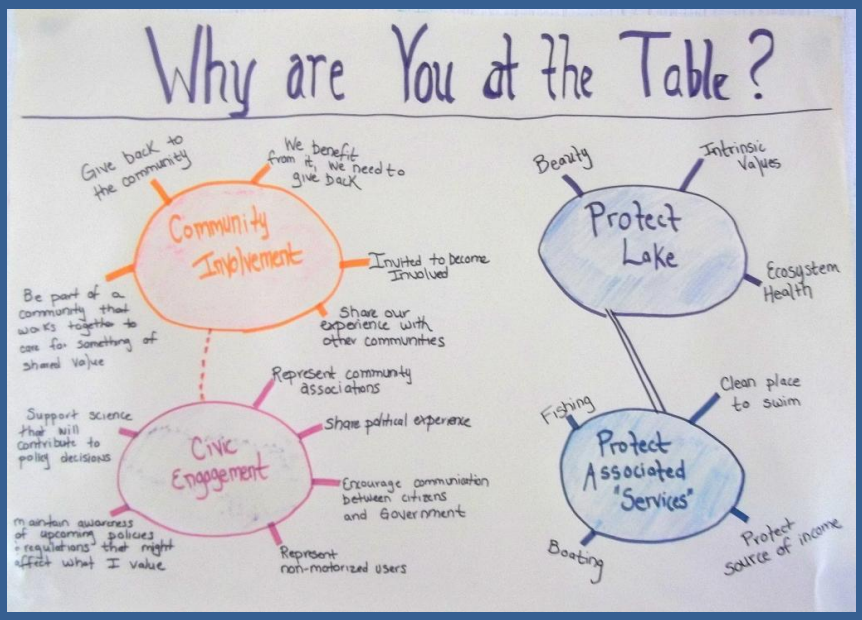
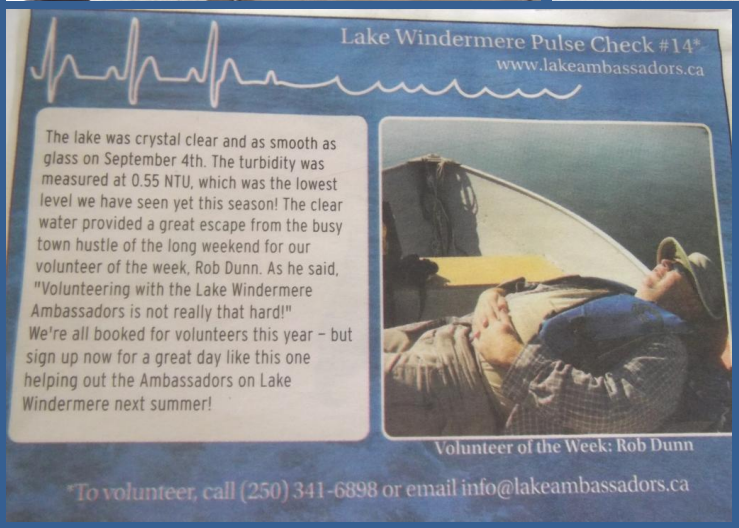
Community based Citizen Science

Learning from success in the United States and Canada





Kerry Riddell

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The Winston Churchill Memorial Trust

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More information from:
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More information from:
The Conservation Volunteers
Sedum House
Mallard Way
Doncaster DN4 8DB
www.tcv.org.uk

Kerry Riddell's interest lies in innovative approaches to environmental engagement and action. She has worked in a range of contexts to support people to make change to their lives, community and environment. As a Development Manager for The Conservation Volunteers, she has initiated and manages a number of Scotland- and UK- wide projects which focus on increasing community environmental engagement and widening public participation in Citizen Science including Scotland Counts, Natural Communities, Natural Talent UK and Natural Networks. She is a project partner for the OPAL UK project and participates in amateur wildlife recording in her spare time.

riddellkerry@gmail.com
k.riddell@tcv.org.uk

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Cover Photographs

1. Amelia Rhodewelt demonstrates the ‘Bucket’
2. Lake Windermere Ambassadors identify their motivation
3. Lake Windermere Ambassadors press cutting: ‘volunteer of the week’
4. Belcarra Beachkeepers Volunteer Training

1. Summary

The aim of this research project was to learn from successful community based Citizen Science initiatives in the United States and Canada in order to help inform the development of new community Citizen Science projects in the UK.

The research project identified huge opportunity for the development of community based environmental monitoring in the UK. Substantial outcomes include the potential to increase the body of environmental data available to statutory bodies, contribute to collaborative local environmental management, build community capacity, develop scientific literacy and increase citizen stewardship. Many examples exist of well established and successful initiatives, including the five projects visited for this project during May and June 2014.

The experience of these projects and many researched across North America indicates that community based environmental monitoring works best if it is co-created by a partnership which includes a wide range of stakeholders. Access to scientific expertise in data collection and interpretation is essential, as is a robust process; enabling volunteers to gather data confidently and competently and communicate their findings to scientists and local decisions makers. The monitoring activity needs to fit with the values, needs and aspirations of a community and have relevance to the life of volunteers. Support from a coordinating and enabling body is an important factor in achieving long term sustainability of these community based projects.

The development of community based environmental monitoring in the UK will require the implementation of collaborative approaches, linking environmental monitoring techniques with community development expertise. The initiatives visited for this project provide practical models and inspiration for us to develop new 'co-created' projects which integrate Citizen Science into the wider context of environmental stewardship, build community capacity, and increase environmental understanding and action.

2. Introduction

Citizen Science, defined as the involvement of volunteers in scientific research, collects vital data for the environmental sector.

Across the scientific community, there is widespread recognition that Citizen Science "offers a means of doing substantial, thoughtful public outreach and of tackling otherwise intractable, laborious or costly research problems" (Gura, 2013). Participation in Citizen Science is increasingly recognised as a valuable tool for connecting people with nature and influencing the adoption of sustainable lifestyles. At a community level Citizen Science has been shown to be an agent for empowering communities to act as environmental stewards, protecting and improving their local and global environment.

Citizen Science activity is well established in the UK. Over the past decade citizen science initiatives have flourished with several hundred surveys and schemes now in existence. The UK Environment Observation

Forum (UKEOF) proposes that Citizen Science is 'an indispensable means of combining environmental research with environmental education and wildlife recording' and it provides evidence that, across the UK, volunteer observers for biodiversity surveillance are estimated to contribute time in-kind worth more than £20 million per annum.

Citizen Science activity in the UK is, with very few exceptions, 'contributory': defined by the UKEOF as 'established by professionals, and inviting people to contribute data'. Individual Citizen Scientists record local data and sometimes collaborate by acting as part of regional communities of interest in a particular field. Very few examples exist in the UK of ***local communities acting together*** to record data which is of specific local relevance. This lack of community based environmental monitoring initiatives in the UK was the context for this research project. The project sought to inform and inspire new and effective community based monitoring projects resulting in:

- More communities working together to understand and improve their local environment
- More people valuing, understanding and acting to protect the environment
- A wider diversity of people engaged in Citizen Science
- Valuable data for the scientific community

There is a large and growing body of academic research into the benefits of more democratised processes for facilitating Citizen Science, or Public Participation in Scientific Research (PPSR). Community Based Environmental Monitoring has developed with particular momentum over the last 20 years in Canada and the USA, where thousands of community based citizen science projects now exist.

Visiting a number of these projects during this research trip provided the opportunity to forge links and gather practical knowledge, tools and examples of good practice. It is hoped that these will provide inspiration and useful practical models to inform communities, NGOs & agencies developing community based Citizen Science projects in the UK.

This report aims to provide an introduction to community based monitoring in the United States and Canada through a) examination of the activities and experience of five projects visited during May and June 2014 and b) brief reference to relevant research on a number of themes identified prior to and during the research trip.

Within the report I will:

- Provide an overview of the context for community based monitoring in the USA and Canada
- Using practical examples from the projects visited and with reference to research, briefly explore a number of key themes
- Identify key learning points for the UK Citizen Science stakeholders
- Provide case studies for each of the projects visited, summarising the aspirations, activity and outcomes and reporting on the experiences of those involved
- Draw broad conclusions and share plans for dissemination
- Highlight a number of interesting projects and initiatives discovered during the trip and make recommendations for further reading and research

3. Project Method

During the research period I visited a number of different community based Citizen Science initiatives in the United States and Canada. The research was carried out during May and June 2014, visiting the following locations and initiatives:

10th May- 20th May	*New Orleans, USA*	*Louisiana Bucket Brigade (LABB)*
21st May-28th May	*Halifax, Nova Scotia, Canada*	*Community Based Environmental Monitoring Network (CBEMN) & CURA H2O*
29th May-6th June	*Invermere, B.C., Canada*	*Lake Windermere Ambassadors (LWA)*
7th June-17th June	*Vancouver, B.C, Canada*	*Pacific Streamkeepers Federation (PSFK)* *Belcarra Beachkeepers*

These projects were selected because they:

- Had each resulted in successful and sustained Citizen Science activity at a community level
- Represented a range of different organisational structures
- Used a range of different approaches to collect data
- Covered a range of different activities, including both biological recording and environmental monitoring activity
- Used a range of different approaches to support volunteers

During visits to each organisation, I participated in project activity and met project volunteers where possible in order to understand the experience of participants. Both structured interviews and informal discussion were undertaken to gather information regarding:

- Conception, development & structure of each project
- How each project achieved outcomes related to environmental stewardship
- How the project developed social capital and community capacity
- How the project related to environmental justice
- Monitoring & engagement methodologies
- Effective connections between monitoring & decision making
- Problems encountered & strategies for overcoming them

4. The context for community based environmental monitoring

Community Based Environmental Monitoring (CBEM) lies broadly within the field of Citizen Science and was first defined in 2003 as 'a process where concerned citizens, government agencies, industry, academia, community groups and local institutions collaborate to monitor, track and respond to issues of common community concern' (Whitelaw et al, 2003).

A 2012 study: Public Participation in Scientific Research: a Framework for Deliberate Design' identifies a range of social, academic and scientific contexts in which the concept of 'participation' has been

increasingly explored and encouraged across the world over the last two decades. In the context of natural resource monitoring, public participation is identified as 'a means of engaging diverse stakeholders and accessing new knowledge, making power relationships transparent, adapting activities to evolving conditions, and encouraging both ownership and accountability of the management process'. The study proposes that public participation in scientific research (PPSR) is much more than 'just the gathering of data for science or management' because it achieves:

- outcomes for research (e.g., scientific findings)
- outcomes for individual participants (e.g., acquiring new skills or knowledge)
- outcomes for social–ecological systems (e.g., influencing policies, building community capacity for decision making, taking conservation action)

It is the focus on achieving ***outcomes for social-ecological systems*** that identifies CBEM as a distinct process within the broader sphere of Citizen Science. In Canada and the United States, CBEM has gathered substantial momentum over the last decade, partly as a result of a number of government programmes designed to facilitate collaborative local environmental governance, partly as a result of 'increasing mistrust of government's care of the environment coupled with a continued rise in environmental consciousness' (Conrad, 2006) and partly as a result of a groundswell of interest in developing and implementing new initiatives and approaches to environmental stewardship and community capacity building.

The rise in number of CBEM projects has been accompanied by, and in part facilitated through, ongoing academic research into the factors required for effective CBEM. Pollock and Whitelaw (2005) identified four main approaches to CBEM:

- Top down: initiated by government
- Interpretive: gets citizens involved in a problem and thereby educates them about it
- Advocacy (bottom up): efforts are spent reacting to current problems and attempting to force action on an issue
- Multiparty: involves a range of stakeholders from the outset

Conrad (2007) proposes that CBEM initiatives may have a range of different aims and functions, including education, understanding the state of the environment, habitat protection and restoration, but 'regardless of the specific mandate, they all tend to have the hope that their efforts will be used to assist in local decision making'.

Conrad's work distinguishes between the two elements of CBEM: ***Task*** (monitoring) and ***Process*** (how people and groups work together, build and maintain relationships) and emphasises the importance of process in creating and sustaining CBEM projects which achieve a range of positive outcomes. A 'Conceptual framework to guide CBM in support of sustainability' (Pollock and Whitelaw, 2005) identifies four major components: Community mapping (creating knowledge), Participation assessment (building partnerships), Capacity building (making it happen) and Information delivery (effective communication). It is of note that these components of *process* are clearly developed from community development practice and experience.

Each of the CBEM projects visited during this research clearly aspired to influence local decision making and sought to achieve outcomes for science, for individual people and for socio-ecological systems. For each project, the *task* was without exception the most straightforward aspect of the project, with the challenges reported and the strategies developed to manage them falling within the sphere of *process.*

Further information on each project's outcomes, influence and processes is provided in Section 13 with outcomes for people and decision making discussed below in Sections 7, 8 and 9.

5. Motivating volunteers

Pollock and Whitelaw's 2005 research into 31 CBEM projects across Canada led them to conclude that 'without an understanding of motivations, monitoring programmes may fail to appeal to local interests and concerns'. It was clear that the success of the projects visited for this research was due to an emphasis on understanding and responding to the values, aspirations and motivations of the volunteers participating and in ongoing work to ensure the project continued to respond to these factors for participation.

A number of motivational factors were identified, including:

- Health concerns
- Development concerns
- Empowerment – a sense of having a voice in local decision making
- Commitment to environmental protection
- Learning new skills
- Friendship - making social connections
- Fun

Volunteers were inspired to act due to factors ranging from fear: 'because they are frightened for their own health and that of their loved ones and feel motivated to take action' (LABB) to recreation: participating in monitoring in their spare time as an enjoyable activity which enabled them to learn, make new friends and do something worthwhile (Belcarra Beachkeepers). Despite the variations in motivation a common factor was evident – that volunteers were motivated to participate in monitoring activity *because they saw how that activity linked to their own lives.*

It was particularly interesting that active 'recruitment' of volunteers was only carried out by one of the organisations visited: Belcarra Beachkeepers. This project fits the profile of a contributory[1] Citizen Science project, with the volunteers gathering data that is used by scientists (using a process designed by scientists). In contrast, other organisations all played a role in which they facilitated or coordinated monitoring activity which communities had initiated or had been involved in 'co-creating'[2]. For those who aspire to develop more co-created Citizen Science initiatives in the UK, it may be of value to consider that a

[1] defined by UKEOF as 'established by professionals, and inviting people to contribute data'

[2] ddefined by UKEOF as 'designed by professional scientists and members of the public working together and for which Some of the volunteer participants are involved in most or all steps of the scientific process'.

co-created project will, by its very nature, only involve monitoring activity which clearly links with the lives and personal concerns of the volunteers participating.

6. Sustaining participation

Sustaining the long term participation of volunteers in community based monitoring was an issue that all organisations visited had been forced through experience to consider. Both LABB and CBEMN were clear that it was 'essential for communities to see results from their monitoring in order for them to be motivated to carry on participating' and that 'the length of time it can take between initial monitoring and change being effected means it can be difficult to keep up morale and long term participation'.

This is supported by Conrad (Towards meaningful Community based Ecological Monitoring in Nova Scotia, 2006) which notes that, 'Engaging members of the public remains a challenge for those dedicated members of stewardship groups. Issues include the capacity to build social capital, volunteer recruitment and retention, making volunteers feel valued, and avoiding volunteer frustration caused by the inability to solve environmental problems. A common frustration that has emerged among a number of groups in Nova Scotia is the "monitoring for the sake of monitoring" concern. Members understand the value of undertaking ecological monitoring, but in the absence of the data generated being meaningfully integrated into resource management decisions, frustrations emerged'.

Active support was seen as vital in sustaining volunteer involvement in monitoring. Staff from LABB noted that the communities where LABB were able to provide grass roots support to community activists were much more likely to have sustained participation. Both Belcarra Beachkeepers and the Lake Windermere Ambassadors carry out all the coordination of their monitoring programme, with volunteers only participating in the actual monitoring activity, the latter reporting that 'trying to get volunteers to take on more responsibility than they currently do would mean that the monitoring programme would be difficult to sustain in the long term'.

The groups supported by the Pacific Streamkeepers Federation (PSFK) can have problems with volunteer retention. PSKF noted that it was important that the monitoring is only one part of a larger programme which includes lots of other stewardship activities, (such as stream clean ups, planting programmes, storm drain marking, awareness raising and streambed improvement). This means that volunteers always feel they are able to make a difference somehow, even if the data they have gathered does not result in immediate change. The inclusion of monitoring as one of a range of stewardship activities was also noted as an effective mechanism for sustaining involvement by the Clean Annapolis River Project in Nova Scotia.

7. Encouraging and supporting environmental stewardship

The Stewardship Centre for British Columbia defines stewardship as 'an ethic that recognizes the need to conserve and restore ecosystems for current and future generations of all species. Stewardship is not just a technique. It is a philosophy, and a commitment to act in an environmentally, socially and economically sustainable manner. It refers to a wide range of actions and activities of individuals, communities, groups and organizations acting alone or in partnership, to promote, monitor, conserve and restore ecosystems'. This concept of environmental stewardship is widely understood in Canada and the U.S. and a vast number

of environmental stewardship groups exist, many of them focused around watershed and natural resource management.

The significant rise in the number of stewardship groups over the last 15 years is clearly linked to a comprehensive shift across Canada and the U.S from agency-based environmental management towards local-level environmental management. Several of the organisations visited for this research suggested that the development of these groups resulted in part from a growing lack of trust in responsible statutory care for the environment. A unique and complex history of land ownership and use may also be a factor, resulting in communities with a good understanding the concept of integrated approaches to land management who are predisposed to take responsibility for the ecological wellbeing of local places.

Research carried out with Pacific Streamkeepers Federation Members (Peers, 2007) concluded that 'the success of most stewardship programs relates to strong connections to local circumstances'. Three of the organisations visited worked specifically to support stewardship groups in carrying out CBEM and concurred that community based environmental monitoring played a useful role in encouraging and supporting stewardship. All noted that monitoring activity was most effective in increasing and sustaining stewardship when it was combined with a range of other activities: 'because we include other practical actions as part of the overall programme, volunteers understand that monitoring and action are linked together as part of the overall concept of stewardship. We also encourage the groups to implement their own solutions to issues that they may discover through monitoring…which builds their confidence in their strength and capacity to act as stewards.' (PSKF).

8. Achieving environmental justice outcomes

Across the body of research on CBEM the concept recurs that CBEM can 'spur collective action to help address environmental social problems' (Overdevest, Orr, and Stepenuk, 2004).

Three of the projects visited had a specific focus on achieving environmental justice outcomes through community based monitoring and engaged with many groups in this capacity. Several common elements played a significant role in ensuring these outcomes were achieved:

- Communities are provided with a protocol for data collection designed in partnership with credible experts
- Communities are supported to develop skills to interpret data
- Communities are trained and supported to navigate the administrative and legislative landscape to use the data they gather to achieve change
- Increased scientific literacy is considered an important factor in increasing social justice

The projects visited all noted that it was the combination of these elements, and the fact that all were provided throughout the project as important in achieving environmental justice outcomes: 'none of these elements would be enough in their own right, it's the combined approach that means that results are achieved and the fact that we provide support and a mechanism that people can use themselves' (LABB).

The notion of increased scientific literacy and articulacy is of significance, because it increases the perception of the capacity of a community group to gather data both a) amongst the group members themselves and b) amongst the external bodies who a group might want to influence. It is notable too that all three projects already incorporate, or are working towards incorporating, a database through which communities can compare the data for their own community with that of others. This would appear to achieve additional outcomes for environmental justice both in terms of increasing scientific literacy and providing an accessible mechanism for monitoring and understanding inequalities in local environmental quality.

The potential for community based monitoring to increase community capacity and social capital is also a recurring theme in CBEM research, with a wider outcome of more effective management of local environmental resources and support for conservation. Four of the five projects visited expressed an aspiration to increase social capital, with very positive examples provided by LABB and CURAH2O/CBEMN. However, both CBEMN and LABB noted that 'though social capital is generated by the act of monitoring, the frustration resulting from the inability to get results meaningfully accepted by decision makers can lead ultimately to a breakdown in social cohesion' (Conrad, 2006), defined by Conrad as 'Social liability'.

9. Impact on local policy and decision making

The term '*Democratisation of the environment*' links the concepts of social justice and decision making and is defined by Schwarz (2006) as 'making environmental science and expertise more accessible to the public, while also making scientists more aware of local knowledge and expertise'. Across the body of literature CBEM is consistently cited as a useful mechanism for integrating communities more effectively into local environmental decision making processes.

The CURAH2O project specifically aspires to increase environmental democracy and all projects visited had a core aim of enabling communities to influence local decision making, reflecting Conrad's proposition that this is a defining feature of CBEM projects. There were a number of different and positive examples for how the link between monitoring and decision making is achieved:

1. Monitoring activity informs environmental management decisions and action by local community
Wherever possible projects sought to enable communities to make decisions themselves as a result of the data they had gathered. Much of the monitoring activity carried out fed data into local management plans developed for a water body, catchment or species. For LWA and the community groups supported through PSFK and CBEMN, these management plans also included ongoing community monitoring as part of the ongoing management strategy identified in the plan.

2. Monitoring activity informs environmental management decisions and action by statutory bodies
In the case of Belcarra Beachkeepers, crab monitoring data goes directly to the Department of Fisheries and Oceans to inform local policy on crab catch limits. PSKF also provided examples of decisions regarding restocking resulting from data collected by PSFK community groups.

3. Monitoring activity informs planning and development decisions
Monitoring fed into the development of larger agency led strategies, including the Vancouver Integrated Stormwater Management Plan and the Metro Vancouver Interpretation and Engagement plans. Evidence gathered by groups in Nova Scotia was used to influence and in some cases resist plans for new developments.

4. Monitoring activity informs regulatory decisions
The projects facilitating community based monitoring of air and water quality fed data to regulatory bodies in order to achieve better compliance in local industry, domestic practice and land use. This is a particular focus for LABB, who have supported communities to evidence pollution incidents resulting in fines and enforced improvement of industrial practice and monitoring.

Although these positive examples are encouraging, research amongst community monitoring groups in Nova Scotia (Conrad, 2005) identifies a number of barriers to integrating monitoring activity effectively into decision making which remain relevant. These include a lack of political will, a lack of perceived legitimacy of the group collecting the data and inaction by regulators.

A 2008 study on the influence of community-based watershed monitoring groups on decision-making in Nova Scotia identified three specific issues compromising effective input into decision making: ineffective communication from community groups to decision makers, uncertainty amongst community groups of the kind of information needed by decision makers and a lack of appropriate governance framework for incorporating CBEM information.

Conrad also identifies a further limiting factor on influencing decision making: that the 'majority of CBM groups tend to focus on tasks (monitoring protocols) rather than process (how stakeholders might work together to protect, enhance or restore some environmental component)'. It is of note that all of the organisations visited during this research referred explicitly to the necessity of a coordinating and enabling body developing and supporting community capacity, confidence and articulacy in order to ensure that community based monitoring is able to effectively influence local decision making processes.

10. Data Quality

It could be argued that one of the largest barriers to increasing public participation in scientific research is a perception amongst the scientific community that the quality, reliability and usefulness of data collected by citizen scientists are questionable. Though there have been documented examples of significant variance between the data gathered by volunteers and that gathered by scientists, there has also been substantial research demonstrating that volunteers can collect data that is reliable and comparable to that gathered by professionals.

Cohn (2008) provides examples of projects which have refined the process of data collection by scientists in order to ensure that the data is of high quality and proposes that the key lies in thoughtful and tested protocol design and appropriate training of volunteers.

Conrad (2006) cites research showing that on the whole, water quality data gathered by community groups can be comparable to that gathered by professionals and notes that this has been shown to be the case for

both biological and chemical water parameters. However, a caveat to this conclusion is 'that community groups must use validated protocols, and have adequate resources for equipment and the regular training of volunteers and staff'.

Each of the projects visited for this research fitted Conrad's profile for data integrity by demonstrating the following:

- Monitoring protocols were developed in partnership with, or with approval from 'recognised' bodies, including academic institutions and agencies responsible for environmental management and regulation
- Volunteers are trained to ensure competency in collecting, recording and communicating data
- Volunteers are supported to interpret and communicate data
- Appropriate and functional equipment is made available

Without exception, the organisations visited had worked with a statutory agency responsible for environmental governance to develop the monitoring protocols for their project. It is interesting that the technicality of the monitoring process varied considerably, ranging from:

- very simple equipment requiring little expertise to use (LABB and Belcarra Beachkeepers)
- simple equipment requiring a good level of understanding to use (PSKF and LWA)
- technically advanced equipment requiring a good level of understanding to use (CURA H2O)

All organisations provided training to ensure that volunteers were competent in implementing the protocols. Training also varied considerably, from the informal (and always supervised) support given to the LWA volunteers to the comprehensive programme offered by PSKF, delivered by trainers accredited through Community Colleges Canada. A standard modular training programme is central to PSFK and CURAH2O with certification an option for the PSFK programme (in a number of similar programmes in the States, certification is mandatory).

The effectiveness of volunteers, in gathering quality data is, therefore, achieved through controlling two elements:

- The simplicity and ease of use of the monitoring protocol
- The knowledge, understanding and competency of the volunteer

Methods for validation and verification of data varied depending on the project. Volunteers collecting data for the Belcarra Beachkeepers and the Lake Windermere Ambassadors work alongside the project coordinator who validates and verifies the data as it is recorded. LABB consider more than 3 reports of an incident via the iWitness platform to act as verification of an incident and this triggers a report to the Environmental Protection Agency. The LABB bucket monitoring site, date and operator is validated before the sample is sent for analysis and the sealed sample is analysed by a professional laboratory, so verification is not required.

CURA H2O and PSFK are networks, and as such the coordinating staff is unable to validate and verify every record. In this situation, validation and verification is carried out by the most experienced volunteer(s) in a local group, which implies a need to ensure that a) training is adequate to equip such volunteers to carry out this role and b) volunteers continue to be motivated to continue long term involvement with their

community based project. The nature of these two projects, with community groups gathering data without a professional verification protocol, means that providing a 'foolproof' monitoring protocol, adequate training and support to encourage long term volunteering are a critical aspect of data quality assurance.

Data quality was considered a critical issue by all of the projects visited. The production of valid and credible data was considered important for a number of reasons:

- Credibility: in order that the data produced was taken seriously enough to be incorporated into decision making
- Integrity: in order for the monitoring effort to provide a valid contribution to the body of science
- Confidence: in order that community groups feel that their monitoring efforts are of value

11. Benefits for government

Although there is no strategic requirement to promote community based monitoring in the U.S.A. or Canada, the widespread support from agencies for CBEM though a variety of programmes over the last 15 years indicates that it is increasingly recognised as a valuable tool for monitoring species abundance and environmental quality, as well as providing opportunities for integrated local environmental management, education and building agency for conservation effort.

It is estimated that CBEM projects are supported in some capacity by government agencies in every state of the U.S.A and Canada. Examples abound of community based monitoring projects established by and in partnership with government agencies, such as the National Estuary Program established across the USA by the Environmental Protection Agency, the Canadian Community Monitoring Network, a large scale pilot project which identified factors for success and trialed a framework for activity and the Atlantic Coastal Action Program, initiated by Environment Canada to empower communities to achieve sustainability in their communities.

Benefits for government agencies of active collaboration in community based monitoring projects include:

- Wider spread of data collection
- Access to broad based data able to be used as a trigger for further investigation
- Relationship building at a community level, resulting in increased trust and cooperation
- Collaborative decision making and environmental management
- Opportunities for education and wider engagement

All organisations visited during this research were asked about the relationship between the community based monitoring projects they coordinated or supported and the government agencies with an interest in the data produced. The input provided by agencies into the development and ongoing support of each of these programmes evidences their commitment to the value of these projects. A notable exception was the lack of support provided to LABB by the local Louisiana Department of Environmental Quality, though LABB's relationship with the (USA wide) Environment Agency was considered to be very good: 'we have common aims and have worked together to achieve a number of positive outcomes for communities'.

The possibility that statutory bodies might be burdened by data gathered through CBEM projects was not considered to be an issue by the organisations visited. All concurred that because agencies responsible for environmental protection and conservation and the community organisations gathering the data are essentially working towards common aims, the CBEM effort is considered extremely valuable by the agencies involved. CBEM projects were seen as acting to ***focus*** government resources rather than burden them: extremely useful in a time of universally dwindling statutory funding.

PSKF noted that galvanising CBEM does not result in more work for statutory agencies, but in fact less, as community groups have the confidence and knowledge to take action themselves, and know where to go to move things forward (particularly with a facilitating organisation available to provide support and signpost). Communities who identify and resolve problems themselves are less likely to report issues to be 'dealt with' by statutory agencies, so that the burden on agencies is decreased.

The body of research on CBEM and evidence gathered from the projects visited indicate four essential features of successful collaborations between agencies and communities in CBEM projects:

1. The monitoring activity must be rooted in the community and arise from their concerns, needs and interests: 'citizens acting as scientists' rather than scientists 'using citizens as data collectors' (Conrad 2011)

2. Building and maintaining a community monitoring group takes time and patience and requires extensive relationship building between stakeholders including local government, environmental protection and conservation agencies, existing community groups, neighbouring communities and community members themselves

3. Community based monitoring groups struggle to sustain their monitoring activity without ongoing support from a coordinating and facilitating body of some kind

4. Agencies must be willing to respond to concerns raised through CBEM activity in a timely manner, or risk compromising goodwill from communities and the long motivation of volunteers to continue participation

Targeted financial support from government is clearly an important factor too. Conrad (2006) proposes that 'supporting community groups can be a highly efficient means for government to achieve shared environmental objectives, including CBEM' and cites an report on the Atlantic Coastal Action Program (ACAP) which concluded that it would have cost Environment Canada 12 times the ACAP programme budget, if agency staff themselves had directly delivered the same outputs as the 14 ACAP community organisations.

12. Learning Points

A number of key learning points arose from the research trip, relevant to a wide range of stakeholders including those in the conservation, environmental management and community development sectors.

The potential

There is huge potential for agencies, NGOs and communities in the UK to work together to develop and sustain CBEM projects. CBEM projects in the USA and Canada have been shown to be invaluable in increasing and broadening the body of environmental data that statutory bodies have access to.

CBEM provides opportunities for meaningful collaborative local environmental management resulting in an increase in environmental democracy. It can play an important role in education: not only raising awareness and increasing skills, but increasing scientific literacy too.

CBEM has the potential (and should have the aspiration) to build community capacity and social capital (acknowledged by the World Bank as a critical factor in sustainable development). Engaging in monitoring increases and supports individual and community environmental stewardship.

There is a wealth of experience and many examples of good practice in the USA, Canada and across the world that could inform development of effective, useful CBEM projects in the UK.

What works?

CBEM works bests if it comes 'from within' a community, either initiated by them or developed through a co-created process. Successful CBEM projects take time and patience to set up and should be a partnership involving stakeholders from the community, government agencies, local community groups, NGOs and academia. Access to scientific expertise in data collection and interpretation is essential.

Support from a coordinating and/or enabling body such as a university or NGO is an important factor in achieving long term sustainability of a CBEM project. Funding is also important; CBEMN indicated that the ACAP funded projects that participated in the CBEMN network were far more likely to sustain their monitoring and stewardship activities.

To galvanise and sustain volunteer participation CBEM must fit with the values, needs and aspirations of a community and have relevance to the life of volunteers. Outcomes must be achieved too, in particular an influence on local decision making. Monitoring activities often work best if they are one of a range of environmental stewardship activities that volunteers can participate in.

A robust *process* is essential; this should include a plan for communicating data to volunteers and community members and support to volunteers to communicate their findings to scientists and local decisions makers confidently. Providing volunteers with a sense that their monitoring activity is valued and will influence decisions is critical to the sustainability of the project.

First steps towards developing CBEM in the UK

There are significant opportunities for the development of CBEM in the UK, but the first step is will require a shift in the commonly held understanding of Citizen Science as a largely 'contributory' activity. CBEM requires a redefinition of Citizen Science in the UK to include 'citizens acting as scientists' rather than solely scientists 'using citizens as data collectors' (Conrad, 2006).

There is a need for training, both of volunteers and scientists. As well as increasing the knowledge and skills of volunteers, there may be a need to develop amongst UK science professionals 'the knowledge that would allow them to interact in meaningful ways with non-professional local experts' (Carolan, 2006); i.e.

the skills to engage effectively and on an equal basis with communities in monitoring and managing the local environment.

We need to understand the importance of combining science with community development approaches if we are to effectively engage communities to participate in Citizen Science. Building relationships between scientists and statutory and NGO practitioners in the Community Learning and Development sector will lead to better knowledge exchange and the development of fruitful collaborative CBEM initiatives.

Identifying and securing funds and resources to support the growth of CBEM is essential. If government seeks to engage community groups to play an active role in monitoring and wider stewardship, support will be needed.

Citizen Science in the UK has blossomed in recent years and continues to evolve at a pace. The UK Citizen Science 'community' is open to new conversations and opportunities for collaboration. The challenge for us now is to move beyond the idea of Citizen Science as only 'scientists collecting data' and develop opportunities to collaborate with volunteers themselves to integrate Citizen Science into the wider context of environmental stewardship, community empowerment and increased environmental understanding and action.

13. Community monitoring projects

Table 1 below provides a summary of the projects' structure, monitoring focus and participants.

Organisation	Organisational structure	Monitoring what?	Participants
Louisiana Bucket Brigade	State wide NGO supported by international organisation	• Pollution incidents • Air quality	Groups in at least 20 locations across the state and hundreds of individual observers
CURA H20	Academic and community partnership	• Water quality including temperature, pH, conductivity, total dissolved solids, dissolved oxygen, salinity, and measuring suspended sediment samples	At least 80 local stewardship groups
Lake Windermere Ambassadors	Local NGO	• Water quality including dissolved oxygen, pH, clarity, turbidity, and conductivity	Around 45 individuals since programme inception
Pacific Streamkeepers Federation	NGO covering two states	• Stream Habitat • Invertebrates • Salmonid species • Water quality including dissolved oxygen, pH, temperature, and turbidity	200 membership groups
Belcarra Beachkeepers	Project coordinated and delivered by Regional Parks authority	• Crab catch including species, gender, size, condition	Approximately 200 volunteers since project inception

Each project is explored below in more detail, with information on the project background and the monitoring method, data and outcomes**.** Summaries of interviews with project staff and volunteers are provided.

13.1. Louisiana Bucket Brigade

The Louisiana Bucket Brigade (LABB) is an environmental health and justice charity working with communities that neighbour the state's oil refineries and chemical plants. LABB uses grassroots action to support 'fenceline neighbours' (those that live next to a dump, refinery or chemical plant) to document pollution in their neighbourhoods.

LABB was formed in 2000 and seeks to create an informed, healthy society with a culture that holds the petrochemical industry and government accountable for the true costs of pollution. Their vision is of a healthy, prosperous, pollution free and just state where people and the environment are valued over profit. The organisation does not actively advocate for communities or campaign. Instead it provides tools and support for communities to take action themselves. By monitoring the activity of refineries and chemical plants and communicating incidents and trends to the Environmental Protection Agency and Louisiana Department of Environmental Quality and media, LABB's work leads to more responsible activity amongst these pollution producers.

Around 15 people work with the organisation including permanent staff, individuals on year long funded service programmes run by the national service programme AmeriCorps VISTA, interns and volunteers.

Since the charity was formed, it has worked with community groups across the State of Louisiana, engaging them in a number of projects including:

- Art to Action: collaborative social change community arts projects
- Refinery Accident Database: compiles refineries' own accident reports submitted to the Louisiana Department of Environmental Quality (LDEQ) and presents them in an accessible, public and comprehensive manner. LABB also analyse these data to identify trends which merit further investigation
- The New Orleans Earth Day Festival: an annual event engaging around 9000 members of the local community, environmental organisations and businesses around environmental sustainability
- Oil Spill Response: after the BP Oil Spill, LABB developed the Oil Spill Crisis Map and engaged local communities to use it to report issues of concern; they also carried out seafood and soil samples and around 1000 health and economic impact surveys in coastal communities
- The iWitness Pollution Map: a repository of eyewitness reports and photos of pollution in the Region from affected citizens, NGO's, government agencies, and the parties responsible for the pollution
- 'Bucket' Monitoring: an easy-to-use tool which communities can operate to take air samples
- Community Organiser support for key individuals in 'Environmental Justice' communities
- Active media alert programme raising awareness of both pollution incidents and environmental justice success

LABB operates two Citizen Science projects: the iWitness Pollution Map and the Bucket Monitoring programme. Both projects are designed to collect data as well as actively empowering the Citizen Scientists who participate and help community groups achieve their goals, be it relocation away from a polluting facility, reduced emissions or a moratorium on facility expansions. LABB believe that 'the more evidence the communities gather, the more power they have to achieve their goals'.

13.1.2. iWitness Pollution Map

The map in its current form was developed from the Oil Spill Crisis Map. It utilises the Ushahidi mapping platform, originally developed by Kenyan bloggers to track reports of post-election violence. LABB's iWitness Pollution Map was the first application of the Ushahidi platform in a humanitarian response (the BP Oil Spill) in the United States. The map is managed in partnership with the Gulf Monitoring Consortium and acts as a repository of eyewitness reports and photos of pollution in the Gulf Region from affected citizens, NGO's, government agencies, and the parties responsible for the pollution. This system enables 'fenceline' communities, workers, and concerned citizens to speak out about how oil, petrochemical, and other fossil fuel pollution are threatening their livelihood, their health, and the ecosystems they rely on.

Project method

Citizens are able to make a report of pollution concerns, including chemical accidents and oil spills. Reports can be made by text, email or online submission and include concerns about oil spills, flaring, odours and health effects. Once approved, all reports are made public and are available for viewing on the map.

LABB correlates citizen reports to the map with industry self reports to the National Response Center, the Louisiana Department of Environmental Quality (LDEQ) and the Environmental Protection Agency (EPA) and any other air, water or soil sampling information once per week.

Over 13,000 Citizen reports have been submitted using the iWitness tool.

Project data

The data is used in a number of contexts, both long term and acute. Each week, LABB shares an analysis of iWitness reports with federal and state enforcement officials in the EPA and LDEQ in order to provide information and keep up the pressure on regulators to act effectively to curb pollution and end oil industry accidents in the long term. Clustering of reports, indicating a serious incident, triggers an immediate response from LABB including:

- Alert of EPA, LDEQ and State Police
- Dissemination of safety information, which can sometimes be difficult for workers and communities to access via Emergency Response teams
- A 'Deployment' of LABB workers to gather information on the incident and its impacts, provide support to local communities and encourage further reporting
- Media alerts

Project outcomes

Outcomes from the iWitness Map are both immediate and practical and longer term. LABB staff have identified a number of incidents as a result of a substantial cluster of iWitness reports. These reports were the first, and in some cases only, indication that an incident of severity had occurred. Subsequent alert of statutory authorities resulted directly from the iWitness reports.

In the longer term, the iWitness reports are a key element in combating a culture of under-reporting of accidents in the industry across the State and have resulted in investigations of companies reporting processes by LDEQ and fines for failure to adequately report accidents.

The iWitness map, combined with the Refinery Accident Database, provides a clearer picture of the real state of the local environment and the resulting health impacts in a context which has been historically compromised by the long standing power of the oil and chemical industries and, according to the Environmental Protection Agency, poor enforcement of environmental laws in the state including a 'culture in which the state agency is expected to protect industry'.

As well as providing data, a number of wider outcomes of the iWitness reporting process include:

- Validation of personal experience
- A channel for community concerns
- A sense of being listened to
- Combating misinformation from pollution producers
- Identification of key individuals in communities who can be supported to develop as Community Activists

13.1.3 The 'Bucket' programme

The 'Bucket' monitoring process was developed in the 1990s in California, as a direct result of the experience of attorney Edward Masry whose own health was affected by fumes from a petroleum refinery he was suing on behalf of residents of Contra Costa County, Calif. When he called the local, state and federal environmental authorities, they told him that their monitors detected no problem. Masry hired an environmental engineer to design a low-cost device, and the bucket was born.

Working closely with Ed Masry, Denny Larson of Communities for a Better Environment, now director of Global Community Monitor, promoted the use of the buckets in other communities exposed to toxic air emissions. Larson produced a community manual to educate fenceline neighbours on how to build and operate their own buckets. The manual helped spread use of the buckets throughout the refinery belt of Contra Costa County in California, and eventually to Louisiana.

Project method

The bucket itself is simple to operate and inexpensive. A vacuum is created in a non-reactive plastic bag, inside the bucket using a handheld domestic mini vacuum. The valve is opened, air is drawn in and the valve on the bag is then closed. The bag is shipped overnight to a laboratory for analysis.

At $500 per sample, the lab analysis is the most expensive part of the operation. The air from the bag is run through a Gas Chromatograph Mass Spectrometer, which compares the "fingerprints" of the sample with the fingerprints of about 100 toxic gases in the computer library. The data produced from these samples is considered comparable with monitoring data from EPA equipment and the bucket is 'EPA approved'.

LABB currently has 8 buckets that are available for communities to use and regular requests for a bucket. Given the expense of analysis (funding has to be secured by LABB to cover this cost each time a sample is taken in a community and sent for analysis), the organisation takes great care to ensure that the monitoring is as effective as it can be. This means ensuring that a group of at least 3 individuals are

available and committed to effecting change in the community as a result of the monitoring process. Volunteers are also screened to ensure that they are committed, more recently this has been carried out by requesting that potential bucket users submit reports via iWitness for a prescribed period of between one and three months before being trained and given a bucket to carry out the monitoring. LABB trains community members to monitor when there is a visible problem in the neighbourhood, when they fear they are most at risk of chemical exposure, rather than just taking a sample at a time when there is not perceived to be substantial danger by community members. The bucket is provided alongside participatory training on the chemicals emitted at refineries and regulations for those emissions.

Project data

The data is returned to the community where the monitoring took place; LABB supports the community to use the data to achieve their desired goals.

Project outcomes

The data has been used by communities to secure residential relocation, and work with EPA and LDEQ to exact fines on polluters and enforce installation of new air quality monitoring equipment. As well as resulting in data which has been used to achieve real change for many communities in Louisiana over the last 14 years, the process of monitoring, developing an understanding of the issues and the responsibilities of industry and the state and working to achieve change is a powerful experience for community members who are used to being ignored, overlooked and disrespected by corporations and government.

Interviews with Katie Moore and Molly Brackin, Louisiana Bucket Brigade

Why do people participate?

People get involved because they are frightened for their own health and that of their loved ones and feel motivated to take action. When they come to us we tell them 'you are the best advocate for your health and that of your family, your report is important because it will help to make this locality a better place to live in.'

What is the most successful aspect of the project?

The huge difference that has been made to pollution in the state as a result of the Citizen Science activity and the raft of support that LABB provides.

What are the most common problems encountered?

- *The length of time it can take between initial monitoring and change being effected means it can be difficult to keep up morale and long term participation*
- *The long standing failure of LDEQ to enforce effectively in the State of Louisiana*
- *The long standing close relationship between LDEQ and the oil and chemical industry in the State*
- *Resources - in particular securing funding for use of the bucket*

How do you keep volunteers engaged on a long term basis?

*It's **n**ot easy! Having a long term strategy helps. Grass roots presence in the community really helps too, but this is not easy as some of the communities we work with are 4 hours away. We try to support Community Activists as much as possible*

How do the projects link environmental justice and environmental stewardship with scientific *approaches?*

We do this effectively by combining rigorous science with activity that empowers communities. We don't just offer a tool for monitoring, we provide training and we offer support, often on a long term basis, to write funding applications and make the right contacts to be heard. None of these elements would be enough in their own right, it's the combined approach that means that results are achieved and the fact that we provide support and a mechanism that people can use themselves.

13.2. CBEMN and CURA H2O

Dr Cathy Conrad, Professor in Geography at Saint Mary's University, Halifax has been working in the field of community based environmental monitoring for approximately 15 years. Her research background began in fluvial geomorphology and has evolved into community based environmental monitoring, aquatic ecosystems, and social justice with respect to water and international development. As well as leading the field in research on effective approaches to community based environmental monitoring (more details in appendix), Dr Conrad and her team have established two projects which support communities to monitor their local environment: the Community Based Environmental Monitoring Network (CBEMN) and CURA H20.

13.2.1. The Community Based Environmental Monitoring Network

The CBEMN was initiated in 2004 by Dr Conrad in response to enquiries from local communities who requested more academic and practical field support for the environmental monitoring they were carrying out. Reduced government funding for the environment, specifically monitoring, across North America has been a factor in the substantial rise of the number of community stewardship organisations carrying out monitoring over the last 15 years. For some communities, key planning, development or pollution events led to them contacting the university to seek guidance on monitoring processes and to establish credibility for the monitoring processes they were involved in. Dr Conrad identified a need for a project which provided a source of expertise for these communities and helped them to network to share resources and good practice and support each other. Seed funding for the network was initially provided by Saint Mary's University to establish the CBEMN as part of the University's ongoing support of community-based research.

The CBEMN has provided training, support and a Stewardship Equipment Bank. Its function has always been responsive, supporting nearly 80 groups in whatever way was most appropriate for them and their situation. The network was designed not only to provide technical support for community based monitoring but to facilitate networking between groups and help to build community capacity and confidence. Its purpose was to serve as a location that members of the community can contact when they have a question about:

- How to monitor/measure the environmental quality of the ecosystems in their community
- How to access scientific and social scientific data related to the environment
- How to use this data and utilise technology as a tool to further their understanding of their communities

Project Method

The CBEMN works in collaboration with Stewardship organisations organizations in the Atlantic region, across Canada, and internationally providing:

a) Equipment, resources, tools, and training

b) Reactive support as required by individual groups

The Equipment Bank was set up in order to help environmental stewardship organisations access high quality, scientifically accurate equipment that they could not otherwise afford. It is open to all members of the community and provides equipment for environmental monitoring, mostly focussing on monitoring of water quality parameters including temperature, pH, conductivity, total dissolved solids, dissolved oxygen, salinity, and measuring suspended sediment samples. The equipment is maintained and calibrated by CBEMN staff.

Project data

The data is owned by the community organisations collecting it. Dr Conrad and CBEMN staff have begun providing basic training workshops to develop the skills of community volunteers in analysing and presenting data.

Project outcomes

The main outcomes of the project have been: increased scientific literacy among the general public, increased comprehension and capacity for navigating issues of social justice, access to water, and governance issues, increased education and engagement of communities in understanding and protecting freshwater sources, and research results critical to the ongoing development and support of community-based monitoring and management (see http://curah2o.com/research/research-highlights/).

13.2.2. CURAH2O

The CURA (Community University Research Alliance) H2O project arose from the CBEMN as it became clear that there was a real need from communities to become better integrated in management of their local environment and have a more effective voice and to improve the general capacity of watershed management in Nova Scotia. The 5 year project was launched in 2011 and is funded by the Social Sciences and Humanities Research Council of Canada with the purpose of standardising water quality data collection at the community level and working towards integrated management with government agencies. As well as supporting community based monitoring organizations in Canada, the project also works with groups in West Africa, and Nepal.

The project is built around:

a) A water monitoring training and certification course
b) An accompanying Wet-Pro toolkit that provides all equipment necessary to conduct methods taught in the course
c) Supporting research on issues of watershed governance, effective community-based resource management, improved accuracy of data collected by volunteers, and the successful integration of volunteer monitoring into resource management

CURA H2O has recently launched an online geodatabase with an interactive mapping component to house this standardized (and now comparable) data set. Training is now being delivered to community groups to support them to use the database to store, manage, and export data for analysis.

The research element of the project aims to generate new knowledge to inform regional and international CBEM. Partnerships with government agencies and research being conducted at four major universities will result in a large data set which will build capacity and inform more effective watershed management.

Project Method

18 partner organisations were originally involved across Nova Scotia, with a further 14 now participating from adjacent states. Any new partners coming forward are provided with substantial support to get them to a situation where they are most likely to be able to continue on a long term basis.

All groups are provided with a full Wetpro toolkit and ongoing support and training. Participants undertake all elements of the Wetpro training framework, which includes:

- Foundation training course and keys
- One day introductory training on use of equipment followed by ongoing support
- One day introductory on site training followed by ongoing support
- Introductory training to upload data to database followed by ongoing support as database is updated

The training course is online; participants are introduced to it by CURA staff and then complete it at their own pace. In-person training workshops are offered annually or sometimes at the request of a partner organisation. The training course is updated regularly based on partner feedback and with help from technical advisors who participate in our Steering Committee.

Project data

The data is owned by the communities who collect it; the online database has substantially increased the potential for community groups to use the data. The database resulted from requests by community organisations and has been a major new feature of the CURAH20 project. Ultimately it is anticipated that the database will serve as a vehicle for the data to be used in governmental management. It provides a tool for data storage and analysis for - community-based water quality data, regionally, in all Atlantic Canada provinces and expanding nationally). It also serves as a networking tool for stewardship organizations to share knowledge, resources, and data.

Project outcomes

A number of outcomes have been achieved by the project to date:

- Non variability of parameters: data is now comparable across the region and by organizations who are producing it
- Credibility of data, because a) the programme was designed by the University and with full partnership from agencies Environment Canada and Nova Scotia Environment in order to dovetail with their own parameters and b) a comprehensive training course and multiple quality assurance measures
- An effective data sharing mechanism that community groups are increasingly confident to use

Interview with Sarah Woods and Oliver Weston, St Mary's University

Why do people participate?

A number of reasons lead communities to participate. Some have concerns about the impact of proposed developments such as a mink farm, gold mine or golf course. There is a healthy culture of environmental stewardship in Nova Scotia, partly because outdoor tourism (boating, kayaking, seafood, driving tours, boating tours, natural landmarks, etc.) is a major contributor to the struggling local economy, and also because of local dedication to personal outdoor activities. An established and thriving cottage industry in the region and a historic need to preserve property and well-water quality that has been passed down through generations also play a role. Local fisheries associations were already engaged in monitoring as part of the process of supporting and increasing stocks. All of these organisations wanted to have a voice in management of their local environment and were concerned that the monitoring they were undertaking was of value - support from academia provided this for them, as well as providing the credibility required in order to use the data to effect change.

What is the most successful aspect of the project?

There are a number of successes:

- *An increase in scientific literacy at the community level*
- *Community empowerment and an increase in environmental democracy*
- *The aspiration for the project is that it will continue to provide a framework for civil society to be effectively integrated into management of the local environment*

What are the most common problems encountered?

The capacity of a local community group to support the monitoring effort on a long term basis. Groups that have been supported through The Atlantic Coastal Action Program (ACAP) tend to be better placed to do this because their capacity has already been built through the provision of core funding (ACAP was launched by the Government of Canada as part of its Green Plan in 1992 to help Atlantic Canadians restore and sustain watersheds and adjacent coastal areas. Its purpose was to enhance the traditional government delivery of programs by empowering and building the capacity of ecosystem-based coalitions of stakeholders to take the lead in identifying and acting on their local environmental and sustainability priority issues).

How do you keep volunteers engaged on a long term basis?

Communities were not formally engaged by us for the CBEMN but came forward as they heard about the project for a variety of reasons. We know that it's essential for communities to see results from their monitoring in order for them to be motivated to carry on participating. CURA H2O project partners have a variety of capacities: some well-established and some just starting out. We approached the most active users of the CBEMN to become CURA partners. Because they have varied capacities, they can help each other through networking, mentorship and knowledge and resource-sharing. The more established groups benefit and move forward from a more advanced level with equipment and database use.

How do the projects link environmental justice and environmental stewardship with scientific approaches?

Community organisations have become more confident and empowered because there is an increased perception of their capacity and ability to gather valid data. Communities have become much more articulate in expressing their concerns and aspirations. Communities are better able to have a say in all aspects of their own sustainability, including job security and local economy.

Increased scientific literacy has meant that volunteers are able to clearly understand the implications of the data they are gathering and have a much better picture of the state of their local environment.

13.3. Lake Windermere Ambassadors

Lake Windermere is in southeastern British Columbia in the Columbia Valley, which stretches 121 miles from Canal Flats to Golden, B.C. with the Rocky Mountains to the east and the Purcell Mountains to the west. The lake is a shallow widening of the great Columbia River and links to the Columbia Wetlands. These internationally-significant wetlands are a crucial part of the Pacific Flyway, one of the last intact resting and breeding habitats for migrating and resident birds in the greater region. The Columbia Wetlands is the largest wetland of its kind in British Columbia, protected under the BC Wildlife Act and designated a Ramsar site in 2005. The wetlands comprise a regionally unparalleled diversity of 16 habitats, sheltering around 216 species.

The year round resident community numbers about 4000, with an influx of around 36000 additional visitors and second home owners every year, who support the local economy but are perceived by some to be a cause of over development and irresponsible recreational use of the lake. Lake Windermere is very heavily used for motor-boating, sailing, windsurfing, canoeing, fishing and other recreational activities. More than 50 per cent of the lakeshore has been disturbed or developed. On summer days there can be as many as 200 power boats on the lake at the same time.

In 2004 the Canadian Rockies based conservation charity, Wildsight, decided to consult the community around Lake Windermere to ascertain how people felt about the increased pace of development around the lake. They found that there was widespread concern about the impact of development on the lake, which is central to the local economy, has substantial cultural value for local First Nation communities, provides drinking water for all those living around the lake and is a key part of the ecology of the Columbia River system.

Wildsight established the Lake Windermere Project in 2005, because of 'concerns that human caused impacts on the lake may exceed its ecological carrying capacity and degrade drinking water'. The project aimed to ensure the ecological integrity of Lake Windermere through science and community stewardship. The project sought to protect biodiversity and encourage sustainable communities through establishing a number of stewardship and education projects, including a volunteer water monitoring project.

The Lake Windermere Project was a key partner in the development of the Lake Windermere Management Plan, initiated by the Regional District of East Kootenay. The plan was published in 2011 and was designed to:

- protect environmental health and ecological integrity of the lake
- safeguard the lake for the purposes of recreation
- encourage responsible use of the lake
- clarify management and enforcement responsibilities

The plan included a role for the Lake Windermere Ambassadors (LWA), newly established as a successor to the Lake Windermere project. Lake Windermere Ambassadors is an NGO delivering a range of education and stewardship initiatives including:

- Development and dissemination of a Green Boating Guide
- Shoreline and whiteway (route on frozen lake) clean up projects
- Shoreline restoration projects
- Regatta and other events
- Education and awareness raising through local media and work with schools
- Lake Guardians volunteering
- Lake Monitoring programme

13.3.1. Lake Monitoring Project

The Lake Windermere Ambassadors have been monitoring water quality and bacteria on swimming beaches since June 2011. Previously, the Lake was monitored through the Lake Windermere Project which gathered data from 2005 onwards. The protocol for monitoring was developed in partnership with the Ministry of the Environment and includes monitoring of dissolved oxygen, pH, clarity, turbidity, and conductivity.

Between 40 and 50 volunteers have been involved in the programme since it started. Any individual who volunteers is trained and will be able to participate in the monitoring programme several times throughout the monitoring season. Beyond encouragement in media releases and on the website, volunteers are not actively recruited.

Project Method

Monitoring is carried out once a week during the summer months from a boat loaned by the District of Invermere. Monitoring must be carried out on a week day as this is when the boat is available and the lake is not too busy with recreational users. Volunteers participate individually or in pairs, working as part of a team led by a LWA staff member. Training comprises ‘a day on the boat’ during which the volunteer learns the process of monitoring. Each individual goes at the pace required by their knowledge, experience and confidence, so some volunteers are confident to monitor after the first training trip whilst others take longer.

Project data

The data is owned by the Lake Windermere Ambassadors. Results of the monitoring are published yearly with online updates throughout the summer.

Project outcomes

A number of outcomes have resulted from the project:

- Knowledge: local people feel they understand what is happening in the lake and reassured that there is a process to keep gathering data
- Awareness raising: weekly updates in the local press keep the monitoring process in the mind of the local population, and provide accessible information about the lake
- More responsible behaviour: because the LWA are known to be 'out there' keeping an eye on what is going on, people behave more responsibly because actions resulting in pollution are not likely to go unnoticed

Interview with Kirsten Joy Harma, Lake Windermere Ambassadors

Why do volunteers participate?

Volunteers initially participated because they were alarmed by the pace of development and felt they needed to know about its impact. There was perceived to be relatively low impact on the lake from local forestry, mining and farming activity, but people are concerned about the impact of damage to the shoreline habitat, the impact of poorly controlled drainage from properties and the impact of recreational boat use. Many of these volunteers still participate although the data collected shows that the lake is in a relatively healthy condition.

What is the most successful aspect of the project?

The fact that members of the community keep coming back to volunteer. Also that we have a process now to ensure that the lake and the services it provides are protected. The awareness raising element of the programme and the interest it has generated amongst the people that live beside and use it.

What are the most common problems encountered?

There aren't many problems, but the need for the LWA to play a fairly substantial role in the monitoring process could be seen as one. We think that trying to get volunteers to take on more responsibility than they currently do would mean that the monitoring programme would be difficult to sustain in the long term.

How do you keep people engaged on a long term basis?

We don't find this difficult because people love to have a day out on the boat. The aspect of fun is important, and a chance to get away from everyday life and do something they perceive as worthwhile. The fact that the volunteers don't need to do anything other than turn up and do the monitoring is a big factor, because LWA organise the boat and deal with the data, volunteers can be involved without having to take too much responsibility. The volunteering 'experience' is good quality with a 1:1 or 1:2 ration of LWP staff to volunteer, there is lots of interaction with the volunteer and they feel valued.

How do the projects link environmental justice & environmental stewardship with scientific approaches?

The fact that monitoring is just one of a number of ways in which the community can be involved in stewardship is important. Not everyone wants to be involved in science, they want to volunteer to carry out an activity which fits with their own interest, but they understand the value of the science involved in the monitoring project alongside the other initiatives that LWA facilitates.

How does the monitoring link into decision making - locally and regionally?
The LWMP includes a clear process for acting on data gathered, in the context of planning, permits and enforcement. There are a lot of different bodies with responsibility for regulation of activity on and around the lake and the Management Plan provides clear guidance regarding who is responsible for what. LWP doesn't enforce anything, we raise awareness of responsibility and enable stewardship activity, but we can act as a conduit to the appropriate department for peoples' concerns.

13.4. Pacific Streamkeepers Federation

The Pacific Streamkeepers Federation (PSKF) was initiated in May 1995, at a Community Involvement Workshop held by the Department of Fisheries and Oceans Canada (DFO), attended by more than 300 stream restoration volunteers from BC and the Yukon. PSKF is a non profit organisation dedicated to helping 'streamkeepers' (defined as 'people who are interested in working together to protect and preserve local streams') in British Columbia and the Yukon through support, education and building partnerships. The Project is funded by the Department of Fisheries and Oceans Canada.
The objectives of the PSKF are to:

- Provide an information exchange for streamkeeper and enhancement groups
- Help co-ordinate streamkeeper and enhancement efforts
- Lend a larger voice to streamkeeper and enhancement issues
- Facilitate training for streamkeeper and enhancement groups
- Help like-minded groups get started
- Provide support for existing streamkeeper and enhancement groups
- Foster co-operation amongst watershed stakeholders
- Promote local management of aquatic resources

PSKF works with around 10,000 individuals every year and has around 200 membership groups. The project offers:

- An online forum where streamkeepers can share ideas and information
- The Streamkeepers Handbook and project modules: a very comprehensive and accessible guide to assessing and monitoring the health of local streams and undertaking restoration
- Streamkeepers training, which is certificated and provided by certificated trainers
- A directory of groups and support to link up, work together and learn from each other
- Group insurance that covers all groups activities as long as they have been carried out using protocols outlined in the Streamkeepers guide
- Storm drain marking programme (Yellow Fish)

Project Method

The Streamkeepers Programme was developed to provide volunteers with the training and support required to protect and restore local aquatic habitats and to educate the public about the importance of watershed resources. At the heart of the Programme is The Streamkeepers Handbook which provides a

resource to guide volunteers to carry out a number of projects, ranging from simple to complex. Some projects require formal approval or technical training, but many can be started right away.

Many of the groups involved have been active since the development of the programme and each group will be different in the scope of activity it is interested in carrying out, so there is plenty of flexibility in how much of the Streamkeepers programme is used. However, both in terms of using standard and approved processes and rendering the insurance cover valid, Streamkeepers are all expected to implement the protocols for all activities outlined in the Handbook and Modules.

The Handbook provides an overview of watershed ecology, advice on maintaining a community based volunteer group and guidance for groups to negotiate issues regarding land ownership, governance and decision making. It also provides guidance on carrying out:

- Introductory and advanced Stream Habitat Surveys
- Water Quality Survey
- Stream Invertebrate Survey
- Storm Drain Marking
- Stream Clean-up
- Streamside Planting
- Streamside Fencing
- Juvenile Fish Trapping and Identification
- Salmonid Spawner Survey
- Creel Survey
- Stream Channel Improvement
- Community Awareness raising

A group can just access this resource and begin taking forward the activities that are most of interest if they choose, but most choose to set up the 2 day training programme for their members, which covers:

- Module 1: introductory stream habitat survey
- Module 2: advanced steam habitat survey
- Module 3: water quality survey
- Module 4: stream invertebrate survey
- Module 7: stream side planting
- Module 11: juvenile fish trapping and ID

Once the Streamkeepers group begins to carry out monitoring, they will be using standard protocols and recording sheets to gather data. Kits are available for members to borrow and include low tech and simple to use equipment.

Project data

Streamkeepers own the data and are encouraged to use it in whichever way they choose. Since 2012 Streamkeepers are also able to complete surveys through an online database. Work is currently underway to develop the database to enable data comparison. A recent project has linked survey completion to Facebook posts so that completion of a survey by a group is promoted and celebrated and the online survey can be viewed.

Project Outcomes

The programme is designed so that groups who work through all the modules will end up with all the material they need to draft a management plan for their local watercourse.

There is a focus on resolving issues identified through the monitoring process by local community action where possible. Scientists from the Department of Fisheries and Oceans Canada can be consulted to support groups to identify potential causes and data is sometimes taken by a group to a municipal council to raise issues of concern.

Interview with ZoAnn Morten, Director, Pacfic Streamkeepers Federation

Why do volunteers participate?

Research carried out as part of an MSc study identified 3 key elements that motivate Streamkeepers to participate: friendship, learning something new and the opportunity to 'give something back' to the environment.

What is the most successful aspect of the project?

The huge number of volunteers we've got involved and the diversity of the volunteers, from all walks of life and the long term awareness raising achievements. Physical outputs include the watershed plans that have been developed through the Streamkeepers activities and the data that they've collected in their surveys.

What are the most common problems encountered?

It can be tricky if people want to do things their own way or are motivated solely by single issues. Sometimes it can be difficult, if a group has managed to secure funding for staff time, to disentangle what is good for the local community and the local watercourse from the desire to keep someone in post.

How do you keep people engaged on a long term basis?

The groups do this themselves, to a greater or lesser degree, but we help by providing continuing opportunities for volunteers to develop skills and making the process simple for people through the guide and modules. Because the monitoring is only one part of a larger programme which includes lots of other stewardship activities, such as stream clean ups, planting programmes, storm drain marking, awareness raising and streambed improvement, people feel they are able to make a difference.

How do the projects link environmental justice & environmental stewardship with scientific approaches?

Providing a programme which combines the citizen science with other activities is essential. The Citizen Science is not the main focus of the programme; it's simply one of a number of activities that people can participate through which they can be good stewards of their local stream. Because we include these other practical actions as part of the overall programme, volunteers understand that monitoring and action are linked together as part of the overall concept of stewardship. We also encourage the groups to implement their own solutions to issues that they may discover through monitoring, as much as they can. This builds their confidence in their strength and capacity to act as stewards.

How does the monitoring link into decision making - locally and regionally?
In all sorts of ways. For example, by monitoring fish stocks, local groups are able to identify where restocking is needed and work with DFO to achieve that. Where communities are noticing data that concerns them and that they can't account for, they are able to work directly with DFO scientists and community liaison officers to identify potential causes and manage the issue. Sometimes communities use the data to provide evidence to the municipal council to propose or oppose change. We envisage that the data collected by the groups will prove essential in the development of the Integrated Stormwater Plan and support its eventual implementation.

13.5. Belcarra Beachkeepers

This programme combines Citizen Science and education to promote stewardship and community involvement in resource protection. The programme was initiated in 1997 when a local resident began to be concerned that visitors to the beach were causing damage to the habitat through a number of activities, including taking home large shells that provide essential shelter for hermit crabs, harvesting bivalves and undersized crabs and not taking care to leave the beach as us disturbed as possible. An education programme was set up partnership with Metro Vancouver Regional Parks and the Department of Fisheries and Oceans Canada and monitoring of crab species by Park staff began at that time.

13.5.1. The Beachkeepers Programme

The Belcarra Beachkeepers programme as it runs today began in 2004. The programme runs each Saturday and Sunday and on public holidays throughout the summer months. On these days, a team of Beachkeeper volunteers are present at the beach all day carrying out education activities and crab monitoring. Volunteers are recruited from a wide range of sources, including final years of local high schools, universities and colleges and there are usually around 25 volunteers involved each year, each working on 6 days during the course of the summer. The programme and volunteer team are coordinated by a Metro Vancouver Regional Parks staff member.

The monitoring programme focuses on crabs because crabbing is a popular pastime for visitors to the beach and the statutory partners are interested in developing long term data sets for crabs in the area. Recreational crab fishing in Canada is governed by regulation which states that crabbers must have a fishing licence, harvest only male crabs and take only those that comply with the size regulation for that species. An individual can harvest a maximum of 4 crabs a day and only from open areas; some areas are designated off limits.

Project Method

The monitoring activity is carried out on the jetty where crabbers congregate. Beachkeeper volunteers ask individual crabbers if they would be willing to participate in the programme, if they agree, they will bring every crab they catch to the volunteer team. It is usual to have around 20 crabbers are participating in the programme. Once a crab is caught, the team will record information on its size, gender and condition.

Undersized and female crabs are numbered and returned to the water, legal catch crabs are returned to the crabber who caught them.

The monitoring process uses the Department of Oceans and Fisheries Canada standard crab recording protocols and records sheets.

Project data

The project collects data on behalf of the DFO.

Project outcomes

The data feeds into the crab monitoring programme for the DFO, which is used to determine catch limits for species.

The programme effectively supports regulation in an informal and accessible way by increasing knowledge amongst recreational beach users of the species, catch and size limits for crab.
The education element of the programme happens through:

- Greater awareness amongst volunteers carrying out the programme
- The education tent, close to the beach, at which members of the public can learn about beach creatures through hands on activities
- Informal education of those on the jetty close the monitoring programme
- Several specific public engagement events taking place throughout the summer

Interview with Melissa Holloway, Belcarra Beachkeepers Coordinator

Why do volunteers participate?

Motivation varies depending on the volunteer. Those still at school can use the volunteering experience to fulfil the work experience they require to graduate. University students are keen to gain additional experience. At least 20% of the volunteers return following participation in previous years and these individuals usually simply enjoy participating in the programme and see it as a good way to spend some of their vacation.

What is the most successful aspect of the project?

The project is a great way to provide people with practical education, not just about crabs, but about respectful enjoyment of all the species found at the beach. It also substantially increases understanding in the volunteers carrying out the programme, training them as informal ambassadors for responsible beach use for the future.

What are the most common problems encountered?

It's not always easy to tell crabbers that the crab they were planning to take home for their tea is illegal! We have developed a number of ways to do this diplomatically though, and there is always a Vancouver Metro staff member around to support volunteers to do this. At the end of the day we are not enforcers, so if a situation were ever to get tricky (it hasn't yet) we'd be protecting our own safety first.

How do you keep people engaged on a long term basis?

The nature of the programme is such that we don't expect volunteers to stay involved for years. Because most of them are young adults, they are likely to move on to other locations and areas of focus. So any that do return another year we think of as a bonus. Our job is to keep them engaged all summer and we do this be providing them with a positive, fun experience and not asking too much of them (6 five hour sessions). We are good at thanking them and celebrating their involvement too, and at the end of each programme we organise a trip or event by way of thanks.

How do the projects link environmental justice & environmental stewardship with scientific approaches?

The monitoring is so visible and as well as gathering data, acts to reinforce regulation in a positive and educative way. It is an important element in the education of the public as to how to fish in a sustainable way. For the volunteers and the crabbers who participate in the study (estimated >350 over the course of the season) there is an opportunity to really understand the concept of sustainable fishing through involvement.

How does the monitoring link into decision making - locally and regionally?

The data goes directly to the Department of Fisheries and Oceans Canada and is of value in informing decisions regarding access to fishing in the area. A significant decline in crab numbers observed through the monitoring process could lead to closure of the area for crabbing and other activities to allow recovery. The programme also links into the wider work carried out by Metro Vancouver Regional Parks and feeds into decisions regarding local management of the Belcarra Regional Park and interpretation and engagement strategy across the 22 parks in the Greater Vancouver District.

14 Conclusion

The experience and knowledge gained as a result of this research trip indicates there is substantial potential for the development of community based Citizen Science in the UK and hundreds of well established projects from North America and across the world that we can learn from to galvanise new Citizen Science activity in the UK. As well as increasing the body of environmental data available to statutory bodies, community based Citizen Science can contribute to collaborative local environmental management, build community capacity, develop scientific literacy and increase citizen stewardship.

The most successful community based Citizen Science projects are those where volunteers are motivated to participate in monitoring activity because they see how that activity links to their own lives. Projects that include monitoring as part of a range of wider stewardship activities are most likely to be able to sustain volunteer involvement. Support or coordination from an enabling body is considered to be vital in sustaining community based volunteering monitoring projects in the long term.

Inspiring examples from the projects visited during this research trip illustrate how community based Citizen Science can galvanise collective action to achieve environmental justice outcomes. Ensuring an effective process for linking communities' Citizen Science activity to decision making is crucial. A sense that data gathered is not valued or acted upon by decision makers leads to low morale, decreasing participation and decreases social capital.

Research has shown that volunteers can collect data that is reliable and comparable to that gathered by professionals. The case study projects included here ensured data integrity by developing monitoring protocols in partnership with academic institutions and agencies responsible for environmental management and regulation, as well as the provision of robust training and support.

The first steps in realising the potential for community based Citizen Science in the UK will involve a commitment from those working within the Citizen Science 'community' to explore the development of more co-created projects. This will involve increasing the capacity of the scientific community to engage with local communities and community based NGOs and building more Citizen Science projects through community development approaches.

The initiatives visited for this project provide practical models and inspiration to develop new projects which integrate Citizen Science into the wider context of environmental stewardship. Collaborating with local communities to co-create projects will produce valuable data for the scientific community as well as building collective environmental responsibility. By supporting and enabling the development of community based Citizen Science projects in the UK we can realise the potential of Citizen Science to achieve more integrated decision making, build community capacity, and increase environmental understanding and action.

15 Dissemination of Learning

I hope that the key themes explored in this report provide useful guidance for all those interested in expanding Citizen Science activity and participation in the UK. The case studies were designed to provide accessible examples and practical tools to inspire readers to implement new community based Citizen Science projects. This report will be disseminated widely through the environmental, conservation & community sectors in the UK and available online through The Conservation Volunteers website, but as I discovered from visiting these inspiring projects, nothing beats learning face to face, so I welcome the opportunity to share my experiences in person.

I plan to apply the learning from my research through community projects supported by the Conservation Volunteers over the next two years and develop and deliver a workshop to share both this research and our experiences of putting it onto practice in due course. More information about those workshops will be available on the TCV website; in the meantime, I welcome questions, comments and opportunities to work in partnership to develop and implement innovative approaches to community based Citizen Science.

Kerry Riddell
September 2014

16 Linked initiatives

A number of initiatives were recommended or discovered during the research trip that may be of interest to readers of this report:

British Columbia Lake Stewardship Society
The BCLSS recognises the importance of volunteers and help individuals and local groups take on a greater role in lake stewardship activities throughout BC.

The Secchi Dip-in
The Secchi Dip-In project demonstrates the potential of volunteer monitors to gather environmentally important information on lakes, rivers and estuaries through gathering data on an agreed day each year and provision of a data repository.

Citizen Science Central
US site (run by Cornell University) which supports organisers of all initiatives involving public participants in scientific research.

Stewardship Centre for British Columbia
Provides technical, educational and capacity resources to support British Columbians to understand, enjoy and sustain healthy ecosystems through stewardship.

Operation Paydirt
Multidisciplinary artist-led project raising awareness of childhood lead poisoning.

Gulf Restoration Network
Works to empower people to protect communities, ecosystems and cultures in the Gulf of Mexico.

Public Lab
Develops and applies open source tools to support "civic science", generate knowledge and share data about community environmental health.

Nature Canada
Canada’s oldest and largest conservation charity.

Centre for Indigenous Environmental Resources
Assists First Nations to build the capacity to address local environmental issues.

Waterkeeper Alliance
Global initiative supporting citizen action on issues that affect waterways.

Stormwater Central
Volunteer project developing rain gardens for low-impact stormwater management.

References

Carolan, M. S. (2006). Science, expertise and the democratization of the decision-making process. Society and Natural Resources, 19, 661–668.

Cohn, J. (2008). Citizen Science: Can Volunteers do real research? BioScience (2008) 58 (3): 192-197.

Conrad, C. (2006). Towards Meaningful Community-based Ecological Monitoring in Nova Scotia. Environments Journal 34, 2006

Conrad, C, Daoust, T. (2008). Community based Monitoring frameworks: Increasing the Effectiveness of Environmental Stewardship. Environmental Management (2008) 41:358–366

Conrad, C, Hilchey, C.G. (2011). A review of citizen science and community-based environmental monitoring: issues and opportunities. Environmental Monitoring and Assessment (2011) 176:273–291

Gura, T. (2013) Amateur experts. Nature 496 (11 April): 259–261.

Overdevest, C., Orr, C.H., Stepenuk, K. (2004). Volunteer Stream Monitoring and Local Participation in Natural Resource Issues. Research in Human Ecology

Peers, J. (2007). Learning through Collaboration: An investigation of Communities of Practice in Streamkeepers Groups. MSc Thesis, University of Guelph

Pocock, M.J.O., Chapman, D.S., Sheppard, L.J., Roy, H.E. (2014), A Strategic Framework to Support the Implementation of Citizen Science for Environmental Monitoring. Centre for Ecology and Hydrology.

Pollock R., Whitelaw, G. (2005) Community-Based Monitoring in Support of Local Sustainability, Local Environment: The International Journal of Justice and Sustainability, 10:3, 211-228

Roy, H.E., Pocock, M.J.O., Preston, C.D., Roy, D.B., Savage, J., Tweddle, J.C., Robinson, L.D. (2012). Understanding Citizen Science and Environmental Monitoring. Centre for Ecology and Hydrology

Schwartz, M. W. (2006). How conservation scientists can help develop social capital for biodiversity. Conservation Biology, 20, 1550–1552.

Sharpe, A, Conrad, C. (2006). Community based Ecological Monitoring in Nova Scotia: Challenges and Opportunities. Environmental Monitoring and Assessment (2006) 113: 395–409

Shirk, J. L., H. L. Ballard, C. C. Wilderman, T. Phillips, A. Wiggins, R. Jordan, E. McCallie, M. Minarchek, B. V. Lewenstein, M. E. Krasny, Bonney, R. (2012). Public participation in scientific research: a framework for deliberate design. Ecology and Society 17(2): 29.