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Volunteer monitoring in biosecurity: An issues paper

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Summary

This paper considers issues associated with involving community volunteers in monitoring programs, particularly those established for biosecurity purposes. By reviewing existing literature on community volunteers, and particularly volunteer involvement in natural resource and environmental monitoring, the paper seeks to answer these questions:

- What is volunteer monitoring?
- What are the characteristics and motivations of volunteer monitors?
- How can the environment, agriculture and society benefit from volunteer monitoring programs?
- What factors limit the potential of these programs?
- How can these programs be successfully applied in a biosecurity context and is there an ideal model?
- What issues need to be addressed to help develop volunteer monitoring programs for biosecurity?

Volunteers provide unpaid help in the form of time, service or skills, usually through an organisation. Many volunteers in Australia and other nations participate in environment or natural resource monitoring programs. Volunteer programs vary greatly in design, and particularly in the roles volunteers play and how much involvement they have in designing as well as conducting programs.

Australian survey data indicate that people aged 35–74 years old are most likely to volunteer, as are people with higher incomes and higher formal educational qualifications. People working part-time tend to be more likely to volunteer than full-time workers or those who are not in the paid workforce. Retirees tend to spend more hours volunteering than working people. Most volunteers are attracted to volunteering through personal contacts and personal invitations. The main motivations identified for volunteering in the environmental context are:

- helping a cause
- social interaction
- improving skills
- learning about the environment
- general desire to care for the environment
- a desire to care for a particular place
- simple enjoyment in being active and outdoors.

Potential benefits of volunteer monitoring include:

- extending effort and resources—involving volunteers can greatly expand the monitoring efforts of paid staff, for example, by enabling program organisers to collect more data
- independent data collection—volunteer-collected data can have the advantage of being seen as independent of commercial considerations and not influenced by vested interests
- collecting additional incidental data—volunteer monitors may further knowledge and understanding by recording data and observations additional to those specified by the monitoring program
- empowering local communities and encouraging ownership and action—involving local volunteers can build their confidence and encourage them to take action to address any biosecurity issues identified
- building community skills, capacity and knowledge—by being involved, volunteers may develop skills and knowledge they can apply to other local environmental activities and can pass on to others
- incorporating local knowledge—involving volunteers can provide an opportunity for local, place-based knowledge to be incorporated into monitoring programs, with potential benefits for interpreting and applying data.

Potential costs, risks and constraints associated with involving volunteers in monitoring include:

- recruiting volunteers—this may require significant staff time and costs, particularly as demands for volunteers tend to be increasing faster than numbers of potential volunteers
- maintaining volunteer interest and commitment—maintaining volunteers' interest, providing them with opportunities for personal development, and giving feedback, are critical
- program design, support, coordination and funding—the monitoring model and process needs to be matched with the overall monitoring purpose, and the needs and aspirations of volunteers
- data validity, reliability and credibility issues—volunteer-collected data are sometimes viewed sceptically by professional scientists, and care needs to be taken to ensure data quality, particularly through effective volunteer training
- health, safety and insurance issues—organisations using volunteers have legal obligations under occupational health and safety legislation, and need to ensure they comply
- logistical issues—it may not be appropriate to use volunteers in some monitoring situations, particularly those involving difficult or dangerous environments or extreme weather or climatic conditions.

Previous biosecurity engagement work has developed guidelines for engaging community members, including community volunteers. While there is no ideal model suited to all circumstances, applying the community engagement guidelines and considering the issues identified in this paper will help develop and implement biosecurity volunteer monitoring programs. In appropriate circumstances, community volunteers can play a significant role, particularly in enhancing government biosecurity monitoring and surveillance activities.

1 Introduction

The agriculture, fisheries and forestry industries make a significant contribution to the Australian economy. In 2010, agricultural products accounted for 10.6 per cent of Australia's total exports, worth more than 30 billion Australian dollars (DFAT) 2011. Australia is internationally recognised as being free from many pests, weeds and diseases that affect other countries, a status that confers significant economic, environmental and community benefits to Australians and Australian primary industries. However, Australia has many pests, weeds and diseases that require monitoring and control.

The biosecurity challenge

Biosecurity is defined as the protection of the economy, environment and human health from the negative impacts associated with entry, establishment or spread of exotic pests (including weeds) and diseases (Beale et al. 2008).

Keeping Australia free from exotic pests, weeds and diseases that could harm its human or animal health, primary industries or environment is difficult and becoming harder. Preventing the expansion of existing threats is equally difficult. Population mobility, international trade, climate change and possible agriterrorism threats are factors increasing the likelihood of pests, weeds and diseases entering the country, becoming established and spreading. It is increasingly important to identify and address critical risks and find new opportunities to ensure Australia's favourable biosecurity status is protected.

Surveillance is crucial to biosecurity. A 2008 review of Australia's quarantine and biosecurity arrangements (the 'Beale Review'), found that while Australia has a strong biosecurity system that is frequently commended by other countries, there is a need for more surveillance and incident reporting (Beale et al. 2008). One suggestion made about how to achieve this was by enlisting the community to help address biosecurity issues and identify and report suspicious exotic pests, weeds and diseases. The Beale Review identified a need for better communication about biosecurity issues between the different levels of government, non-government organisations, and community groups (Beale et al. 2008).

A growing body of evidence suggests voluntary monitoring programs may be one way to improve monitoring and surveillance of biosecurity threats, and encourage community participation in biosecurity. In Australia, coordinated volunteer monitoring programs like Waterwatch, FrogWatch and Saltwatch have had significant community support over the past decade, as has the Landcare program (Dovers 2000). In the biosecurity arena, the Weed Watchers and Weed Spotters programs, which aim to prevent high risk environmental and agricultural weeds spreading, have also been well-supported by volunteers. Details of these and some other relevant Australian monitoring programs are given in Appendix A.

However, while there are many volunteer monitoring programs relevant to biosecurity, few have been evaluated for their effectiveness in reducing biosecurity threats or their longer-term community benefits. There is relatively little information about the role of volunteer monitoring programs in preventing new pests, weeds or diseases becoming established in Australia, or preventing existing them from spreading.

Key questions this paper addresses

This paper explores the role community-based volunteer monitoring could play in improving biosecurity outcomes, and examines issues associated with volunteer monitoring of biosecurity threats. It draws mainly on information from volunteer monitoring experiences in the natural resource and environmental management context, and includes international and Australian examples. In particular, the paper seeks to address the following key questions:

- What is volunteer monitoring?
- What are the characteristics and motivations of volunteer monitors?
- How can the environment, agriculture and society benefit from volunteer monitoring programs?
- What factors limit the potential of volunteer monitoring programs?
- How can volunteer monitoring programs be successfully applied in a biosecurity context?
- What potential significance do volunteer monitoring programs have for biosecurity?
- What issues need to be addressed to help develop volunteer monitoring programs for biosecurity?

2 Definitions of volunteer monitoring

What is a volunteer?

The Australian Bureau of Statistics (ABS) defines a volunteer as 'someone who … willingly [gives] unpaid help, in the form of time, service or skills, through an organisation or group' (ABS 2010: 3). Volunteers can contribute to a range of services needed by the community or governments across sectors, such as health, welfare, sport and recreation, education and the environment. Their work often has a public good aspect.

Other studies make a distinction between organised and 'unorganised' volunteering (Ironmonger 2011, 2008, 2002). As with the ABS, these studies define organised volunteering as volunteering efforts that are mediated through an organisation or group. Unorganised volunteering is the informal volunteering that occurs within personal networks of families, friends, neighbours and acquaintances, without needing an intermediary organisation.

The economic value of volunteering

Attempts have been made to put a dollar value on the contribution volunteers make to society. One approach is to value the time spent in an unpaid activity, like volunteering, in terms of the value or costs of a comparable market wage. For example, a recently published study of the economic value of organised and unorganised volunteering in South Australia estimates that the work of volunteers contributes more than $4.89 billion annually to the state's economy (Ironmonger 2011). This is equivalent to 107 400 full-time jobs across the state. The value of volunteering in South Australia more than doubled from 1992 to 2006. A similar study in Queensland estimated that volunteering was worth $13.4 billion to the Queensland economy in 2006, equivalent to 299 000 full-time jobs (Ironmonger 2008).

These are very considerable contributions to state economies, and indicate the scale and value of volunteering in Australia as a whole.

Volunteers in environmental and natural resource management

This report focuses on situations where volunteer monitoring contributes to understanding and effectively managing the environment or natural resources. Monitoring may focus on, for example, air or water quality, or the distribution, abundance or behaviour of particular plants or animals—in aquatic or terrestrial environments. Volunteers can monitor 'dolphins to dung beetles' (White 1995: 25). Voluntary activities by community members can complement formal research by paid professional scientists, and monitoring and management activities of landowners, government agencies and others with direct responsibility for the environment or resources.

Terms used to describe voluntary monitoring in the resource and environmental management fields are provided in Table 1.

Table 1 Definitions of voluntary community-based science, monitoring and management activities

Volunteer monitoring	Unpaid people, usually locals, monitor a range of attributes of a local environment, such as air, land or water quality, plant or animal species, weather and climate
Voluntary biological, biodiversity or conservation monitoring	Unpaid people collect data about spatial or temporal distribution of species, species diversity, abundance or habitats (Lawrence 2005; Berkes 2004)
Citizen science, community science or civic science	Individuals or communities conduct research or monitor in the interests of science and the public. The research or monitoring may be conducted in whole or in part by amateur scientists rather than paid professionals (Irwin 1995; Trumbull et al. 1999; Fischer 2000; Carr 2004; Bäckstrand 2003; Colvin 2002; Silvertown 2009; Cohn 2008; Brossard et al. 2005)
Community monitoring/community-based monitoring	Community members initiate, design and plan projects, and collect, analyse and/or interpret data, often for natural resource or environmental management purposes (Berkes et al. 2007; Environment Canada 2003; Kellert et al. 2000)
Community-based natural resource management	Local communities have a major role in decision-making and action in this bottom-up approach to natural resource management. A key assumption is that locals are often better placed to manage natural resources than people based elsewhere (Agrawal & Gibson 1999; Kellert et al. 2000; Borrini-Feyerabend et al. 2000; Aslin et al. 2009)

Common features of volunteer monitoring in environmental and natural resource management

As can be seen from Table 1, volunteer monitoring is a type of citizen, community or civic science activity, or a subset of broader community-based natural resource management. While volunteer monitoring can take many forms, the activities share some common features:

- volunteer monitors contribute to environmental research—although other fields draw upon volunteer monitors, volunteer monitoring programs typically involve observations of nature, wildlife and natural resources for environmental restoration, conservation or protection purposes [Carr 2004; Cohn 2008; Conservation Council of Western Australia (CCWA) 2009
- volunteer monitors are unpaid—participants receive minimal or no payment for their contributions (CCWA 2009; Carr 2004). However, community groups may independently raise funds for volunteer monitoring programs, programs may have a paid facilitator, and volunteers may receive reimbursement for costs they incur in monitoring (for example, travel costs)
- volunteer monitors often operate through partnerships or collaborations—these partnerships may be with government agencies, museums, universities, other research organisations, or non-government organisations (Carr 2004; Cohn 2008).

Roles of volunteer monitors in environmental and natural resource management

Organisationally, partnerships or collaborations that involve volunteer monitors vary according to whether the approach is top-down or scientist-directed, or bottom-up or more community-based (Ely 2008). The nature and form of the partnership largely determines what role or roles volunteers can play. Table 2 shows questions that can be asked to assess the extent to which communities and community volunteers 'own' or control the research or monitoring programs in which they are involved.

Table 2 Community-based research and monitoring approaches

Function	**Model**		
Who does the task?	**Community workers**	**Consulting**	**Participatory**
Who defines the problem?	Professionals/scientists	Community	Community
Who designs the study?	Professionals/scientists	Professionals/scientists	Community
Who collects data?	Community	Professionals/scientists	Community
Who interprets data?	Professionals/scientists	Professionals/scientists	Community
Who communicates results?	Professionals/scientists	Professionals/scientists	Community
Who takes action?	Professionals/scientists	Professionals/scientists	Community

Note: After Wilderman and Ely 2008

How these approaches are classified owes much to Arnstein (1969) and her 'ladder of citizen participation'. In the case of volunteer monitoring, approaches could be said to vary from top-down to bottom up. In a top down or expert-led approach, volunteers are told what to do by scientists or government staff and merely collect data according to instructions (Arnstein's 'being informed'). A bottom up approach involves volunteers in all stages of monitoring, from defining problems to acting on results (Arnstein's 'being engaged').

Ely (2008) considers that, in reality, the role of volunteers in monitoring is often limited to collecting data. Broadening volunteers' roles to include formulating problems, designing studies, analysing and interpreting data, and taking action, provides more opportunities for volunteers to apply their local knowledge (Wilderman 2007).

The nature of the problem being investigated will influence the role of volunteer monitors. However, some volunteering programs effectively incorporate the strengths of a range of approaches to a particular problem. One example is the Florida LAKEWATCH program discussed by Ely (2008). In this case, participating lake associations use the data collected by volunteers to manage individual lakes, while the University of Florida uses the LAKEWATCH database to answer other scientific questions.

Some volunteer projects have also been able to shift between different approaches, including going from government-initiated to community-run, or vice versa. For example, the Alliance for Aquatic Resource Monitoring (ALLARM) program began in Pennsylvania in 2002–03 as a government-initiated community monitoring program, but later became a community-owned project (Stenekes & Sahlqvist 2009).

A case study of an Australian biosecurity project that relied heavily on volunteer monitoring is provided in Box 1.

Box 1 Volunteer monitoring in action—red imported fire ant project, Brisbane, 2002–2006

This case study of the red imported fire ant project draws on interviews in 2010 with Marion Lawie and Wayne Roberts from the Queensland Department of Employment, Economic Development and Innovation.

Project background
Following an outbreak of the red imported fire ant in 2001, the then Queensland Department of Primary Industries established a network of community-based groups to conduct surveillance and awareness-raising activities. Participants were recruited from environmental groups, service groups and networks in greater Brisbane. The project was based on the Neighbourhood Watch concept of 'protecting your patch'.

Project goals and activities
The project goals were to recruit volunteers to:
—monitor and survey parks, reserves and other areas for fire ants
—raise community awareness of fire ants, including the threat they pose to the environment and people
—champion the eradication project.

How the project worked
—The department recruited volunteers from existing community-based networks, for example Lions Club, Landcare groups and garden clubs.
—Volunteers received general training that included identifying fire ants and nests, surveillance techniques, sampling, code of ethics, and workplace health and safety.
—Volunteers received specific ant identification training from a qualified entomologist in a laboratory setting.
—Departmental community engagement officers provided the groups with administrative support.
—Participants decided the location and timing of surveillance events (usually monthly), and which community events to attend to help raise awareness of the threat.
—Groups surveyed and collected ant samples so the department could verify their identity.
—The groups participated in promoting awareness of the fire ant threat by attending local shows, field days and events; delivering presentations at schools; displaying fire ant awareness and volunteer ranger identification stickers on their cars, mailboxes or windows; wearing red fire ant shirts when carrying out surveillance or awareness-raising activities; and helping departmental staff deliver communication materials, for example, addressing and posting fliers and brochures.
—Volunteers were reimbursed for travel costs to events where they promoted the eradication project.
—Volunteers were recognised and rewarded for their efforts through awards and annual events.

Project successes
—Although the network was mostly used to confirm absence, in one instance volunteers detected a new fire ant incursion.
—Collecting high quality data over large areas helped satisfy reporting requirements. Volunteers were well-trained and successfully identified the target species.
—The project expanded the department's ability to respond to incursions. Many volunteers from the fire ant project helped contain the equine influenza outbreak and the Mexican feather grass incursion.
—Volunteers greatly extended information exchange by attending events, and through personal networks.

Departmental staff reported being sustained by the enthusiasm and commitment of volunteers. By 2006, their activities had reduced infestations in Brisbane. The groups were disbanded at this time, with volunteers invited to join a volunteer register. The department used the register to continue work with individuals on the eradication and other invasive species projects.

Program considerations and limitations
Fire ants were an easy pest to engage volunteer interest. This was due to the visibility, danger to human health and relative unattractiveness of the pest. Pests that do not pose a threat to humans may attract less interest.

Volunteer retention can be difficult. Many full-time workers withdrew because they were unable to devote the hours required. Surveillance in hot weather or uneven terrain posed difficulties for some elderly volunteers.

Two-way information flow is critical and can take time. Volunteers appreciate feedback, and like to be able to ringand 'have a chat' and understand what impact their contribution has made. Volunteers also need to be kept up-to-date with progress and developments to avoid 'telling an old story'.

This form of monitoring worked well in an urban, densely-populated environment. A project like this may be more difficult to organise in rural residential or rural areas with a smaller pool of potential volunteers and larger geographical scope.

3 Characteristics and motivations of volunteer monitors

While almost anyone can participate in a volunteer monitoring program, the motivations, interests and abilities of individuals will influence whether or not they want to participate and, if so, in what way. This chapter examines the characteristics and motivations of volunteers generally and of volunteers in natural resource and environmental management specifically.

Socio-demographic characteristics

An ABS Australia-wide survey on voluntary work (ABS 2010) found that 6.1 million (36 per cent) of Australians aged 18 years and over had participated in voluntary work. The survey revealed the following characteristics of volunteers and volunteering across all sectors:

- a slightly higher proportion of women than men tended to volunteer—38 per cent of women and 34 per cent of men had volunteered in the previous 12 months
- people in the middle age and early retirees groups (35–74 years old), were most likely to volunteer—couples with dependent children had the highest participation rate (55 per cent) reflecting their family commitments (for example, volunteering at their children's schools or sporting activities)
- volunteering was more common in areas outside capital cities—the rate was 34 per cent for capital cities overall and 41 per cent for areas outside capital cities
- people employed part-time were more likely to volunteer than those employed full-time, unemployed, or not in the labour force—44 per cent of part-time workers were volunteers, 38 per cent of full-time workers, 20 per cent of the unemployed, and 31 per cent of people not in the labour force.

Volunteer-related ABS data from previous years (ABS 2006) provide further insights:

- retirees tend to spend more hours a week volunteering than people in the workforce—retired men did on average 5.9 hours of voluntary work a week and retired women 3.5 hours
- educational status is related to volunteering rates—43 per cent of people studying volunteered and 45 percent of people with a diploma/advanced diploma, bachelor degree or higher qualification, while those not engaged in study or with lower levels of formal education tended not to volunteer
- income was correlates with volunteering—people earning higher incomes tended to have higher volunteering rates
- almost two-thirds of those who had volunteered in the past ten years did so because they had been asked by someone (35 per cent), or because they knew someone else involved in voluntary work (29 per cent). Recruitment to volunteering is therefore very much via word of mouth and personal contacts.

The results from the ABS surveys are supported to some extent by the literature on volunteer monitoring in environmental and natural resource management. While volunteers engaged in environmental monitoring may be any age, from schoolchildren to retirees (Fitzpatrick et al. 2009), some case studies of volunteer monitors have noted particular demographic

characteristics. For example, demographic data collected in 1999 as part of a national birdwatching project in the United States found that volunteers tended to be from somewhat older age groups, with a median age of 49 years. Twenty-five per cent of these volunteers were over 65 (Trumbull et al. 1999). Of the volunteers monitoring the red imported fire ant in Brisbane, most were retirees and only two were under 30 (M Lawie, Manager, Community Engagement, Biosecurity Queensland Control Centre, Queensland Department of Employment, Economic Development and Innovation, 2010, pers. comm.).

As also reported in the ABS studies (ABS 2010, 2006), volunteering rates tend to be consistently associated with particular demographic characteristics. In Penner's (2004) United States study, the highest demographic correlations for volunteering were educational and income levels. This is also supported by Trumbull and colleagues (1999), who found that 70 per cent of the 375 volunteers in their study had at least a bachelor's degree.

Motivations

CSIRO researchers (Kelly et al. 2006; Measham & Barnett 2007) have identified six broad motivations underpinning environmental volunteering, based on reviewing the literature and interviews with volunteers and their coordinators:

- helping a cause
- social interaction
- improving skills
- learning about the environment
- general desire to care for the environment
- desire to care for a particular place.

Similarly, other research has identified a sense of satisfaction from contributing to science and protecting the environment as a key motivation for volunteer environmental monitors (Cohn 2008; Fitzpatrick et al. 2009).

Volunteers in New Zealand Department of Conservation projects have been the subject of several studies, including Bayliss in 2000 and Cosslett in 1997 (Bell 2003), and Johnson and Wouters (2008). These studies found that the main motivations for these volunteers were:

- enjoyment, recreation (the opportunity to spend time in attractive outdoor settings) or personal interest in experiencing the environment
- personal concern for the environment or conservation
- desire to improve the environment for the future so that future generations can enjoy it
- desire to improve an amenity that they do not currently use, but may wish to use in the future, or that they would like others to have the opportunity to use
- a chance to learn new skills and increase personal knowledge and awareness
- to help the department achieve its objectives

- to contribute to the community where they live, work, and play (to give something back)
- for work experience for career or study
- to keep mentally stimulated and physically fit
- a sense of achievement
- to make people aware of conservation issues and teach others about conservation
- to socialise, meet people with the same interests, develop a sense of group identity, for companionship.

In relation to the first point, Trumbull and colleagues (1999) also found that many birdwatchers participated in monitoring projects simply because it was fun. This was supported in the red imported fire ant project, where volunteers reported they really enjoyed being outside while monitoring (M Lawie 2010, pers. comm.).

Research also suggests that volunteers who find participation in one volunteer monitoring program rewarding may be more likely to commit to similar projects. A mammal monitoring project undertaken in Oxfordshire in the United Kingdom found that approximately 30 per cent of the volunteers subsequently joined related conservation groups, including the British Trust for Conservation Volunteers and the Mammal Society (Newman et al. 2003). Similarly, volunteers involved in the Brisbane fire ant project helped combat later incursions of different pests.

Allowing networks of volunteers to expand their activities from focusing on monitoring for just one specific pest (for example, the fire ant) to monitoring for several (for example, looking for several insect pest species), can significantly increase social capital related to biodiversity and enhance the potential for community action.

4 Benefits of volunteer monitoring

The actual or potential benefits of volunteer monitoring programs to individuals, society and the environment have been widely discussed. Benefits to agriculture are considered less often, partly because private rather than public interests tend to be involved in agriculture and agricultural production issues. This chapter summarises general benefits of volunteer monitoring identified in the literature.

Extending effort and resources

Studies indicate that volunteer monitoring programs can extend monitoring efforts well beyond those paid professionals can provide (Goffredo et al. 2009; Kadoya & Washitani 2007). Involving volunteers can increase the numbers of monitors, numbers of monitoring sites or overall area covered, frequency with which data are collected, or the duration of monitoring.

Short-term funding cycles and resource constraints often limit opportunities, especially when long-term monitoring is essential to measure outcomes of natural resource management programs or to detect long-term trends in resource condition. By supplementing the efforts of paid staff, volunteer monitoring can be a cost-effective way to collect data that would otherwise be impossible to obtain with existing resources (Fitzpatrick et al. 2009). For example, data collected by volunteers have been used in modelling the potential distribution of invasive species (Kadoya et al. 2009). Thousands of community volunteers in Japan monitored areas for the presence or absence of the invasive bee, *Bombus terrestris*, to help develop a map of areas that should be regularly surveyed. The map helped ensure new bee populations were rapidly detected and existing infestations controlled. The study found that continuous participatory monitoring and follow-up population control was an extremely useful and cost-effective way to manage this invasive species.

Volunteer monitors have made substantial contributions in recording the diversity of bird species, distribution and numbers. For example, one of the ongoing projects run by the non-government organisation, BirdLife Australia (formerly Birds Australia), is the Atlas of Australian Birds and and Birdata. This atlas began in 1977, had more than 7000 volunteers contributing by 2012, and had incorporated more than 6 million bird records from volunteers by 2012. It is claimed to be the largest continent-wide survey of birds in the world (BirdLife Australia 2012). BirdLife Australia has also developed an online citizen scientist web portal that allows volunteers and others to access a range of data on Australian birds.

By increasing the intensity of monitoring efforts, enabling more sites or a larger area to be covered, or collecting data more frequently, volunteer monitoring activities can provide an early warning of change, allowing action to be taken in time to avert potential threats—of particular importance to biosecurity. Amateur naturalists and other citizens, partly because of their numbers, may be the first to discover a new invasive species is present in their local area. This was demonstrated in the red imported fire ant case study, in which a new incursion was found by a volunteer monitor (M Lawie 2010, pers. comm.).

Independent data collection

Data collected by volunteers often have the advantage of being largely independent of commercial considerations and free from the influence from vested interests. For example, in Western Australia, it is claimed that citizen science has played an important role in enabling

balanced assessments of information provided by development proponents or their consultants in environmental impact assessments (CCWA 2009).

Independence and perceived freedom from outside influence were important in the success of an ongoing government-funded Seagrass-Watch monitoring project in the Torres Strait. Now a global monitoring program, Seagrass-Watch originated in Australia in 1998 and has since extended to 26 countries. In a project conducted in Australia's Torres Strait, Seagrass-Watch trained students and community members to monitor their marine environment. Although scientists, government officials and rangers were involved, custodianship of the project rested with the local Indigenous community. Given their limited trust in government and suspicion of outside intervention, local ownership of the project was essential both to achieve wider community participation and project success (Mellors et al. 2008).

Collecting additional incidental data

Volunteer monitors may further scientific knowledge and understanding by recording incidental observations additional to those required by the monitoring program. A citizen science birdwatching project run by the Cornell Laboratory in the United States found that participants went beyond the research protocol to record further observations and propose explanations for the bird behaviour they observed (Trumbull et al. 1999). This may arise partly from the constant exposure of volunteers to, and keen interest in, their local environment, and hence a desire to understand what is going on.

Empowering local communities and encouraging ownership and action

Involving local volunteers in monitoring activities is likely to build their confidence and encourage them to take action to address any issues identified through monitoring. From an assessment of 104 published papers on environmental monitoring, Danielson and colleagues (2010) found that the extent to which local stakeholders were involved had a profound influence on the overall size of the area monitored, the number of monitoring sites, and how quickly action was taken on the basis of monitoring results. Involving local resource managers at a geographical scale matching their interests and knowledge allows them to identify what findings are significant to them and respond with appropriate local management solutions.

Other studies have found that volunteer monitoring efforts enhance a sense of community and promote a sense of place, both of which are likely to encourage community action (Gooch 2003; Curtin 2007).

Building community skills, capacity and knowledge

Volunteer monitoring programs can build the skills, capacity and knowledge of local communities and organisations. Carr (2004) found that unskilled, but interested, volunteers involved in monitoring water quality developed skills and knowledge that they could use in other local environmental and stewardship activities.

Community education is widely cited as a key benefit of volunteer monitoring (Trumbull et al. 1999; Cohn 2008; Braschler 2009). Involving volunteers in monitoring their own environment can help them develop an understanding of ecosystem function and local biodiversity that cannot be achieved in other ways.

An example is the Seagrass-Watch project in the Torres Strait Islander community (Mellors et al. 2008), which aimed to:

- educate and train participants in biological monitoring of marine plants, habitats and ecosystems
- involve individuals in community activities
- help interpret data collected.

This project increased community understanding and appreciation of the coastal environment; improved understanding of potential biosecurity threats; increased involvement in caring for the environment; and allowed data to be collected in areas that would otherwise be hard to monitor (Mellors et al. 2008).

Partnerships developed in volunteer monitoring programs can lead to the organisations and paid staff acquiring new skills and knowledge. They can provide an opportunity for scientists and other staff to better understand the broader political dimensions of their expert field and their professional practice (Carr 2004).

Incorporating local knowledge

Different stakeholders hold different kinds of knowledge because of their background, training and experience. Community members and volunteers can provide local knowledge derived from living in a particular place (Fischer 2000; Berkes et al. 2007). This knowledge can be invaluable at every stage of a monitoring program, from design to evaluation. Local knowledge can also greatly improve how scientific data about local environments are interpreted, and help identify what action should be taken on the basis of findings, how action should be taken, and who needs to be involved. Providing an opportunity for local knowledge to be incorporated into monitoring programs, and combined with other kinds of knowledge, can be a major advantage of volunteer monitoring programs.

5 Costs, risks and constraints to volunteer monitoring

While the voluntary sector is becoming increasingly significant and the range of programs involving volunteers is increasing, volunteer numbers may not be increasing at a comparable rate (Bussell & Forbes 2001). Also, the number of hours people spend volunteering has been decreasing over time (ABS 2006). This explains some of the difficulties recruiting volunteers when demand is already high.

Recruiting volunteers can involve significant staff time and expense. So it is important that the issues associated with utilising volunteers are well understood. For example, potential recruits tend to be people who know other volunteers or are already volunteering for other organisations or programs (Newman et al. 2003; M Lawie 2010, pers. comm.).

This chapter discusses costs and risks associated with involving volunteers and possible constraints on when volunteer monitoring programs can be used, and proposes ways of overcoming these limitations.

Maintaining volunteer interest and commitment

Chapter 3 addressed motivations for volunteering. Attracting volunteers and sustaining their commitment to monitoring programs can be challenging.

If volunteer monitoring programs are to continue, volunteers need meaningful, motivating roles and activities, and opportunities for personal development. Potential volunteers are unlikely to be attracted to programs unless they reflect their values, personal or career development opportunities, or social aspirations. Cosslett (2009) identified some disincentives to volunteers participating in the New Zealand Department of Conservation's programs, including:

- lack of a feeling of achievement
- lack of recognition of the importance of their work
- having an unexciting or monotonous environment.

Rewarding past participation may encourage continued participation in a volunteer program. Studies suggest giving volunteers feedback on their contributions and findings is an important reward and motivator for continuing (Silvertown 2009; Vos et al. 2000). Volunteers in the Brisbane fire ant incursion program appreciated knowing how their efforts made a difference.

Another issue identified in maintaining volunteer commitment is burnout (Johnston et al. 2006). The same people may be called upon to perform many voluntary roles simultaneously, particularly in small communities. This can lead to them becoming overcommitted and exhausted by the demands placed on them. The term burnout describes this psychological state and an inventory of questions has been developed to measure it (Maslach et al. 1996). If volunteers experience burnout, there is little alternative but to allow them to drop out, at least temporarily, and replace them if possible.

Program design, support, coordination and funding

As highlighted above, the success of volunteer monitoring programs depends largely on matching the volunteer monitoring model and process with the overall monitoring purpose and volunteers' needs and aspirations. For example, a community Landcare group that monitors changes in local weed cover and composition to plan and set management priorities may implement a very different program from that needed by a research organisation monitoring weed dispersal and spread. This highlights the importance of designing programs carefully with the end in mind.

Cuthill (2000) has emphasised the need to have an understanding of potential participants when designing volunteer programs. He argues for an approach that broadens the primary scientific focus of these programs to include greater consideration of participant motivations, skills and knowledge.

Inadequate institutional support and lack of direction can affect commitment to voluntary work. Bureaucratic processes and delays in making use of their findings, can affect the ongoing commitment of volunteers. This was recognised in the Brisbane fire ant incursion program, where staff responsiveness helped keep volunteers engaged (M Lawie 2010, pers. comm.). Penner (2004) also emphasises the importance of good relationships between the organisation managing the program and their volunteers, the nature of interactions between volunteers and the organisation, and the characteristics of the organisation and how it changes over time.

Inadequate program coordination or funding may also limit the potential of volunteer monitoring programs. Support from paid coordination or facilitation staff has been identified as a critical factor in the success of the Landcare movement (Curtis 2000). Lack of resources, insufficient supervision, poor coordination and technical support, and a lack of training or education opportunities have also been identified as challenges in the Waterwatch program [Department of the Environment and Heritage (DEH) 2004]. Stimulating interactions between citizens and scientists are often necessary to engage and maintain the interest of volunteer monitors and ensure that all parties adapt to change (Kadoya & Washitani 2007).

Data validity, reliability and credibility issues

It is often assumed that data collected by professional scientists or paid staff will be more reliable, accurate or valid than data collected by volunteers—and the quality of volunteer data is questioned. Some professional scientists and their organisations see data credibility as a key problem with volunteer monitoring programs (Stenekes & Sahlqvist 2009; Fitzpatrick et al. 2009; Mayfield et al. 2001). However, careful research design, reasonable expectations of volunteers, and good initial and follow-up training will help ensure volunteers collect valid and reliable data, and that the programs to which they contribute are credible (Cohn 2008; CCWA 2009).

Supporting the value of volunteer-collected data, Fore and colleagues (2001) compared the field and laboratory performance of professionals and volunteers in identifying macroinvertebrates from streams in the Seattle area of Washington State in the United States. Fore's team found no significant differences between two groups and concluded that properly-trained citizen volunteers can collect reliable data and usefully supplement the work of government agencies. Similarly, work at the Cornell Laboratory in the United States demonstrated that, with adequate training, volunteers could use sophisticated techniques and equipment. This included, for

example, monitoring air and water quality, observing and documenting animal migratory behaviour, and recording plant life cycles (Cohn 2008).

However, one concern about volunteers collecting data for biosecurity purposes is that inexperienced volunteers may be less likely to detect a species that is in low numbers and more likely to incorrectly identify species than are professional staff (Fitzpatrick et al. 2009). This may lead to less reliable information on low-density pest populations. This concern was partly supported by a 2007 evaluation of a volunteer monitoring project in Massachusetts in the United States that focused on the pathogenic tree insect, *Adeles tsugae* (Fitzpatrick et al. 2009). This evaluation found that volunteers were more likely to miss spotting *A. tsugae* on its hemlock host than were trained professional monitors. However, contrary to expectations, the research also found that volunteers were less likely to misidentify the insect than were professionals. So the volunteers' efforts had both strengths and weaknesses as compared with those of paid staff.

In programs requiring species identification, Lodge and colleagues (2006) highlight the need to have adequate taxonomic information, especially about insects during different parts of their life cycle. Without this information, training volunteers to identify species is difficult. Volunteers should also receive ongoing training or training updates. When surveyed after a follow-up training session, volunteers from the Weed Spotters program in Victoria's Goulburn–Broken Catchment stated the session had improved their skills and knowledge (McInerney 2007).

Many issues related to volunteer monitoring, including the need for adequate training and for careful program design, may also apply equally to fully-funded and professionally-staffed monitoring programs. Overall, the great advantage that much larger-scale data collection exercises may be possible because volunteers are involved always needs to be considered, even if some volunteer data need to be discarded.

Health, safety and insurance issues

Organisations using volunteers have legal obligations under occupational health and safety legislation in the jurisdictions where they operate. Both volunteers and employees are entitled to a safe and healthy working environment.

On 1 January 2012, new workplace health and safety laws came into force for the Commonwealth, New South Wales, Queensland, Australian Capital Territory and Northern Territory Governments. These laws apply to both volunteers and paid staff working for organisations within these jurisdictions. Safe Work Australia is the national policy body responsible for developing and evaluating model work health and safety laws adopted by these governments. Safe Work Australia has collaborated with Volunteering Australia on a volunteer assistance package involving a dedicated phone line, email address and webpage (Safe Work Australia 2012). The new legislation helps make occupational health and safety and workers compensation obligations more consistent across the nation.

Safe Work Australia provides fact sheets on its website about the rights and obligations of volunteer organisations and volunteers under the new workplace health and safety laws:

- How volunteer organisations can comply with the model Work Health and Safety Act
- Volunteer 'officers' and their duties under the model Work Health and Safety Act
- Volunteer organisations and the model Work Health and Safety Act
- Volunteers and the model Work Health and Safety Act.

Meeting workplace health and safety obligations in relation to volunteers requires:

- consulting and involving volunteers in meetings to discuss health and safety and raise awareness of issues
- identifying possible risks, people at risk, assessing risks and establishing priorities, and developing strategies to eliminate or minimise risks
- providing appropriate instruction, training and supervision for volunteers
- ensuring that emergency and first aid arrangements are in place
- providing support to any injured volunteers when they return to their roles (WorkSafe Victoria 2008).

Organisations using volunteers must ensure their insurance covers both their employees and volunteers for any work-related injury, illness or death. It may be necessary to take out separate insurance cover for volunteers.

Logistical issues

Practical issues may arise due to where volunteers live in relation to the resources or environment that needs monitoring, and the nature of the monitoring sites they need to visit.

A 2004 review of Waterwatch revealed that a key challenge was achieving the temporal and spatial requirements for a rigorous program. Some areas critical for monitoring could be in relatively remote or dangerous regions where volunteers would be at risk, for example, crocodile-infested rivers near Darwin (DEH 2004). It is also unreasonable to expect volunteers to travel long distances to monitoring sites, particularly on a regular basis, or to negotiate very difficult or dangerous terrain. If there are key sites like this that need to be monitored, it is probably best to leave them to paid staff.

Another logistical issue is the weather or climate in the monitoring area. Extreme cold, heat or humidity are likely to deter volunteers from monitoring, as are short-term climatic events like severe thunderstorms or heavy rainfall. Apart from the difficulty of collecting accurate data during these events, extreme weather can pose unacceptable risks to volunteers and they should be warned not to undertake monitoring under these conditions.

6 Applying volunteer monitoring to biosecurity

This chapter briefly considers the role volunteer monitoring could play in addressing biosecurity issues, provides guidelines for engaging the community in biosecurity, and considers program design and resourcing. There is no universally applicable ideal model, but there are issues to consider when designing and conducting volunteer programs.

Volunteer roles in biosecurity

Volunteers can make a significant contribution to biosecurity in addition to field-based monitoring. Volunteers can help with administration, awareness raising and championing current programs. Providing these other roles can be very important in allowing volunteers with varying experience, abilities, needs and preferences to all find a place in biosecurity programs.

For example, volunteers in the Brisbane fire ant eradication program carried out a range of activities, including surveillance, awareness raising and administrative duties. Role diversity helped attract a wide range of volunteers (M Lawie 2010, pers. comm.).

Guidelines for engaging community members in biosecurity

Kruger and colleagues (2010) provide general guidelines for engaging the community in biosecurity issues, including the need to:

- develop trust
- be responsive
- build relationships and networks
- involve community 'champions'
- promote a sense of community/place
- make it convenient
- 'piggy-back' biosecurity messages onto other relevant messages
- be committed to the process
- be accountable.

Considerations in designing and conducting volunteer monitoring programs for biosecurity

Other important considerations mentioned in studies on volunteer monitoring, and which need to be incorporated in programs for volunteer monitoring in biosecurity, are:

- monitoring programs should be designed with a level of scientific rigour appropriate to the purposes of data collection (ensure data are fit for purpose), and that it is appropriate to use volunteers to collect these data

- appropriate training for volunteers is important to ensure data quality and provide educational benefits for volunteers
- establishing partnerships with the community early on will foster local ownership
- two-way communication between volunteers and partner organisations is critical to ensure volunteers are well-informed and understand the value of their contribution
- community monitors are frequently motivated by environmental concerns; therefore, volunteer monitoring programs may work best for species or issues that pose a threat to the environment, rather than to primary industries
- programs need to reflect volunteers' personal values, needs and motivations in order to attract them initially and encourage them to remain involved
- volunteer monitoring programs may be of limited value where the areas to be monitored pose physical or logistical difficulties for volunteers; for example, areas that are large, remote, or dangerous. Similarly, difficult climatic or seasonal conditions may be a barrier to enlisting volunteers and conducting effective volunteer monitoring programs.

7 Discussion and further issues

This paper demonstrates that community monitoring programs can deliver significant benefits for resource managers, communities, the agricultural sector, and ultimately Australian society as a whole—in appropriate circumstances and with appropriate design. Because members of the public and potential volunteers greatly outnumber the scientists and government staff who often identify the need for monitoring, a significant opportunity exists to expand monitoring efforts by enlisting volunteers (Lodge et al. 2006).

This chapter summarises some potential benefits and costs of involving volunteers in biosecurity monitoring programs, raises some questions that may need answering to run effective volunteer monitoring programs like this, and provides a brief concluding summary.

Potential benefits of involving volunteer monitors in biosecurity

Key benefits of volunteer monitoring for biosecurity purposes identified in this paper include:

- providing a cost-effective means to expand surveillance of biosecurity threats to identify new incursions of pests or diseases, or provide evidence of their absence
- increasing community understanding of the science and scientific processes associated with biosecurity, and building community capacity in relation to this scientific knowledge
- providing opportunities for the community to contribute local knowledge relevant to biosecurity and to add to scientific or expert-based knowledge
- independence of data collection
- incidental data collection
- improving relationships and understanding between community, researchers and government that may extend to other related activities and issues
- increasing community engagement in, and acceptance of responsibility for, addressing biosecurity threats—thereby empowering the community to take action.

Potential costs or risks

The potential benefits need to be balanced against the costs, constraints and possible risks of involving community volunteers, including:

- considerable time, effort and resources required to recruit, train, reward and retain volunteers
- ways to address concerns about the accuracy, reliability and validity of volunteer-collected data, and to ensure that data collected are fit for purpose
- potential health and safety risks to volunteers and the need to ensure risks are anticipated, assessed and dealt with to minimise any possible harm

- compliance with relevant work health and safety laws and ensuring that organisations involved have appropriate insurance to cover accidents or injuries to volunteers
- whether volunteer involvement is appropriate, given the nature of the monitoring required and the environments where it will be undertaken.

Unanswered questions

While this paper provides guidance about what volunteer monitoring programs can contribute to biosecurity, there are still many questions that could be further investigated, including:

- Does the species to be monitored influence an individual's decision about whether to volunteer? For example, does the appearance of the species, potential environmental impact, or how easy it is to identify have an influence? Is the community more likely to be interested in monitoring ants, fungi, or weeds? Does potential risk associated with the species, for example, the risk of being stung or bitten, affect the decision to volunteer?
- Are pest-specific monitoring programs likely to be more successful than general monitoring programs covering a range of species?
- How important is it to have paid staff to support volunteer monitors?
- What role can information technology, for example, online reporting and distributed databases, play in surveillance by volunteer monitors?

Conclusion

This paper has reviewed literature on volunteers and volunteering, particularly volunteer monitoring in the resource and environmental management arena. On this basis, it has identified issues that need to be considered when involving volunteers in biosecurity programs.

Maintaining Australia's biosecurity status by avoiding the introduction of new pests or diseases, and effectively controlling existing threats, is a major challenge for Australians and their governments. There are limits to using volunteers to help address this challenge. However, the potential advantage of enlisting the help of many engaged, aware, motivated and empowered citizens suggests that both government and non-government organisations should be encouraged to further develop volunteer monitoring programs for biosecurity.

Appendix A Examples of Australian community monitoring programs

Program name	Program description
Atlas of living Australia (ALA)	ALA's Biodiversity Volunteer Portal encourages the public to help understand, manage and conserve Australia's biodiversity through community-based capture of biodiversity data.
BirdLife Australia	Formed in 2012 with the merger of Birds Australia and Bird Observation & Conservation Australia, BirdLife Australia runs over 30 volunteer monitoring programs. The Atlas of Australian Birds program tracks changes in the distribution and status of birds across Australia. Most threatened bird species have their own monitoring project coordinated by the Threatened Bird Network and involving members and volunteers.
Saltwatch	An ongoing environmental monitoring program helping communities to better understand Australia's salinity problems. Hosts the annual Saltwatch Week events in May, and works with school and community groups across Victoria.
SeaSearch	As part of this citizen science program individuals and community groups monitor and collect reef and shoreline data in Victoria. Volunteers collect data on marine biodiversity and seasonal change in local marine national parks or sanctuaries.
Tasmanian Weed Alert Network	A group of volunteers on the lookout for 'serious' new weeds. Volunteers include farmers, agronomists, local and state government staff, field naturalists, botanical consultants, weed control operators and interested members of the public.
Waterwatch Australia	Community groups, individuals and schools participating in this community-based environmental initiative help protect their local waterways by monitoring water and aquatic ecosystems. Volunteers are supported by government-funded coordinators or facilitators.
Weed Spotters, Queensland	This community-based weed alert system in Queensland is based on a model developed by the Cooperative Research Centre for Australian Weed Management.
Weed Spotters, Victoria	Community members in Victoria look out for and report state-prohibited weeds.
Weed Warriors	In this national program participants learn about invasive pest plants, and become part of the solution to the problem. Weed Warriors aims to foster an increased awareness of and participation in local weed issues.

Note: Websites were current as of July 2012.

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