Exploring those characteristics which may help to foster and support people's social-ecological resilience: an environmental volunteering case study

Valentine Seymour[1] · Mike King[2] · Roberta Antonaci[3]

Abstract

Engaging in environmental community-based practices such as environmental volunteering has been shown to offer a range of benefits, including social connectivity. There has been a growth in studies exploring the potential impact of people engaging in environmental community-based practices has on the resilience of social-ecological systems. However, these studies have not fully explored those characteristics environmental volunteering groups undertake which can help to promote and support the resilience of social-ecological systems. This study provides further understanding about social-ecological resilience and examines how environmental volunteering has the potential to promote and strengthen the resilience of social-ecological systems. This is explored through the lens of four characteristics regarded as key attributes fostering resilience in social-ecological systems using focus group interviews: activity, self-organisation, connections and skills and knowledge. The study is reported from the perspective of 13 local community groups in Greater London (UK) who engaged in environmental volunteering as a case study. Findings show there to be variability in these characteristics explored amongst local community groups, providing further contextual insight into how these local community groups operate. By exploring these characteristics, groups were able to understand how they operate, knowledge which can then be used to enhance their future activities to help strengthen the resilience of social-ecological systems.

Keywords Local community groups · Social-ecological resilience · Civic ecology · Impact measurement · Case study

Introduction

Within the last decade, the relationship between engaging in environmental activities and health has received increasing attention with regard to its importance for the vitality of individuals, communities and natural environments (Monroe 2003; Hargreaves 2011). To strengthen this relationship, some suggest the need to adopt a resilience perspective to promote and support the adaptability of communities and natural environments (Wulff et al. 2015).

More recently, the UK government has set out several campaigns to encourage community resilience (Steiner and Markantoni 2014). These government-led campaigns have emerged in part to increase the efficiency of public spending. These campaigns are also guided by the view that communities are able to take responsibility for their own actions as well as to draw from their skills, connections and expertise to develop solutions to local challenges (Steiner and Markantoni 2014). Reasons for this relate to a community's ability to engage in collective action, to provide service delivery and to connect with a hard to reach population as well as to foster trust both in action and communication (Büchs et al. 2012). In response, there has been a growth in studies exploring the potential impact that engaging in environmental community-based practices has on the resilience of social-ecological systems (e.g. Tidball and Krasny 2007; Svendsen and Campbell 2008; Crona and Hubacek 2010; Barthel and Isendahl 2012; Fisher et al. 2012; Tengö et al. 2014; Dolan et al. 2015).

✉ Valentine Seymour
  alentine.seymour.12@ucl.ac.uk

1 Department of Civil, Environmental and Geomatic Engineering, University College London, Gower Street, London WC1E 6BT, UK

2 Resources for Change, Y Wern, Powys, Wales SY22 6PF, UK

3 The Conservation Volunteers, Sedum House Mallard Way, Doncaster DN4 8DB, UK

To date, a full exploration of selected characteristics which can help to promote and support such relationship is an understudied area of research in the voluntary sector, particularly those voluntary groups who engage in environmental community-based practices. Nor have they used collaborative approaches (e.g. focus groups) and provided useful feedback to the community-based groups themselves so that they may use it to strengthen their future impacts on the resilience of social-ecological systems and related benefits (e.g. ecosystem and social outcomes). Therefore, this article aims to explore this gap in knowledge.

This article reports a study which implements a cross-sectional research design, using focus group interviews. As environmental community-based practices were a broad topic, it was therefore not feasible for us to address the aim's entirety in this study. We therefore narrowed the research focus, reporting from the perspective of 13 local community groups in Greater London (UK) who engaged in environmental volunteering activities as a case study. Community groups in this study were apolitical thus avoiding any activism, and who engage in a wide range of environmental activities including habitat management and ecological restoration. Reasons for this selection was twofold. First, environmental volunteering is a type of environmental community-based practice and shares many goals with other environmental community-based practices (e.g. civic ecology practices; see Krasny et al. 2014) which each engage members of the public in activities that help contribute to the natural environment (Bruyere and Rappe 2007; Svendsen and Campbell 2008; Measham and Barnett 2008; Smith et al. 2010). Findings observed in this study can therefore be applicable to similar environmental community-based practices. Second, environmental volunteering has a more direct involvement in managing the natural environment in comparison to other environmental community-based practices (e.g. raising awareness of issues relating to environmental policy and fundraising activities) which tend to be indirectly involved.

Specifically, this study aimed to:

- explore key characteristics undertaken by those who engage in environmental community-based practices and how these have the potential to foster the resilience of social-ecological systems at group level;
- assess the types of self-reported activities of those who engage in environmental community-based practices and whether they act as enablers or barriers within the key characteristics being explored; and
- examine group differences in the type and amount of self-reported activities they undertake within the key characteristics being explored.

Social-ecological resilience, civic ecology and environmental volunteering

'Resilience' is a widely used concept that has been studied across various fields, including social-ecological systems (Adger 2000; Folke et al. 2016), disaster preparedness (Norris et al. 2008; Longstaff et al. 2010), business continuity (O'Sullivan et al. 2015) and adaptive capacities of individuals (Butler et al. 2007). Resilience can be described as a system or item's capability of recovering or adjusting to adverse change (Adger 2000). As the concept of 'resilience' has been interpreted in various ways across disciplines, evaluation frameworks developed have been orientated towards a specific research domain and is often described in accordance with different characteristics (O'Sullivan et al. 2015). For instance, in disaster preparedness, resilience has been described as the ability of a community to adapt to adversity through changing its basic function and structure (Norris et al. 2008). Within this, resilience is viewed through the lens of community adaptation, which has been evaluated through its various characteristics, including community competence, resources (e.g. economic capital) and wellness (Norris et al. 2008; Houston et al. 2015). In this study, we refer to social-ecological resilience. This is due to the study's focus on ecological and social systems as well as being more relevant to the aims and subjects discussed in below sections: civic ecology and environmental volunteering. Social-ecological resilience is described as the capacity of social-ecological systems (e.g. biosphere and communities) to maintain their structure and functioning despite any perturbations and other stresses (Folke et al. 2016). Originating from systems ecology, social-ecological resilience draws on the assumptions of non-linear dynamics of change in complex systems, focusing on a systems' ability to adapt or transform in ways that continue to support the well-being of humans and non-humans alike (Wilkinson 2012). The concept itself draws on two systems: social and ecological (the latter of these is also termed the biosphere) (see Folke et al. 2016).

Social systems are those systems which integrate human dimensions, such as community, economic, societal, political and cultural. The biosphere refers to the global ecological system which integrates all living things (e.g. humans) and their relationships, with their interactions with Earth's dynamic systems (e.g. the water cycle) (Folke et al. 2016). When integrated, social-ecological systems place emphasis on the interconnectedness between them, where both systems shape, are shaped by and evolve together from local to global scales (Folke et al. 2016).

In recent decades (e.g. 2000 to present), there has been a gradual increase in the number of studies examining the relationship between resilience and social-ecological coupled systems, including resource depletion and natural disasters (e.g. Adger 2000; Berkes and Jolly 2001; Norris et al. 2008; Kelly

et al. 2015; Johnson et al. 2019). Of these relationships, there has been a growth in studies exploring the potential impact that engaging in civic ecology practices has on local urban communities (e.g. Barthel et al. 2010; Dolan et al. 2015; Johnson et al. 2019).

Civic ecology a type of environmental community-based practice that can be defined as community-based practices used to conserve, manage and create green infrastructures in urban cities, such as community gardens and allotments (Krasny et al. 2014). Civic ecology practices often reflect the local environment and culture, forming partnerships with scientists and non-profits and government organisations (Krasny et al. 2014). These practices not only work towards protecting and enhancing the natural environment but are also part of other large-scale environmental initiatives, such as reconnecting people in cities (Svendsen and Campbell 2008; Krasny et al. 2014). Examples include community tree planting and urban environmental stewardship (Tidball et al. 2010; Connolly et al. 2014; Dolan et al. 2015).

Environmental volunteering is another type of environmental community-based practice and refers to the practice of unpaid volunteers spending time engaging in a wide range of practical conservation and outdoor-based activities, including pond weeding, dry stone walling and coppicing trees (Measham and Barnett 2008; Smith et al. 2010; Seymour and Haklay 2017). Examples include environmental volunteering or certain Non-Governmental Organisation (NGO) projects (e.g. the Burrenbeo Trust in Ireland). Environmental volunteering shares some parallels with civic ecology practice, as both engage members of the public in activities that help contribute to the conservation and restoration of natural environments (Krasny et al. 2014). However, environmental volunteering can be viewed as a partial definition of civic ecology practice. What distinguishes these two practices is the types of activities they engage in. Whilst in civic ecology practice, it 'refers to local, hands-on environmental stewardship actions taken to enhance both green infrastructure and community well-being in human-dominated systems' (Krasny et al. 2014: 178), environmental volunteering projects are also involved in activities 'such as donating money or signing petitions' (Krasny et al. 2014: 178).

Researchers have identified various reasons why volunteers are motivated to volunteer in nature conservation projects (Russell 2009). These include, though are not limited to, the following motivations. First, studies show that volunteers are motivated to engage in these projects owing to their love or enjoyment of the outdoors (O'Brien et al. 2008; Sonti and Svendsen 2018). Second, volunteers have also indicated social and cultural factors, such as social connectedness with other volunteers and making a difference to their community. Third, people can be motivated to volunteer to improve their skills and employability (Russell 2009). Fourth, more recently studies have identified a new perspective of environmental

volunteering in the way of motivations, linking instead volunteers' motivations to participate in ecological restoration projects can be strengthened or weakened depending on the promise of hedonic experiences (e.g. pleasant or unpleasant experiences) (Strzelecka et al. 2017; Strzelecka et al. 2018; Woosnam et al. 2019). Yet, as O'Brien et al. (2008) highlight, it can be hard to distinguish a clear motivation, and is instead collective and can change throughout a volunteer's lifetime.

Engaging in environmental community-based practices, such as civic ecology practices and environmental volunteering, has been shown to offer a range of benefits (e.g. Krasny et al. 2015; Seymour et al. 2018). These include strengthening ecosystem and social outcomes (e.g. food production and social connectivity) from individual communities to larger ecosystem system scales due to each scale's interactive nature and feedback loops (Krasny et al. 2015; Folke et al. 2016; Johnson et al. 2019). Such social and ecosystem outcomes generated from civic ecology practices have also been suggested to foster local urban resilience through its ability to develop personal and collective capacity (e.g. adaptive co-management) in response to environmental change and sustain themselves (Krasny and Tidball and Krasny 2009; Barthel et al. 2014; Kelly et al. 2015). Examples of recent work in this area include the co-production and connection of diverse knowledge systems to enhance ecosystem governance (Tengö et al. 2014), as well as the adaptive co-management systems supported by various organisations at different levels (e.g. stewardships and non-governmental organisations) which share the power of resource management in tune with the biosphere (Barthel et al. 2005; Folke et al. 2016). However, whilst these studies provide useful insights into the relationship between resilience and social-ecological coupled systems, they remain largely generalised in scope, conducting evidence base analysis of existing literature or exploring the management of civic ecology practices more broadly (e.g. Barthel et al. 2014; Tengö et al. 2014). To date, they have not yet studied in-depth selected characteristics which can promote and support such relationships. Nor have they used collaborative approaches (e.g. focus groups) and provided useful feedback to the community-based groups themselves knowledge which can then be used to enhance their future activities to help strengthen the resilience of social-ecological systems and related benefits (e.g. ecosystem and social outcomes).

It is therefore anticipated that our current understanding of those characteristics, which could help support the development of social-ecological resilience, would be better understood if we identify which supporting actions to implement as well as barriers to consider. This in turn would allow community-based groups (e.g. environmental volunteering groups), to better develop their practices to encourage these characteristics. This would also be valuable in assisting practitioners in socio-ecological and ecosystem service fields in

their understanding of how characteristics emerging from the engagement in these environmental community-based practices may strengthen ecosystem and social outcomes. Therefore, this study explores this gap in knowledge.

Social-ecological resilience and the Green Impacts project

The Green Impacts project was a two-year research funded project, undertaken by sustainable development consultancy, Resources for Change (see www.r4c.org.uk), and UK environmental charity, The Conservation Volunteers (see www.tcv.org.uk). It was conducted from April 2012 to April 2014 and explored two behaviours which could be generated or enhanced when people engage in environmental volunteering. Each of these behaviours were explored as two separate studies, one focusing on pro-environmental behavioural change and the other on characteristics of social-ecological resilience. Further details and findings of the pro-environmental behavioural change study are reported in Seymour et al. (2018).

The second of the two studies is reported in this paper and focuses on those behavioural characteristics of those who engage in environmental volunteering which can promote and support the resilience of social-ecological systems. In particular, the study focused on the following characteristics which are summarised below: activity, self-organisation, social connections, and skills and knowledge. The four characteristics have been highlighted by other researchers as key attributes fostering resilience in social-ecological systems and have received most attention in this research area (e.g. Krasny and Tidball 2009; Kelly et al. 2015; Folke et al. 2016). Whilst the study focuses on characteristics which occur in social systems (e.g. social connections), civic ecology practices like environmental volunteering often use these characteristics with an aim to maintain the structure and functioning of the natural environment, thus enhancing the environment's resilience.

Activity

Activity refers to the engagement and regularity of a person's involvement in an activity or interaction within a community group. Within social-ecological resilience, the type as well as level of activity that one or more members of the group engage in can facilitate and support social systems whilst serving as a source of input to carry out activities to manage and sustain ecological systems (Krasny and Tidball 2012). These can include volunteer management meetings, local community engagement events (e.g. bat walks) and conservation activities (e.g. woodland management). Studies have shown engagement and communication can be important assets in facilitating resilience to construct social support, create a sense of belongingness, achieve goals and develop relationships

(Norris et al. 2008; Houston et al. 2015; O'Sullivan et al. 2015). Activity can be evaluated through identifying the type and frequency of activity that one or more group members engage in. This measurement is important from a project management perspective, particularly when planning for regular activities (e.g. weekly or monthly) or single events which can lead to the promotion of social ecological resilience in relation to their ongoing and future sustainability. This is because any variability in either characteristic can enable or inhibit project management. Through understanding local community groups' interacting activities and engagement behaviours could be considered an important characteristic in relation to the goals they wish to attain and whether they were attainable.

Self-organisation

Within social systems, self-organisation can refer to a group of peoples' abilities to work together towards a collective goal, having the ability to make decisions, manage resources and readily adapt to changing conditions. Within social-ecological resilience, self-organisation can be viewed as an adaptive governance process (e.g. learning by doing), leading to the resilience of both social and ecological systems in response to change (Barthel et al. 2005; Tidball and Krasny 2007). This can encompass a host of activities (e.g. developing objectives and managing resources), which can be measured similar to 'activity', through identifying the type and frequency of these activities that one or more group members engage in (Krasny and Tidball 2009). Evaluating self-organisation as such could enable civic ecology practices to implement plans to increase their degree of long-term management and self-sufficiency, such as adequacy of recruitment and retention, as well as the allocation of equipment and training resources (Steiner and Markantoni 2014). This is supported by research which shows that a group that is effective in self-organising has the resources in place to deliver its aims and have plans in place to gain new resources, as they are needed (O'Sullivan et al. 2015; Kelly et al. 2015).

Skills and knowledge

Skills and knowledge are two separate yet related concepts. Knowledge refers to factual information and theoretical concepts learnt through sensory input (e.g. reading and listening), whilst skills is the ability to apply knowledge to situations developed through practice (e.g. problem-solving and driving) (Tidball and Krasny 2007). Within social-ecological resilience, skills and knowledge that one or more person possess in a group can be viewed as tools for promoting or supporting social and ecological systems that can lead to action and advocacy (Tidball and Krasny 2007). These can be both technical and interpersonal and include communication, administration, practical woodland management and ecosystem

functioning. Groups who understand their skills base and recognise its local value are well placed to share the skills and local knowledge with the wider community and learn from others. One way is through direct measurement. Though some elements of these two concepts can be hard to measure (e.g. problem-solving ability and tacit knowledge), a group's degree of knowledge and skills can be measured by the level and type they attain collectively. In doing so, this can lead to adaptive learning, a characteristic which can also help to encourage resilience (Krasny and Tidball 2012). This can be helpful to local community groups, enabling them to tailor future programmes to enhance the fit between volunteers' contributing attributes as well as the group's sustainable functioning (Magis 2010).

Social connections

Finally, social connections or networks are the relationships you have with those around you, such as co-workers, friends, family and stakeholders. Within social-ecological resilience, social connections are those who create and support social systems whilst serving as a source of input to carry out activities to manage and sustain ecological systems. These can include funders, environmental volunteers, project officers and local business partners. This characteristic can encourage a sense of social cohesion and belonging as well as contributing to the connectedness of a group or community (O'Sullivan et al. 2015). This characteristic is important due to its potential ability to help foster engagement and related benefits (e.g. diffuse information and coordinate management efforts), whereby the wider and more diverse a group's social network enhances their ability to share and learn information. Groups who widen and diversify their social networks have the ability to promote social-ecological resilience outcomes, enhancing their ability to integrate more effectively into their locality, encouraging adaptive learning, receiving feedback on local issues, aspirations and opportunities (Tidball and Krasny 2007; O'Sullivan et al. 2015). However, for such approach to be beneficial requires sufficient time, effort and an adequate scale of resources from the groups themselves. Further, connections can be simpler to evaluate than the other three indicators, detailing the number and type of connection one or more group members attain. Such information is again helpful to local community groups, enabling them to identify the strengths and weakness of their existing social network as well as develop and implement plans to improve this network (e.g. distribution of connections in the group) to best enhance their ability to promote social-ecological resilience outcomes.

Study design and methods

To examine those characteristics employed by environmental volunteers to help promote and support the resilience of social-ecological systems, the following methods were used from December 2013 to June 2015: focus groups interviews, general inductive and descriptive analytical methods.

Participants

The snowball sampling method was used to identify and recruit volunteers. This was because the sampling population was unknown prior to the study (Carter and Lubinsky 2016). There are various strengths to this sampling method, including accessing unknown or hard to reach populations, diffusing knowledge about the study, fostering collaborative with ourselves and participants, as well as overall cost-effectiveness (Bryman 2012). Weaknesses of this methods include nonresponse biases and issues gaining access to sampling populations for various reasons (e.g. organisation protocols) (Carter and Lubinsky 2016). As these convenience methods do not give all individuals in the population an equal chance of being selected, the sampling population may not be truly representative, thus increasing potential biases which may reduce the validity of findings (Bryman 2012; Carter and Lubinsky 2016).

The sampling method was conducted as follows. An initial Internet search was first conducted to identify those local community groups which met the study criteria (Bryman 2012). Our criteria defined the sampling population to include those local community groups which were all not-for-profit organisations and charities that engaged in environmental volunteering activities within Greater London (UK). Those involved in these groups were all unpaid and were short- and long-term environmental volunteers (see Seymour and Haklay (2017) for the definition of short- and long-term volunteers). Reasons for this selection was twofold. First, the groups shared goals with many other environmental volunteering organisations and community groups across the UK, engaging members of the public in activities that help contribute to the conservation and restoration of natural environments (Bruyere and Rappe 2007; Measham and Barnett 2008; Smith et al. 2010). Findings from this study can therefore be applicable to other similar environmental volunteering organisations and local community groups (Bryman 2012). Second, those groups with short- and long-term volunteers were selected (Seymour and Haklay 2017) to ensure that the study could explore groups' existing volunteering activities in order to provide useful feedback to the community-based groups themselves so that they may use it to strengthen their future social-ecological resilience and related benefits (e.g. ecosystem and social outcomes). One-off volunteering events were therefore not able to be included for this reason (see Seymour and Haklay (2017) for the definition of one-off volunteers). Additionally, Greater London was selected as a study location due to the distances travelled, time and resource availability of the authors. From the initial search, 20 groups were

identified as meeting the criteria, 7 of which responded to author's email invitations and were therefore representative of an 'accessible target population' (Bryman 2012). Those who were unable to participate were either being unavailable at the time of the study or did not respond.

These initial groups were then able to act as gatekeepers and assisted authors in identifying other groups which met our sampling criteria (Bryman 2012). This was because this approach was effective in diffusing knowledge of the research over a wide geographical area, fostering both collaboration and trust between the author and participants (Rattani and Johns 2017). Collectively, gatekeepers had connections to 8 further groups, 6 of whom were recruited for the study. High ethical standards were maintained throughout the study to reduce any potential for harm and upset to the participants. Authors adhered to all requirements stated in the UCL Ethics Committee Research Ethics guidelines and the study did not require any ethical approval. This was because the study did not include any of the following: vulnerable groups, deception and intrusive interventions as well as personal or sensitive information. Each local community group was provided with an information sheet explaining the nature, purpose and general format of the interviews. A written consent form was also attached to the information sheet. Volunteers were asked to sign the consent forms only after they had read, understood and voluntarily agreed to be involved in the research, enabling them adequate time (e.g. 1 to 4 weeks) to ask any questions they had. Participants were also aware that they could withdraw from the study at any time.

The study sample comprised of 70 participants from 13 local community groups consisting of between 4 and 10 participants per group. Further details about each group's backgrounds and characteristics as well as how they were recruited in this study are summarised in Table 1.

Groups varied in the number of volunteering sessions held throughout the year. Further details on how environmental volunteering sessions are delivered more generally as well as how volunteers engage in these volunteering sessions are available in in Seymour and Haklay (2017).

Groups also engaged in a variety of environmental volunteering projects. Projects include habitat management, creation, restoration and maintenance as well as creating new nature gardens for local communities and schools. As the groups are all located in Greater London, all projects occur in urban settings. Urban settings in the UK have been described as being continuously built-up or at least highly predominant. Approximately, 47% of Greater London is defined as being 'green', 33% of which is classified as natural habitats (e.g. parks, woodland, wetland, farmland) within open space according to surveyed habitat information and 14% is estimated to be vegetated private and domestic garden land (see https://www.gigl.org.uk/keyfigures/).

Each group was established at least 6 years prior to the start of this study and were established by their founding members for their own individual purposes, including enjoyment of being outdoors, wanting to protect the natural environment and skills development (Measham and Barnett 2008; Smith et al. 2010; Asah and Blahna 2013).

It is noteworthy that volunteers from each of the different local community groups represented a diverse demographic background (e.g. gender, level of deprivation, age groups and ethnicity). The socio-demographics of volunteers were not recording and therefore are not included in this study. This was in line with the ethical practices and a data sharing agreement with TCV, with all volunteer information being both confidential and anonymised.

Research design and data collection

A snapshot and cross-sectional research design was used to explore the four selected characteristics (Bryman 2012). Thirteen focus group interviews were conducted from December 2013 to June 2015 with local community groups. Each interview length was approximately an hour and a half duration ($n = 19.5$ h). Interviews were conducted by the first and third author, each having a good level of experience in using the method and an in-depth knowledge of social-ecological resilience and environmental volunteering (Patton 2002). Due to time and resource availability of the volunteers, focus group interviews were held at community centres, booked conference rooms and offices used by local community groups and external stakeholders (Doody and Noonan 2013).

Focus group interviews consist of two main parts: icebreaker and group discussion. Icebreaker sessions were used at the start of the focus group discussions (Kilanowski 2012). In these sessions, volunteers from each local community groups were asked to say their name and to introduce themselves. This approach was used as a pre-intervention strategy to allow the researchers to become acquainted with the volunteers and increase group interpersonal interactions as well as engage volunteers in understanding the objectives of the study (Kilanowski 2012). When transcribing the ice breaker session, volunteers' identities were protected using pseudonyms (Patton 2002), with the data collected not being used in the main data analysis. This was because the session was used purely as a pre-intervention strategy and did not relate to the study's overall aim (Kilanowski 2012).

The focus group discussion directly followed the ice breaker session and was used to collect data relevant to the study's aim. In this session, the groups were each asked a series of semi-structured open-ended questions which aimed to explore each of the four characteristics in turn, providing a description of each characteristic at the start. Questions relating to each

Table 1 Summarised descriptions of the four characteristics explored for the local community groups. Group's background information, individual characteristics and how they were recruited in this study

Group no.	Group goals	Description of group activities	Approx. size of the key long-term group members (*[1]—see also Seymour and Haklay [2017])	Approx. years the group have been active	Recruitment method used
1	To provide a wildlife-friendly community space with a focus on and increase awareness of environmental sustainability and 'forest gardening'. To support local community food growing projects for the benefit of the local community and wider environment.	Teaching members how to recognise edible plants, how they are grown in the forest, and how to cook them.	10	9	Gatekeeper
2	To protect, promote and enhance an important inner-city London park.	To plan improvements to the park (e.g. sports facilities), to complete planning applications, to develop a programme of community event and wildlife projects.	13 committee members and 200 voting members.	6	Email invitation
3	To maintain the woods for the benefit of plants and wildlife living in the woods and for the benefit of the public visiting the woods.	To hold weekly conservation sessions for volunteers, to collect annual membership fees apply for funds to buy resources (e.g. tools), to sell woodland products the group creates as well as to hold annual general meeting open to all stakeholders and members.	12	14	Email invitation
4	To promote the health, well-being and creativity of the local community, provide learning experiences and build a sense of community. It also aims to protect and enhance a unique and rare wildlife habitat in London.	To grow food, medicinal herbs and wildflowers, to undertake conservation activities, to construct on-site structures (e.g. main club house) and upkeep of the site, as well as undertake beekeeping events, well-being activities, arts and crafts.	10	9	Gatekeeper
5	To maintain the woods for the benefit of the woodlands, grasslands and wildlife for the benefit of the public visiting the woods.	To undertake conservation management of the flora and fauna on-site, and to ensure the site is safe to visitors whilst retaining its natural beauty and diversity.	17	35	Gatekeeper
6	To conserve and grow a variety of herbs and edible plants for the benefit of the group and the local community.	To undertake the conservation management of an allotment site as well as ensure the maintenance of the garden area.	5	10	Gatekeeper
7	To preserve the green space as an open space for the community to use.	To conserve and maintain the garden on a seasonal basis.	5	6	Email invitation
8	To enhance, encourage and facilitate the work done by volunteers concerned with nature conservation. It also aims to foster an interest in the natural world within the community.	To undertake the conservation management of the park, engage the community in wildlife events as well as oversee the training of volunteers.	10	22	Email invitation

Table 1 (continued)

Group no.	Group goals	Description of group activities	Approx. size of the key long-term group members (*1—see also Seymour and Haklay 2017)	Approx. years the group have been active	Recruitment method used
9	To preserve mature orchards for their biodiversity value, history, heritage, beauty, and fruit.	To grow natural fruits, to teach educational programmes about the orchards, and to sell their produce locally to support the project.	22	9	Email invitation
10	To care for the park and to ensure the improvement of its appearance, facilities and safety.	To conserve and maintain the park, to oversee the work undertaken by volunteers, and to train volunteers in areas of conservation management.	6	19	Gatekeeper
11	To demonstrate that rivers can be major assets to an urban environment. It also aims to bring natural beauty, educational facilities and wildlife value into urban landscapes and urban lives.	To conserve and maintain river environments, to restore river habitats, to monitor river wildlife, to provide input on riverside planning applications, to raise awareness about river wildlife through newsletters, exhibitions, events, and talks, as well as engaging in fundraising activities for financing these projects.	11	29	Gatekeeper
12	To help maintain and improve the ecology of the park.	To conserve and maintain the park, to oversee the work undertaken by volunteers, to hold a fitness programme for volunteers and to train volunteers in areas of conservation management.	5 committee members and 100 voting members.	6	Gatekeeper
13	To promote environmental sustainability within the borough and manage our sites to maximise biodiversity and encourage wildlife.	To undertake conservation training schemes, volunteer gardening sessions, health and well-being projects, environmental playschemes and environmental education in local schools as well as assist local groups in the design, plan and management of their green spaces.	8	35	Gatekeeper

*1 Volunteer numbers have not been included as numbers tend to fluctuate widely (see Seymour and Haklay 2017)

characteristic followed the same sequence only changing the characteristic name before moving on to the next characteristic (Patton 2002). Example questions used for 'Activity' are outlined below:

> What types of activities would you say your group engage in? Please can you provide examples of these where possible.
> Why do you engage in these activities?
> How often would you engage in these activities?

Based on our discussion, how active would you say your group was? Based on your rating for this characteristic and reflecting on your responses so far provided, what impacts do you think your activities have on the resilience of social-ecological systems? Reflecting on your existing activities and your rating for this characteristic, would you change anything about the activities your group engages in? If so, please provide examples of how you would do this. How might these changes, if any, have an impact on the resilience of social-ecological systems?

To ensure the validity, the questions used in the focus group interview were discussed with researchers from UK academic institutions and other non-governmental organisations with a good level of knowledge on social-ecological resilience and environmental volunteering as well as experience of conducting similar interviews (Patton 2002). Feedback provided strengthened questions making alterations where required. This was to ensure the questions were clear, neutral and sensitive in nature (Bryman 2012). Plans were also made in case any difficulties emerged, including phrasing of complex questions or prompts and any reserved members of the local community groups interviewed (Doody and Noonan 2013).

Each question was discussed in turn and asked volunteers to provide examples to support their answers (Patton 2002). Volunteers were also asked to record their answers onto post-it notes, an interactive method shown to help facilitate discussions as well as to draw out central ideas and encourage those reluctant volunteers (Peterson and Barron 2007).

A probing technique was also used throughout to encourage elaboration or explanation, using 5 focused follow-up questions (e.g. 'Can you tell me more about that?'). This technique has been shown to increase the richness and depth of responses (Doody and Noonan 2013). The technique also allowed the flexibility to focus on promising avenues of conversation that might not have otherwise been in the list of questions (Bryman 2012).

Each group was then asked to collectively rate themselves for each of the characteristics in turn. This enabled and supported our aim of examining any differences between the groups (Bryman 2012). Each question was rated using a 5-point Likert scale with a total score of 20, 5 being the most and 0 being the least (Joshi et al. 2015). The Likert scale was selected as a simple and readily comprehensible method where groups choose those options that best support their self-reported opinions and enabled us to measure these opinions (Joshi et al. 2015). It is noteworthy that the ratings were based on a group consensus and it is uncertain whether data generated might be subject to group effects (e.g. dominant group members and other group dynamics), particularly as volunteers were already known to each other and may be responsible for incomplete or biased information processing (Joshi et al. 2015). Rating scales for characteristics 'activity' and 'self-organisation' were based on their perceived frequency of occurrence (1 = 'never', 2 = 'rarely', 3 = 'sometimes', 4 = 'often', 5 = 'always'), whilst for 'connectivity' and 'skills and knowledge' scales were based on their perceived quality (1 = 'very poor', 2 = 'poor', 3 = 'fair', 4 = 'good', 5 = 'excellent'). Outcomes of the scales were therefore not comparable across each of the four characteristics.

All data collected was made both confidential and anonymised, where no individual could be linked to or identified from their data information, before being stored in compliance with the Data Protection Act (1998). In-depth discussion notes were written for each focus group interview and were validated by the volunteers during and at the end of each session. To ensure validity of information gathered, all content recorded was clarified with volunteers and their identities were protected using pseudonyms (Patton 2002).

Data analysis

Data analysis was conducted using a mixed method approach which consisted of two main parts: descriptive summary of each group's self-reported ratings for the four characteristics, and a hybrid thematic coding analysis of focus group interview discussion notes and post-it notes. The descriptive summaries were performed using R (Version 3.1.1) and qualitative analysis using Atlas.ti (Version 8).

Due to the nature and scale of data collected, each group's self-reported ratings were summarised for the four characteristics using a descriptive data analysis approach (Jebb et al. 2016). This approach supported the study's aim of examining the any differences between each group. Authors were also able to measure groups' self-reported opinions (Joshi et al. 2015). Likert scores were first summarised for each of the four characteristics as perceived by each local community group. The general descriptions for each of the four characteristics were then explored presenting their variable types, descriptions, group members involved and frequency or amount (Jebb et al. 2016). This flexible approach was used to reveal and visually represent the underlying features of the dataset, using both graphical (e.g. bar charts) and non-graphical (e.g. descriptive) summaries (Jebb et al. 2016).

Focus group interview discussion and post-it note data were then analysed using a thematic hybrid coding approach, integrating data-driven codes (inductive) with theory-driven ones (deductive), as detailed by Fereday and Muir-Cochrane (2007). Whilst this approach does share some similarities with Grounded theory, balancing both inductive and deductive reasoning, authors did not use a systematic set of procedures with the purpose of developing a substantive theory (Grbich 2013; Braun and Clarke 2008). Instead, the purpose of the approach was to progress towards the identification of overarching themes that captured a phenomenon rigorously and was used to categorise data into themes (Fereday and Muir-Cochrane 2007).

The thematic hybrid coding technique allowed flexibility to explore emerging data that was new or expanded on the predetermined codes that might not have otherwise been captured thereby enriching study findings. The technique also facilitated a systematic approach, assessing to what extent engaging in environmental volunteering has the potential to strengthen social-ecological resilience as well as whether the four characteristics explored were contributing factors

(Fereday and Muir-Cochrane 2007). An inductive approach was first used to identify key themes, categories and linkages that emerged from the text data (Thomas 2006). A deductive approach was then used to analyse the discussion and post-it note data using predetermined codes based on the four characteristics being explored in this study (Fereday and Muir-Cochrane 2007). During these two stages of analysis, the themes which emerged through the inductive coding of the focus group interview discussion and post-it note data were first compared with concepts and themes mentioned in relating literature (e.g. co-management system; see the literature section of this article). The focus group interview discussion and post-it note data was then additionally coded in relation to the concepts and themes mentioned in relating literature as part of the deductive coding stage. This data triangulation approach was used to increase the credibility and validity of the results as well as to strengthen the knowledge and understanding about the phenomena being explored (Patton 2002; Bryman 2012).

Coding was conducted by the first and last authors, each with in-depth knowledge of social-ecological resilience and environmental volunteering (Grbich 2013). Intercoder reliability was measured using a simple proportion agreement method due to the large-scale variations in coding, and exploratory nature of the study (see Campbell et al. 2013). An intercoder agreement score of 79% percent was identified which is deemed acceptable (Kurasaki 2000; Campbell et al. 2013). This was achieved using a mutual codebook and interrater agreement between coders on coding categories and level granularity (Campbell et al. 2013). The codebook contained the following aspects: code type, basic definition of code, a full description of code, granularity of code, guidelines of when and when not to use it as well as examples. This approach increased consistency in coding, intercoder reliability as well as training and support to all coders (Campbell et al. 2013).

Results

Findings from this study explore the ways in which engaging in environmental volunteering has the potential to strengthen social-ecological resilience at group level. The local community groups' self-reported ratings are first summarised for each characteristic. The in-depth interview discussions are then explored. Direct quotations from the discussion and post-it notes illustrate selected themes and serve to contextualise volunteers' responses. Pseudonyms were used to protect the identity of respondents.

Resilience profiles of local community groups: self-reported scores

Descriptive measurable summaries of the 13 local community group's self-reported scores for each characteristic explored are found in Fig. 1. Nine groups perceived the amount of activity they engaged in to be high and rated themselves with a score of 5 (e.g. 'always'). The remaining 4 groups perceived their activity levels as either scores of 1 (e.g. 'never' active) or 4 (e.g. 'often' active). Further, all 13 groups reported mixed scores for their overall amount of self-organisation they perceived themselves to be engaged in, ranging from a score of 1
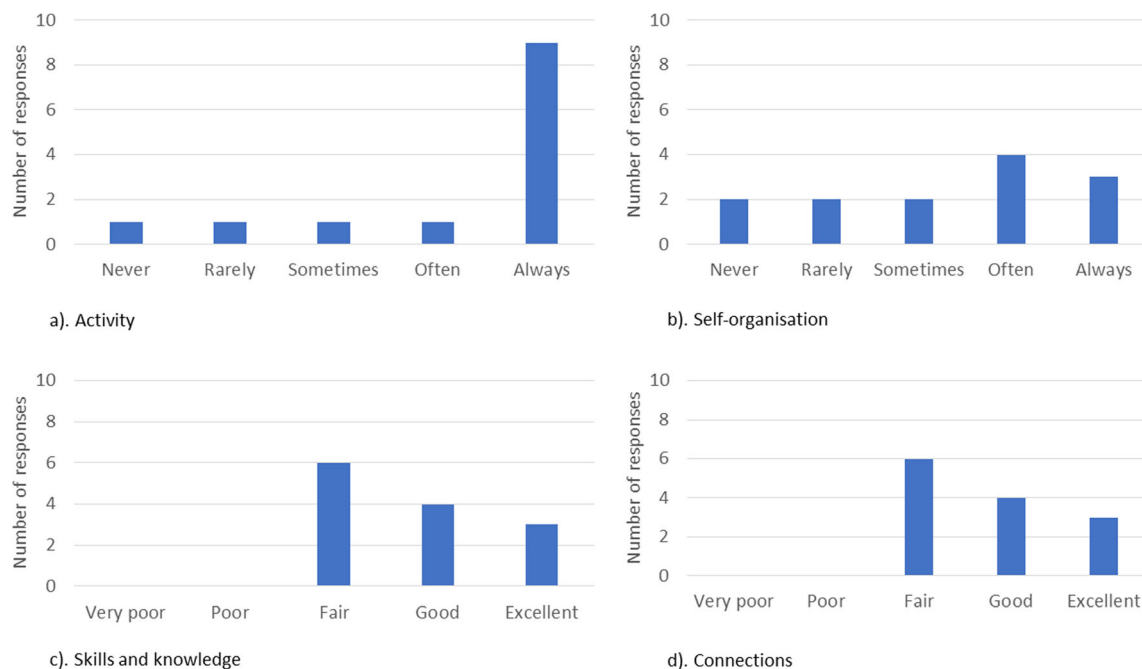

Fig. 1 General summary of local community groups' perceived scores for each characteristic

(e.g. 'never') to 5 (e.g. 'always'). No groups reported their level or quality of connections and skills and knowledge to be 'poor' or 'very poor' (score of 1 and 2), instead scoring themselves from 3 (e.g. 'fair') to 5 (e.g. 'excellent').

Summarised descriptive notes for the characteristics explored with each of the groups are found in Table 2. The table illustrates the various types of activities the groups engaged in for each of the characteristics explored. The number of activity types per characteristic ranged from 2 to 11, and covered a wide spectrum, including involvement in management plans, experience in financial organisation and obtaining skills in public relations. For instance, 2 groups reported that few members had knowledge in administration, whilst the other 11 groups reported a wide range of skills in horticulture and conservation, from non-experienced to those more experienced. Similarly, there were mixed responses between groups in terms of the number of connections they had with local services, ranging from none to 10. There were also mixed findings in the number of group members being involved in the different activity types. For example, whilst there were often 1 or 2 members involved in undertaking finance and resource management activities, all members were involved in environmental volunteering activities.

Resilience of local community groups: group discussions

The 13 local community groups in this study presented mixed responses to the focus group interview questions. The responses and discussions for each these characteristics as well as other relating themes which emerged are outlined below.

All groups in this study reported that they were engaged in a variety of different activities or interactions both within the group as well as the local community. Activities included holding committee or community 'meetings', 'frequent email correspondence' and 'local events', as well as undertaking regular local conservation and community activities (e.g. guided wildlife walks and community gardening). However, differences were identified in the amount of activities each group engaged in. Reasons for these differences in activity levels related to a number of factors, such as issues surrounding land ownership, financial resources, seasonal variability and ability to self-organise. For example, 11 groups reported that they engaged in regular amounts of activities on a weekly or fortnightly basis, with one volunteer commenting:

[W]e carry out various activities every Tuesday and Friday as well as the first and third Sundays of every month. Our activities centre on conservation, environmental education, and sustainable agricultural techniques due to them recognising that children are future guardians of the environment. A lot of activities take place at the ecology centre, including, pond dipping,

talks on sustainable living, star gazing, tree identification, and habitat creation for badgers, bats and foxes. We also organise Green Fairs in which organisations can come and demonstrate different skills or sell locally made, organic products.

By contrast, only 2 groups noted having a low amount of activities. For example, one volunteer stated:

[W]e meet once every three to four months to have discussions. However, as four members are family or close friends, they sometimes talk about the green 'off the record' in between this time. We work on the garden on a seasonal basis and highlight the need for further activities to enhance our group's intercommunications.

Further, 9 groups in this study identified sources of 'activity' as being one way to strengthen the resilience of ecological and social systems (e.g. restoration of natural habitats). These groups reported this to occur both at a group level through holding regular volunteering sessions or committee meetings as well as those within the local community that engaged in the group's community events (e.g. social connection). Three of these groups went on to suggest social and ecological system outputs fostered by these activities which can strengthen the resilience of these systems. These outputs included widening social connectivity (both at group and wider community levels) and the groups' support system (e.g. collective capacity building; see Krasny and Tidball 2009; Barthel et al. 2014; Kelly et al. 2015), as well as increasing the awareness and capacity to learn about the environment and its ability to sustain human well-being. These 3 groups also identified other secondary social, environmental and economic impacts associated with increase amounts of activity, including transferable learning opportunities and increases in financial capital to support groups' environmental practices.

For example, as one volunteer stated:

[We] are very hospitable and the idea of events on the green such as Christmas mulled wine, summer BBQ, and cake sales could be the projects best way to raise community resilience.

This is supported by another volunteer who noted:

We are looking to strengthen current links with residents and the wider community as well as help other community groups carry out their activities. By doing this, we could ensure greater support for various projects as well as a more consistent core or base of volunteers that are needed in order to carry out planned activities and events.

Table 2 The table illustrates the various types of activities the groups engaged in for each of the characteristics.

Characteristic	Types of activities	Description	Frequency, number or quality	Number of group members involved
Activity	Environmental volunteering sessions	Group members engage in a wide range of practical conservation and outdoor-based activities. These include food growing, pond weeding, dry stone walling, and coppicing trees.	Ranges from 2 days a week to monthly	All members
	Events	Educational learning programmes for schools, guided walks and fairs to sell local produce (e.g. vegetables or homemade chutneys).	Ranges from monthly to every 6 months	1 or 2 members of the group
Self-organisation	Fundraising and finance	Financially resource and manage the daily running of these groups. This can include applying for funding grants, organising membership fees and raising charitable donations.	Weekly to 6 months	1 or 2 members of the group
	Meetings	Organised meetings are used to discuss topics relating to the management of the local community groups. These include events, activities and resources. These usually involve most group members, with some groups including external stakeholders, governing bodies and funders to attend.	Ranges from weekly to monthly	4 to 10 members
	Management Plans	Written documents which provide a detailed description of group's goals, objectives, activities and resource management plans. These plans are usually reviewed at meetings (see above) and assigned to one or more members of the group.	Yearly to every 20 years	1 or 2 members of the group
Connectivity	Contractors	People or firms that are hired by the group to provide materials or to perform activities. These include building materials (e.g. wood), hired equipment and those licenced to coppice trees.	None to 6 connections	1 or 2 members of the group
	Local services	Schools, colleges, governmental ministers (MPs), education outreach programmes and local businesses (e.g. garden centres) which provide goods or services (waste management) to the community or town.	None to 10 connections	4 to 10 members
	Other non-governmental organisations	Independently run charitable trusts and community-led organisations. These includes friends of the local park, resident associations and rehabilitation groups.	None to 3 connections	4 to 10 members
Skills and Knowledge	Public relations, communication and media	Communicated key messages about their work or advertise upcoming events to local newspapers and through social media platforms. This is usually done by one or more members of the group who have pre-existing skills and knowledge in this area.	Ranges from non-experienced to experienced	1 or 2 members of the group
	Finance and resource management	Financial and resource organisation within the group, including overseeing the management of a funding grant and the allocation of equipment required for the group's activities. This is usually by one member of the group who has been assigned the role of 'treasurer' who have pre-existing skills and knowledge in this area.	Few members are experienced	1 or 2 members of the group
	Horticulture and conservation	A wide range of gardening and habitat management activities, including food growing, community gardening, pond weeding, dry stone walling, and coppicing trees. These activities are mostly undertaken by all members of the local community group, some with pre-existing skills and knowledge with others learning from these members.	Ranges from non-experienced to experienced	4 to 10 members
	Administration	The general organisation of the local community groups, including computing, organising, scheduling and recruitment. This is usually by one or two members of the group who has been assigned the role of administrator who have pre-existing skills and knowledge in this area.	Few members are experienced	1 or 2 members of the group

Further, this study identified variability in each of the 13 groups' abilities to self-organise in relation to acquiring resources (e.g. fundraising and grant applications), decision-making processes, as well as strategic aims for the future of the group and its activities. For instance, 4 groups have a future management plan in place outlining any potential future risks and are supported through a regular funding source or self-sufficiency (e.g. membership fees). As one volunteer reported:

> [We] receive our income from various sources, the biggest being from fee-based education work that they do with schools in the borough and the contracts they receive to deliver environmental projects and training … Projects are also funded by the lottery and other charitable trusts.

Conversely, 2 groups in this study had no set aims or objectives. This related to various reasons, such as no formalised decision-making processes, permissions for use of land and lack of regular and consistent members. As one volunteer commented:

> It's hard to imagine the future … There is no secure or regular funding in place or funding applications. [We] do not have plans in place to recruit new members because there is no membership.

In addition, 3 groups noted that despite having a sufficient number of volunteers who were regularly involved in volunteering sessions which aim to support the natural environment, volunteers were often reluctant to get involved in other activities viewed as equally important for the self-organisation and sustainability of the group itself (e.g. committee meetings). This reluctance to be involved was viewed as a contributing factor reducing their group's continuity and adaptive capacity, particularly as those volunteers who are involved were soon to retire.

All 13 groups in this study presented a good degree of awareness of their skills and knowledge base, both within the groups themselves as well as those external stakeholders they connect with. These varied widely from those transferable skills and knowledge associated. For example, skills relating to existing employment (e.g. 'teaching' and 'project management'), as well as those skills more specific to their groups' activities, including 'conservation management', 'horticulture' and 'volunteer mentoring and co-ordination.' As one volunteer said:

> [We] currently have the knowledge and skills needed to complete our work. Our wide variety of backgrounds means that we can draw on a wealth of knowledge and experience to support our work. Some members are

experts on plants and animals found in the woods, some have expertise in woodland management and others in administration and use of IT. The group can also draw on outside expertise through the local council and contractors. Two of our members also are qualified in chainsaw use, two others are qualified to use herbicides, and a number of members have experience of using a brush cutter. But only one group member has access to a four by four vehicle, which we use for transporting heavy equipment and product around the woods.

Similarly, 10 groups in this study recognised their ability to make a wider contribution to their local environmental and community work, with one volunteer commenting:

> [We] serve the local community by providing herbs and lots of edible plants and educating young people who visit on school trips as well as those who have fallen out of school … liaising with local shops and businesses for prizes for the summer events which we organise.

In addition, 9 groups highlighted areas that they felt there was room for improvement as well as how particular skills and knowledge are distributed within the group themselves and those external stakeholders they connect with. For instance, as one volunteer stated:

> [W]e feel that more conservation knowledge is desired because knowledge of the plants specific to our reserve is limited. But logistics and cost limit our ability to do this. Also, we feel somewhat uncomfortable with public relations and using newspapers, so more development of public relation skills are needed. We do have access to these skills and knowledge through some members, but the members won't necessarily have the time to spare. Also, we feel that the group is dependent on certain members bringing skills and knowledge from other areas of their life and so over the long term there is a danger of not replacing any that are lost if [volunteer] recruitment is low.

In response, 5 groups in this study identified the need for merging knowledge both within the group and incorporating that from those external stakeholders or sources (e.g. ecosystem governance; see Tengö et al. 2014). For instance, 2 groups sponsored volunteers to attend relevant training courses held by third parties or other stakeholders. Three other groups held management meetings open to the public and its members and viewed this as a knowledge exchange opportunity (e.g. collective capacity to learn and adapt; see Krasny and Tidball 2009; Barthel et al. 2014; Kelly et al. 2015). These 5 groups felt such approach would both be used to support volunteer's ability to conserve the natural environment as well

as other group activities which can foster those characteristics explored in this study and strengthen their sustainability (e.g. the use of public relations to raise awareness of their work, recruit volunteers and increase social connectivity).

Finally, all 13 groups in this study reported a good degree of awareness of their social connections. Examples of social connections mentioned by these 13 groups included family, friends, schools, other local community groups, funders, members of the councils, housing associations and contractors. However, differences were identified in the amount of connections each group had. Reasons for these differences in the amount of connections related to a number of factors, such as time availability and size of the group as well as how connections are distributed within the group.

Three groups presented a wide range and amount of connections; many individual connections were shared equally across members of the groups. As one volunteer commented:

> [W]e have a strong range of connections we currently use, and many individual connections are shared between so in the event of loss of one of our committee members there would not be too much of an impact and increase our degree of resilience. We also have consistent ideas about what further connections we need and are gradually expanding the reach of our group where necessary.

In addition, there were 4 groups in this study who identified a good level of social connectivity (score of 4) owing to the co-management system the groups used (e.g. 'Friends of X' community groups). These groups worked collaboratively or in partnership with various stakeholders to achieve their ongoing activities, including council members, local businesses, schools and community associations. In doing so, these 4 groups were able to distribute activities more widely, update members on their activities and seek wider support in decision-making. These groups also felt their management system enabled their ability to foster and strengthen resilience in both social and ecological systems (e.g. restoration of natural habitats and social connection) as well as strengthening their community's ability to adapt to future changes.

Conversely, 6 groups reported a low amount of connections identified the need to expand their connections and outreach as well as distributing connections more widely within the group to ensure their long-term sustainability. As one volunteer commented:

> [T]wo of the group have the majority of the connections and each of these group members have different points of contact. This will be helpful in acquiring different skills and knowledge. Potential contacts are limited, but we could use them to meet the needs for working on the greenspace. These [potential contacts] could be

the local garden centre, scouts, guides, local flower shop and national lottery funding. If these contacts are used effectively as well as our existing contacts our group could achieve its main aim of becoming an enjoyable space in a short amount of time.

Discussion and implications of this study

The study finds there to be variability in those characteristics undertaken by local community groups those who engage in environmental volunteering activities regarded by some to be key attributes which have the potential to foster the resilience of social-ecological systems at group level (Krasny and Tidball 2009). The study's findings also provide further contextual insight into the types and variability of self-reported activities of those who engage in environmental community-based practices and whether they act as enablers or barriers within the key characteristics being explored (e.g. Barthel and Isendahl 2012; Barthel et al. 2014; Tengö et al. 2014). Such knowledge is useful for practitioners, policy makers and researchers for providing an understanding of existing behavioural characteristics of those who engage in environmental community-based practices (e.g. environmental volunteering sector) and how these may relate to social-ecological system outcomes. For example, if a community group engages in a high amount of activity (e.g. meetings, local events and group activities), this can help to facilitate and support social systems whilst also serving as a source of input to carry out activities to manage and sustain ecological systems (Krasny and Tidball 2012). This knowledge could also be used to help design environmental community-based practices that could help promote and strengthen the long-term resilience of social-ecological systems, identifying which enablers to implement (e.g. meetings and management plans) and barriers to consider (e.g. retention and funding resources) within those characteristics explored.

Additionally, the collaborative approaches (e.g. focus groups) used in this study could also be viewed as valuable to relevant practitioners, providing useful feedback methods to other groups who engage in similar environmental community-based practices. For instance, the method allows local community groups to not only identify their existing degree of skills and knowledge, but it also enables them to discuss ways of strengthening those skills or areas of knowledge that they feel could be improved (e.g. developing skills in volunteer mentoring). Such an approach could be used to strengthen those enabling characteristics in social systems (e.g. social connections), thus enhancing the resilience of social and environmental systems as well as other related benefits (e.g. well-being). Further discussions about those characteristics explored in this study are outlined below.

Most groups in this study perceived the amount of activity that one or more members of the group engage in as relatively high and centred on those activities which can facilitate and support social-ecological systems (Krasny and Tidball 2012). The findings from this study resonate with other similar studies (e.g. Krasny and Tidball 2009; Kelly et al. 2015; O'Sullivan et al. 2015). Further, when asked what impacts do you think your activities have on the resilience of social-ecological systems, groups in this study also identified social and ecological outputs fostered by these activities (e.g. food production and social connection), as well as identified other secondary social, environmental and economic impacts associated with increase amounts of activity (e.g. well-being). These findings from this study again resonate with other similar research (Krasny et al. 2015; Folke et al. 2016; Seymour et al. 2018; Johnson et al. 2019). Conversely, a few groups in this study instead reported a low level of activity when asked to rate how active the group was as well as the frequency of the activities they engaged in. Reasons for these differences between the groups in this study in activity levels are explored in other literature and relate to various factors, including issues surrounding landownership, sustaining motivation, financial resources, seasonal variability and ability to self-organise (e.g. Kelly et al. 2015). Of these reasons mentioned, the issue of sustaining motivation has also been raised by O'Sullivan et al. (2015). In their article, they highlight that whilst engagement in activity can be regarded as a characteristic fostering social-ecological resilience, without knowing how best to implement it in practice can make it a challenge (O'Sullivan et al. 2015). Further, in this study, differences were also observed during the analysis between groups relating to the types of activities they engaged in, covering a wide spectrum. These variable responses were often linked to those contextual factors as outlined above (e.g. financial resources and landownership). Such knowledge from this study can be valuable from a project management perspective when planning for activities (e.g. weekly or monthly) which can lead to the promotion of social-ecological resilience. For example, findings in this study suggest the need for other environmental community-based groups to engage in similar levels of activity regarded by participants in this study as relatively high (e.g. weekly or monthly) as well as those types of activities viewed as effective for facilitating and supporting social-ecological systems (e.g. educational learning programmes for schools, guided walks and fairs to sell local produce). Further, this study shows that such approach can assist local community groups understanding their existing interactive activities and engagement behaviours, knowledge which is useful for planning for future goals they wish to attain and whether they are attainable.

With regard to self-organisation, the analysis from this study presented differences between groups in the amount and types of contributing activities they perceived themselves to be engaged in. Differences identified in this study have been explored by other studies which have often related these differences to contextual factors or a groups' existing practices (e.g. co-management systems and contingency or business planning) to implement plans to increase their degree of long-term management and self-sufficiency (Steiner and Markantoni 2014; O'Sullivan et al. 2015; Kelly et al. 2015). These included acquiring resources and decision-making processes as well as strategic aims for the future of the group and its activities. For instance, whilst some groups reported a high level of self-organisation presenting a strong degree of long-term management and self-sufficiency, others were hindered by both internal (e.g. volunteer retention, reluctance to be involved and insufficient decision-making process) as well as external factors (e.g. financial resources and issues of land-ownership). Several elements explored by other studies might explain the trends identified in this study, including community competence, adequate tangible support, volunteer's own motivations (e.g. linked to hedonic experiences), use of co-produced knowledge and adaptive co-management system as well as flexibility (Norris et al. 2008; Tengö et al. 2014; Strzelecka et al. 2017, 2018; Woosnam et al. 2019). Findings from this study therefore suggest a high level of self-organisation might be needed to ensure the long-term management and self-sufficiency of these local community groups. This could be achieved through implementing similar practices at a similar frequency and quality as groups from this study, including applications for financial support, and frequent group meetings involving external stakeholders as well as developing a management plan. Further, findings from this study suggest that evaluating self-organisation using collaborative approaches (e.g. focus groups providing useful feedback), such as that used in this study, could enable other relevant practitioners that engage in similar environmental community-based practices, like environmental volunteering, to implement plans to help increase their degree of long-term management and self-sufficiency. These plans can include adequacy of recruitment and retention, as well as the allocation of equipment and training resources in order to effectively match a group' aims and management plans (Steiner and Markantoni 2014). Findings in this study are supported by other research which shows that a group that is effective in self-organising has the resources in place to deliver its aims and have plans in place to gain new resources, as they are needed (O'Sullivan et al. 2015; Kelly et al. 2015).

Finally, groups in this study were found to vary in how they rate themselves when asked to for their levels of social connectivity, skills and knowledge, ranging broadly from 'fair' to 'excellent'. Groups in this study varied in the numbers of social connections they currently engage with. Reasons for the differences found in this study in the amount of connections have also been explored by other similar studies relating these differences to several factors, including time availability, collaboration with multiple partners (e.g. co-management system),

size of the group as well as how connections are distributed within the group (e.g. Krasny and Tidball 2009; Houston et al. 2015). Further, those groups in this study who presented a large amount of connections with many individual connections were shared equally across the group worked as a co-management system (e.g. 'Friends of X') known to increase the resilience social-ecological systems (Krasny and Tidball 2009; Barthel et al. 2014; Kelly et al. 2015). Conversely, few groups in this study reported a low amount of shared connections when asked to provide examples, recognising their need to share these more equally. This importance to have a wide range of social connections external to the group as identified in this study is a finding shared more equally within a group and has also been noted by others (Tidball and Krasny 2009; O'Sullivan et al. 2015; Houston et al. 2015) and is an approach recommended by the authors of this study for other similar groups. This could be achieved through various social networking activities (e.g. holding open committee meetings and inviting external stakeholders to group events) therefore enhancing communication channels within the groups and stakeholders. One reason, as they suggest, is that this approach can ensure that external stakeholders are more invested in decisions, thus making the decision-making process better informed. Additionally, having a wider and more diverse social network can be an effective way to diffuse knowledge as well as enhance other aspects of social capital in the community (e.g. social cohesion and trust). This can permit groups to be more effective in working towards a collective goal, leading to the resilience of both social and ecological systems in response to change (Barthel et al. 2005; Tidball and Krasny 2007).

All groups in this study were acutely aware of their skills and knowledge base when asked to describe them, both those within the group and those of external stakeholders they connected with. Skills and knowledge identified by the groups in this study varied widely from those transferable (e.g. teaching and project management) and interpersonal (e.g. networking), to those more specific to their groups' activities (e.g. environmental conservation and volunteer co-ordination). Further, most groups in this study recognised areas for improvement when asked to review the knowledge skills they collectively obtained as a group and consider the impacts their activities have on the resilience of social-ecological systems. In particular, the groups highlighted the need to increase the distribution and sharing of skills and knowledge both within the group as well as incorporating that from those external stakeholders or sources, reflecting what other researchers term as 'ecosystem governance' (Tengö et al. 2014). This view highlighted by groups in this study is also shared by other scholars (Adger 2000; Krasny and Tidball 2009; Kelly et al. 2015) who comment on the importance of diversity and ecosystem governance when fostering social-ecological resilience as well as having the right set of skills and knowledge (e.g. environment specific and local knowledge). In doing so, this can lead to

adaptive learning as well as a group's ability to make more effective informed choices regarding its resource management, such as volunteer retention and recruitment (Krasny and Tidball 2012; Tengö et al. 2014; Folke et al. 2016). This perspective is also shared by the authors of this article who recommend the importance of environmental community-based groups who engage in similar practices to those groups in this study to understanding their skills set. This is because this approach can enable groups to tailor future programmes to enhance the fit between their contributing attributes with the ongoing sustainable functioning of their activities, fostering and strengthening the resilience of social-ecological systems in the process (Magis 2010). For example, one group in this study identified the need for furthering their knowledge of plants specific to their reserve which would increase the reserve's plant health which in turn would contribute to other ecological outputs (e.g. food production). Yet, authors also note that those attributes recognised as areas for improvement may differ across groups' depending various factors (e.g. types of activities they engage in as well as their future goals and objectives). These can range from those more generalised (public relationships) to those more specialised (e.g. conservation management techniques) and can often be limited by shared knowledge and/ or resources.

Study limitations and future research

There are two main limitations relevant to this study. First, findings observed were case specific to local community groups in the Greater London region that engaged in environmental volunteering. As these groups share goals with other environmental volunteering organisations in urban regions across the UK, findings observed in this study can be applicable to other similar environmental volunteering. However, it remains uncertain whether these findings can be applicable to local community groups in other urban and rural populations. It is therefore recommended that further work using the methods applied in this study would be beneficial to explore those characteristics presented by similar local community groups in other urban and rural regions. This would therefore enable one to determine whether these findings are more widespread amongst urban-rural populations.

Second, due to the nature of workshop discussions, it is uncertain whether data generated might be subject to group effects (positive and negative), particularly as volunteers were already known to each other. Reasons for this include dominant group members, peer pressure and other group dynamics and may be responsible for incomplete or biased information processing. Future research therefore needs to identify potential influences of group effects by both measuring separate individual and group effects as well as through implementing additional methods (e.g. one-to-one interviews with volunteers).

Conclusion

This study provides further insight on the nature of social-ecological resilience amongst local community groups within Greater London (UK) who engage in environmental volunteering, a type of environmental community-based practice. Characteristics explored were found to vary differ between groups regarded by some to be key attributes which have the potential to foster the resilience of social-ecological systems at group level. Findings from this study also provided further contextual insight into the types and variability of self-reported activities the groups engaged and whether they act as enablers or barriers within the key characteristics being explored. These findings can be particularly useful to volunteering services and local community groups to create programmes which encourage those enabling characteristics to foster the resilience of social-ecological systems. This knowledge would also be valuable in assisting practitioners in socio-ecological and sustainability fields in their understanding of how characteristics emerging from the engagement in these activities may promote ecosystem and social outcomes.

Most groups perceived the amount of activity that one or more members of the group engage in as relatively high and centred on those activities which can facilitate and support social-ecological systems. However, few groups instead reported a low level of activity. Reasons for these differences in activity levels relate to various factors, including issues surrounding landownership, volunteer's own motivations (e.g. linked to hedonic experiences), sustaining motivation, financial resources, seasonal variability and ability to self-organise. Differences were also observed between groups relating to the types of activities they engaged in, covering a wide spectrum. Through understanding their existing interactive activities and engagement behaviours, such approach can assist local community groups for planning for future goals they wish to attain and whether they are attainable.

In relation to self-organisation, groups differed in the amount and types of contributing activities they perceived themselves to be engaged in (e.g. acquiring resources). Several factors might explain these trends, including community competence, adequate tangible support, use of co-produced knowledge and adaptive co-management system as well as flexibility. Evaluating self-organisation groups can then use this knowledge to implement plans to increase their degree of long-term management and self-sufficiency (e.g. recruitment and retention).

Finally, groups were found to vary in how they rated themselves for their levels of social connectivity, skills and knowledge, ranging broadly from 'fair' to 'excellent'. Reasons for these differences related to several factors, including time availability and size of the group as well as how connections are distributed within the group. Further, all groups were acutely aware of their skills and knowledge base, both those within the group and those of external stakeholders they connected with. Groups also recognised areas for improvement. In particular, they highlighted the need to increase the distribution and sharing of skills and knowledge within the group. This view is also shared by other resilience scholars and can lead to adaptive learning as well as a group's ability to make more effective informed choices regarding its resource management.

The study also identifies areas that warrant more research. For instance, this study serves as a case study focusing on the Greater London region. Future research should make further comparisons across the UK to explore those characteristics presented by local community groups that engage in environmental volunteering in other rural and urban regions as well as across demographics. Similarly, future research therefore needs to identify potential influences of group effects by both measuring separate individual and group effects as well as through implementing additional methods (e.g. one-to-one interviews with volunteers).

Compliance with ethical standards

Conflict of interest   The authors declare that they have no competing interests.

References

Adger WN (2000) Social and ecological resilience: are they related? Prog Hum Geogr 24(3):347–364. https://doi.org/10.1191/030913200701540465

Asah ST, Blahna DJ (2013) Practical implications of understanding the influence of motivations in commitment to voluntary urban conservation stewardship. Conserv Biol 27(4):866–875. https://doi.org/10.1111/cobi.12058

Barthel S, Isendahl C (2012) Urban gardens, agriculture, and water management: sources and resilience for long-term food security in cities. Ecol Econ 86:224–234. https://doi.org/10.1016/j.ecolecon.2012.06.018

Barthel S, Colding J, Elmqvist T, Folke C (2005) History and local management of a biodiversity-rich urban cultural landscape. Ecol Soc 10(2). https://doi.org/10.5751/ES-01568-100210

Barthel S, Folke C, Colding J (2010) Social–ecological memory in urban gardens—Retaining the capacity for management of ecosystem services. Global Environmental Change 20(2):255–265

Barthel S, Parker J, Folke C, Colding J (2014) Urban gardens: pockets of social-ecological memory. In: Tidball K, Krasny M (eds) Greening the red zone. Springer, Dordrecht

Berkes F, Jolly D (2001) Adapting to climate change: social-ecological resilience in a Canadian western Arctic community. Community Ecol 5(2):18. https://doi.org/10.5751/ES-00342-050218

Braun V, Clarke V (2008) Using thematic analysis in psychology. Qual Res Psychol 3(2):77–101

Bruyere B, Rappe S (2007) Identifying motivations of environmental volunteers. J Environ Plan Manag 50(4):503–515. https://doi.org/10.1080/09640560701402034

Bryman A (2012) Social science research methods. Oxford University Press, Oxford

Büchs M, Edwards R, Smith G (2012) Third sector organisations' role in pro-environmental behaviour change – a review of the literature and evidence. Third Sector Research Centre Working Paper 81, pp 1–19

Butler L, Morland L, Leskin G (2007) Psychological resilience in the face of terrorism. In: Bongar B, Brown L, Breckenridge J, Zimbardo P (eds) Psychology of terrorism. Oxford University Press, New York

Campbell JL, Quincy C, Osserman J, Pedersen OK (2013) Coding in-depth semi-structured interviews: problems of unitization and intercoder reliability and agreement. Sociol Methods Res 42(3): 294–320. https://doi.org/10.1177/0049124113500475

Carter RE, Lubinsky J (2016) Rehabilitation research: principles and applications. Elsevier, St. Louis

Connolly JJT, Svendsen ES, Fisher DR, Campbell LK (2014) Networked governance and the management of ecosystem services: the case of urban environmental stewardship in New York City. Ecosyst Serv 10:187–194. https://doi.org/10.1016/j.ecoser.2014.08.005

Crona B, Hubacek K (2010) The right connections: how do social networks lubricate the machinery of natural resources governance? Ecol Soc 15(4):18

Dolan RW, Harris KA, Adler M (2015) Community involvement to address a long-standing invasive species problem: aspects of civic ecology in practice. Ecol Res 33(3):316–325. https://doi.org/10.3368/er.33.3.316

Doody O, Noonan M (2013) Preparing and conducting interviews to collect data. Nurs Res 20(5):28–32. https://doi.org/10.7748/nr2013.05.20.5.28.e327

Fereday J, Muir-Cochrane E (2007) Demonstrating rigor using thematic analysis: a hybrid approach to inductive and deductive coding and theme development. Int J Qual Methods 5(1):80–92. https://doi.org/10.1177/160940690600500107

Fisher DR, Campbell L, Svendsen ES (2012) The organisational structure of urban environmental stewardship. Environ Politics 21:26–48. https://doi.org/10.1080/09644016.2011.643367

Folke C, Biggs R, Noström AV, Reyers B, Rockström S (2016) Social-ecological resilience and biosphere-based sustainability science. Ecol Soc 21(3):4. https://doi.org/10.5751/ES-08748-210341

Grbich C (2013) Quantitative data analysis: an introduction, 2nd edn. Sage, London

Hargreaves T (2011) Practice-ing behaviour change: applying social practice theory to pro-environmental behaviour change. J Consum Cult 11(1):79–99. https://doi.org/10.1177/1469540510390500

Houston JB, Spialek ML, Cox J, Greenwood MM, First J (2015) The centrality of communication and media in fostering community resilience: a framework for assessment and intervention. Am Behav Sci 59(2):270–283

Jebb AT, Parrigon S, Woo SE (2016) Exploratory data analysis as a foundation of inductive research. Hum Resour Man Rev 27(2): 265–276. https://doi.org/10.1016/j.hrmr.2016.08.003

Johnson ML, Novem Auyeung DS, Sonti NF, Pregitzer CC, McMillen HL, Hallett R, Campbell LK, Forgione HM, Kim M, Charlop-Powers S, Svendsen ES (2019) Social-ecological research in urban natural areas: an emergent process for integration. Urban Ecosyst 22:77–90

Joshi A, Kale S, Chandel S, Pal DK (2015) Likert scale: explored and explained. Br J Appl Sci Technol 7(4):396–403. https://doi.org/10.9734/BJAST/2015/14975

Kelly C, Ferrara A, Wilson GA, Ripullone F, Nolè A, Harmer N, Salvati L (2015) Community resilience and land degradation in forest and shrubland socio-ecological systems: evidence from Gorgoglione, Basilicata, Italy. Land Use Policy 46:11–20. https://doi.org/10.1016/j.landusepol.2015.01.026

Kilanowski JF (2012) Breaking the ice: a pre-intervention strategy to engage research participants. J Paediatr Health Care 26(3):209–212. https://doi.org/10.1016/j.pedhc.2012.01.001

Krasny ME, Tidball KG (2009) Applying a resilience systems framework to urban environmental education. Environ Educ Res 15(4):465–482. https://doi.org/10.1080/13504620903003290

Krasny ME, Tidball KG (2012) Civic ecology: a pathway for earth stewardship in cities. Front Ecol Environ 10(5):267–273. https://doi.org/10.1890/110230

Krasny ME, Russ A, Tidball KG, Eluqvist T (2014) Civic ecology practices: participatory approaches to generating and measuring ecosystem services in cities. Ecosyst Serv 7:177–186. https://doi.org/10.1016/j.ecoser.2013.11.002

Krasny ME, Silva P, Barr C, Golshani Z, Lee E, Liga R, Mosher E, Reynosa A (2015) Civic ecology practices: insights from practice theory. Ecol Soc 20(2):12. https://doi.org/10.5751/ES-07345-200212

Kurasaki KS (2000) Intercoder reliability from validating conclusions drawn from open-ended interview data. Field Methods 12:179–194

Longstaff PH, Armstrong NJ, Perrin K, Parker WM, Hidek MA (2010) Building resilient communities: a preliminary framework for assessment. Home Sec Aff 6(6):81

Magis K (2010) Community resilience: an indicator of social sustainability. Soc Nat Resour 23(5):401–416. https://doi.org/10.1080/08941920903305674

Measham TG, Barnett GB (2008) Environmental volunteering: motivations, modes and outcomes. Aust Geogr 39(4):537–552

Monroe MC (2003) Two avenues for encouraging conservation behaviors. Hum Ecol Rev 10(2):113–125

Norris FH, Stevens SP, Pfefferbaum B, Wyche KF, Pfefferbaum RL (2008) Community resilience as a metaphor, theory, set of capacities, and strategy for disaster readiness. Am J Community Psychol 41:127–150. https://doi.org/10.1007/s10464-007-9156-6

O'Brien L, Townsend M, Ebden M (2008) Environmental volunteering: motivations, barriers and benefits. Forestry Commission, Surrey

O'Sullivan TL, Corneil W, Kuziemsky CE, Toal-Sullivan D (2015) Use of the structured interview matrix to enhance community resilience through collaboration and inclusive engagement. Syst Res Behav Sci 32:616–628

Patton MQ (2002) Qualitative research and evaluation methods, 3rd edn. Sage Publishers, London

Peterson ER, Barron KA (2007) How to get focus groups talking: new ideas that will stick. Int J Qual Methods 6(3):140–144

Rattani A, Johns A (2017) Collaborative Partnerships and Gatekeepers in Online Research Recruitment. The American Journal fo Bioethics 17(3):27–29

Russell J (2009) 'Making volunteering easier': the story of environmental volunteering in South West England. Institute for volunteering research, London

Seymour V, Haklay M (2017) Exploring engagement characteristics and behaviours of environmental volunteers. Cit. Sci. Theory Prac 2(1): 5. https://doi.org/10.5334/cstp.66

Seymour V, King M, Antonaci R (2018) Understanding the impact of volunteering on pro-environmental behaviour change. Vol Sec Rev. https://doi.org/10.1332/204080518X15155917206307

Smith FM, Timbrell H, Woolvin M, Muirhead S, Fyfe N (2010) Enlivened geographies of volunteering: situated, embodied and emotional practices of voluntary action. Scott Geogr J 126(4):258–274

Sonti NF, Svendsen ES (2018) Why garden? Personal and abiding motivations for community gardening in New York City. Soc Nat Resour 31(10):1189–1205

Steiner A, Markantoni M (2014) Unpacking community resilience through capacity for change. Comm Develop J 49(3):407–425. https://doi.org/10.1093/cdj/bst042

Strzelecka M, Nisbett GS, Woosnam KM (2017) The hedonic nature of conservation volunteer travel. Tour Manag 63:417–425

Strzelecka M, Woosnam KM, Nisbett GS (2018) Self-efficacy mecha-
    nism at work: the context of environmental volunteer travel. J
    Sustain Tour 26(11):2002–2020

Svendsen ES, Campbell LK (2008) Urban ecological stewardship: under-
    standing the structure, function and network of community-based
    urban land management. Cities Environ 1(1):4–31

Tengö M, Brondizio ES, Elmqvist T, Malmer P, Spierenburg M (2014)
    Connecting diverse knowledge systems for enhanced ecosystem
    governance: the multiple evidence base approach. Ambio 43(5):
    579–591. https://doi.org/10.1007/s13280-014-0501-3

Thomas DR (2006) A general inductive approach for analyzing qualita-
    tive evaluation data. Am J Eval 27(2):237–246. https://doi.org/10.
    1177/1098214005283748

Tidball KG, Krasny ME (2007) From risk to resilience: what role for
    community greening and civic ecology. In: Wals A (ed) Social learn-
    ing towards a more sustainable world. Wageningen Academic
    Publishers, Wageningen

Tidball KG, Krasny ME, Svendsen ES, Campbell L, Helphand K (2010)
    Stewardship, learning, and memory in disaster resilience. Environ
    Educ Res 16:591–601. https://doi.org/10.1080/13504622.2010.
    505437

Wilkinson C (2012) Social-ecological resilience: Insights and issues for
    planning theory. Planning Theory, 11(2):148–169

Woosnam KM, Strzelecka M, Nisbett GS, Keith SJ (2019) Examining
    millennials' global citizenship attitudes and behavioural intentions
    to engage in environmental volunteering. Sustainability 11(11):
    2324. https://doi.org/10.3390/su11082324

Wulff K, Donato D, Lurie N (2015) What is health resilience and how can
    we build it? Annu Rev Public Health 36:361–374. https://doi.org/
    10.1146/annurev-publhealth-031914-1228