, and agricultural interests do not currently appear capable of mounting a coordinated and effective response – a situation typified by the arrival and spread of the red imported fire ant, *Solenopsis invicta* Buren (Zhang et al., 2007).

This is not to say that the ISC model will be required everywhere. In those jurisdictions having only one or two important political actors (e.g., Galapagos), a multi-agency

partnership will be unnecessary. Nonetheless, the same requirement for working outside one's own institutional boundaries will be necessary. In the absence of legislation assigning rapid-response responsibility to a single agency, the ISC model provides a reasonable and successful means of helping to fill that lacuna.

Acknowledgements

We thank Lori Buchanen, Keren Gundersen, Julie Leialoha, Rachel Neville, Zeada Pachecano, and Teya Penniman for generously providing data on ISC accomplishments and funding; Chris Buddenhagen and Randy G. Westbrooks for information; and Lloyd Loope and Teya Penniman for their helpful comments on the manuscript.

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