UCL DEPARTMENT OF GEOGRAPHY

Why do volunteers participate in water quality monitoring? Motivations of citizen scientists in the Anglers' Riverfly Monitoring Initiative

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DEPARTMENT OF GEOGRAPHY

M.Sc. in Aquatic Science

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Abstract

Citizen Science – a term used to describe the involvement of non-professional individuals in scientific research, is considered a highly valuable tool in aiding the collection of environmental and conservation based scientific data. Due to the many benefits citizen science provides to both scientific research and to the volunteers themselves, it is important to understand why people commit their time and resources to such projects. Citizen scientists are willing to contribute to long-term participation in programs that offer benefits matching their initial reasons for volunteering in the first instance. Failure to fulfil an individuals' motivations, will lead to no participation and thus potential failure in retaining experienced and dedicated volunteers. Despite the vast understanding of the benefits provided by citizen science, the motivations of volunteers participating within such initiatives remains significantly under-researched. Therefore, this study attempts to contribute to the understanding of citizen science motivations from the survey responses of 253 volunteers participating in the Anglers' Riverfly Monitoring Initiative (ARMI), a UK-wide citizen science initiative in which trained volunteers monitor river water quality using a standard method to sample river invertebrates. A concern for the health of their local river, and a general interest in environmental issues, were ranked as the most important motivations for participation in ARMI. Gaining experience or having an interest in a career in aquatic conservation, participation to improve health or wellbeing, and social motivations, such as the interaction with people of similar interests and concerns, were not ranked as highly by the sampled volunteers, suggesting that these motives are not as important in motivating individuals to participate in the program. For continued participation in the long-term, volunteers are most likely to be influenced by the provision of further guidance and training, and the opportunity to gain further knowledge and understanding of riverfly monitoring data at a national scale, rather than factors associated with the costs of monitoring and distance to monitoring sites. Health and time constraints were two of the most mentioned factors stated as 'other' by respondents, and therefore may also be important when influencing volunteers to continue monitoring. With a greater understanding of the motives that are particularly important to ARMI volunteers, project coordinators are able to provide adjustments to the project, so that all motivations are satisfied. This is crucial to effectively recruit and retain a pool of dedicated and experienced volunteers.

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1. Introduction

1.1. Background to citizen science

The field of citizen science has increased rapidly within recent years, and volunteer participation is now considered a constant part of environmental, conservation, and ecological based research (Dickinson *et al*., 2010). The proliferation of new citizen science projects has in part, been attributable to increased awareness by non-scientists to the threats facing local environments, and an increased desire to protect from these environmental issues (Halpenny and Caissie, 2003). Furthermore, the involvement of non-professional volunteers allows scientists to obtain more data than was once previously possible under resource constraints, thus highlighting the importance of citizen science as a valuable tool in the collection of scientific data (Nerbonne and Nelson, 2004; Bonney *et al*., 2009; Domroese and Johnson, 2017).

Citizen science is broadly defined as the participation of the public in scientific research efforts (Dickinson and Bonney, 2012). In a survey and interview study with a number of stakeholders within the citizen science field, Geoghegan *et al*., (2016) suggested that the definition of citizen science may differ according to the variety in stakeholder aims in relation to their specific scientific research project. Therefore, citizen science is subject to multiple definitions. In addition to the broad definition, stakeholders also related citizen science to a process that rewards non-professionals for their participation in the collection of such data (Geogheghan *et al*., 2016). Individuals choosing to participate in such projects, are thus considered as 'citizen scientists', deciding to engage in the scientific process within their own spare time (Dickinson and Bonney, 2012). Furthermore, citizen science is able to incorporate a broad range of research areas, primarily engaging volunteers in the monitoring of environmental and biological systems that expand across large geographical scales (Dickinson *et al*., 2010; Dickinson and Bonney, 2012; Ellwood *et al*., 2017; Sullivan *et al*., 2017).

1.2. Importance of citizen science within environmental monitoring and research

Access to the natural world

One main importance of engaging the public in citizen science projects, is the improved well-being of the individual taking part, especially when a project promotes access to the natural world. Bird (2007) suggests that as a consequence of improvements in technology, human beings have become increasingly disengaged from the natural environment. As a result, our

sense of identity and mental health have been significantly impacted. This is a significant point, especially since studies have now highlighted the importance of accessing nature in providing benefits to our mental state, and providing important value in improving an individuals' health (Guiney and Oberhauser, 2009; Barton and Pretty, 2010). As Bird (2007) aptly describes, the natural environment can be regarded as a 'natural health service' (pg. 5). For example, in adults, the attention of an individual can be supported by contact with nature, and can aid in the regaining of attention after fatigue as proposed by the Attention Restoration Theory (Kaplan, 1995). Similarly, in children with ADHD, empirical studies have highlighted that activities undertaken in green spaces enhances a child's functioning, therefore decreasing their symptoms related to attention deficit (Faber-Taylor *et al*., 2001). Furthermore, contact with nature may provide benefits in the reduction and coping of stress, and help with the care of the elderly and dementia treatment (Ulrich *et al*., 1991; Ottosson and Grahn, 2005).

Educating the public

Education is considered as an important goal for many citizen science projects, especially those related to solving conservation issues. To be literate in conservation, an initial understanding of ecology and biodiversity must be acquired by an individual, which can be achieved through public participation in such scientific projects (Jordan *et al*., 2011). It could be argued that the science literacy model, in which knowledge travels from scientific to community actors, is typical of how education is provided to individuals participating in citizen science, with the public more probable to process and learn from data if it exists (Callon, 1999; Jollymore *et al*., 2017). There is still some debate as to whether citizen science programs can simultaneously achieve goals of public scientific education and the collection of large datasets. This is especially reflective in projects where the research topic in question is chosen by the scientists, thus imposing an unsustainable top-down approach on volunteers who do not possess the necessary ecological knowledge (Jordan *et al*., 2011). Nonetheless, there are numerous examples highlighting the success of projects in combining education with the collection of data as the main primary aims for a project (Miller-Rushing *et al*., 2012; Ballard *et al*., 2017). For example, eMammal is a platform for citizen science which recruits volunteers in projects involving the collection of wildlife data from photographs taken from the use of camera traps. Through the provision of training materials, a natural history blog, and volunteer feedback during the project, Forrester *et al*. (2017) studied whether the provision of these materials had an impact on an individual's wildlife knowledge, conservation attitudes, and project specific skills. They found that after joining the eMammal project, volunteer knowledge of wildlife

increased, with around 90% of volunteers accurately identifying more than 75% of the species captured within the photographs. It was also found that volunteers were 84% more likely to talk about local mammal conservation within their social network after volunteering, thus highlighting the ability of citizen science in connecting people to nature.

Similarly, Davies, *et al*. (2011) describe how a community-driven research program can contribute to an expanding database, whilst educating volunteers about local issues affecting their communities. Open Air Laboratories (OPAL) is an example of such community-driven research project, providing a wide range of individuals from all ages and backgrounds the opportunity to connect with nature through the participation in biological surveys, including the monitoring of water and aquatic invertebrates, and the biodiversity of hedgerows (OPAL, 2016). Therefore, OPAL has been successful in providing local communities the opportunity to engage with issues affecting their local environment and to become aware of the ways in which to protect it. In the process of scientific education, scientists have been able to obtain a large and constantly expanding database related to the condition of UK biodiversity and habitats, especially from sites within urban areas that were once largely un-sampled (Davies *et al.*, 2011).

A cost-effective solution to sustaining long-term conservation strategies

The use of citizen scientists provides an acceptable solution to sustaining long-term conservation strategies especially due to financial and resource constraints (Latimore and Steen, 2014). Using citizen scientists is therefore a cost-effective method in collecting large quantities of scientific data over greater spatial scales and timeframes (Cohn, 2008; Silvertown, 2009; Zapponi *et al*., 2017). This is particularly important in nonprofit organisations contributing to scientific research and conservation, or smaller, local-scale projects, who are faced with challenges including lack of technical expertise, access to field sites, and to long-term datasets (Bonter and Cooper, 2012; Peters *et al*., 2017). The Michigan Clean Water Corps in the US for example, has overcome these challenges through the use of citizen scientists to monitor local lakes and streams, including the monitoring of habitats and macroinvertebrates in streams, water chemistry monitoring in lakes, and aquatic macrophyte identification, creating a long-term dataset.

Despite this benefit, some have stated concerns regarding the reliability of data produced by non-professionals, especially when projects do not use standardised sampling methods

(Gouveia *et al*., 2004; Datar *et al*., 2014). For example, analysis into the data collected from Mountain Watch, a citizen science initiative requiring volunteers to collect long-term data on alpine plant phenology, McDonough-MacKenzie *et al*. (2017) highlighted discrepancy between the actual plant species identification results compared with the volunteers' self-assessed results. This subsequently limited the use of the results due to misidentifications of plant species. Unreliability in citizen science data was also found in a study by Uychiaoco *et al*. (2005), who evaluated data collected by local community volunteers aiding in the management of marine protected areas in the Philippines. Several estimates, such as the abundance of certain reef fish species, did not significantly correlate with the abundance estimates determined by marine biologists. However, although Uychiaocco *et al*. (2005) found less accuracy in the results produced by the volunteers, trends in the data were still able to highlight the need for management of the reefs. This suggests that even less accurately collected volunteer data can still be useful in raising awareness of environmental issues, allowing appropriate measures to be put in place to protect and conserve it.

Furthermore, there have also been numerous studies providing evidence of the reliability of data produced thus arguing against the production of data unreliability, and reinforcing the importance of citizen science in providing good quality, long-term scientific data (Greenwood, 1994; Bhattacharjee, 2005; Finn *et al*., 2010; Branchini *et al*., 2015). For example, in a study of the reliability of protocols used in the Florida LAKEWATCH program, a citizen science initiative involving the monthly collection of water chemistry data from a large number of Florida lakes, Canfield Jr *et al*., (2002) produced evidence to suggest that the water quality data collected by the volunteers were comparable to those collected by professional scientists using standardised methods. This therefore provided lake managers with the opportunity to collect reliable data even when limited resources and financial constraints may pose difficulties. Reliable data was also found to be collected by volunteers in a project monitoring sponge biodiversity using morphological approaches in Indo-Pacific coral reefs (Bell, 2007). Morphological data recorded by volunteer divers was compared with data collected by the researcher. Although small sponges tended to be left out in volunteer records, the assemblage structure could still be identified and compared with the assemblages identified by the researcher (Bell, 2007). Identifying differences in data collected by scientists compared to volunteers is just one way of testing the reliability and accuracy of citizen science data. The studies mentioned in particular, therefore highlight the importance of using citizen scientists to collect reliable and accurate data contributing to scientific research.

Additionally, Cohn (2008) suggests that citizen scientists are able to collect data that is as reliable as data collected by professional scientists when volunteers are given the appropriate training to carrying out monitoring. This was highlighted in a study conducted by Fore *et al*. (2001), who trained volunteers to collect benthic macroinvertebrates to assess the ecological health of a stream. When the samples collected by the volunteers were compared with the sites sampled by the professional scientists, no significant differences were found between the two samples, thus suggesting that when trained appropriately, volunteers are able to collect reliable and comparable data. Additionally, professional scientists must be able to construct research projects with specific protocols with citizen scientists in mind. These protocols need to be easy for the volunteers to perform the task, be straightforward, and also highly engaging (Bonney *et al.,* 2009). Schmeller *et al*. (2009) reiterates this suggestion, stating that the quality of data collected by the public is not reliant upon their direct involvement, but on the design quality of the project, the methodology used, and the ability to communicate this to the volunteers. As a result of the appropriate training and protocols, every citizen scientist regardless of age or background will be able to make significant contributions to scientific research without compromising the reliability and accuracy of the collected data.

1.3. Motivations of citizen scientists

The nature of citizen science as an activity individual's voluntary seek out in their own spare time with no remunerative rewards, should raise interest in the reasons why a person decides to willingly participate in the first instance, and why individuals continue to undertake these activities both in the short- and long-term. These questions can be answered by exploring motivation, a term used to describe the reason an individual acts or behaves in a particular way (Kragh, 2016).

To understand volunteer motivations, Clary *et al*. (1998) use a functional approach, first specified by Katz (1960) as an approach to understanding human attitudes and behaviour. This approach suggests that the initial motivations and the motivations to continue volunteering depends upon the functioning of certain mechanisms (McDougle *et al*., 2011). Clary *et al*. (1998) thus states six funtions served by the act of volunteering. The most important functions of volunteering are consided to be 'Understanding', in which an individual wants to learn a great deal about the research in question, 'Values', whereby a volunteer participates to act upon important principles, and 'Enhancement', relating to volunteer participation based upon

psychological development and growth (Clary and Snyder, 1999). The least important functions are reported to be job-related opportunities and gaining career experience, the strengthening of social relationships, and participation to deal with personal issues and decrease the feelings of negativity (Clary and Snyder, 1999). However, the motivations of volunteers are highly complex since motivations are likely to be multifaceted, differing between participants, and along a time gradient (McDougle *et al*., 2011). Researchers have thus tried to simplify the complexity by explaining motivations for volunteering in two categories. The first, relates to the act of volunteerism as an activity that requires a person to give up their personal resources voluntarily, such as time and effort, to enhance the wellbeing of others. Therefore, the motivation to volunteer is based upon altruistic behaviours, putting the well-being of others first (Shye, 2010). The other is seen as a promotion of self interest, and motivations for volunteering is dependent upon egoistic behaviours, or self-gain (Shye, 2010). Others have further suggested that motivations are unidimensional, and that volunteers display both egoistic and altruistic motives, rather than distinguish between the two (Cnaan and Goldberg-Glen, 1991; Rehberg, 2005).

Although researchers have attempted to understand the motivations for volunteering, there has been less research on the motivations for volunteering in citizen science projects specifically (Raddick *et al*., 2013). Nonetheless, the same categories can apply, with the most important reasons for participation tending to either be egoistic, altruistic, or both (Kragh, 2016). For example, Ryan *et al*. (2001) found that helping the environment, including helping to restore the natural environment or to observe improvements, were the most highly rated motivations by volunteers, thus suggesting the significance of altruistic motives in the participation within citizen science projects. Similarly, altruistic motives were found to be important in a study understanding the motivations of 11,000 volunteers participating in Galaxy Zoo, an online survey asking volunteers to classify galaxies according to their shape. Raddick *et al*., (2013) found that the main motivation of these volunteers was a desire to contribute to scientific research. Although contributing to science was found to be the second most important motivation in a study by Domroese and Johnson (2016), an interest in learning about bees, the project focus, was found to be a more important motivator. Therefore, personal interest in the scientific subject of focus as this study showed, also highlights the importance of egoistic motivations in citizen science projects.

A further motivation for the participation in environmental- and conservation-based projects is the idea that individuals feel connections to specific environments and thus acquire a 'sense of place' (Gooch, 2003). Gooch (2003) found that some volunteers expressed a personal physical connection to the places in which they volunteered, and participated because they wanted to enhance their knowledge about a particular environmental setting. Long-term volunteering in local areas can thus be achieved through the creation of activities that focus on teaching volunteers about local environments of interest, thus providing a 'sense of place' in citizen science projects (Gooch, 2003). Haywood (2014) however, argues that further research needs to be undertaken to understand the extent of which a sense of place motivates participants across different citizen science programs, and whether attachments to a specific place changes simultaneously with changes in motivations in the long-term.

1.4. Aims and Objectives

Since there are many benefits citizen science offers to conservation research and the participants themselves, understanding the reasons why people commit their time participating in such projects is therefore necessary (Domroese and Johnson, 2017). Citizen scientists are increasingly willing to continue participating in programs that offer benefits that match their reasons for participating in the first instance (Clary and Snyder, 1999; Jacobson *et al*., 2012). Failure to fulfil an individuals' motivations will lead to no participation and thus the potential failure in retaining volunteers (Clary and Snyder, 1999). However, despite the increase in new citizen science projects within recent years and the benefits they portray, it is still unknown how citizen science can be used most effectively within environmental and conservation research, and the motivations of volunteers to participate in such projects remain poorly understood (Ellwood *et al*., 2016).

Focusing on the Anglers' Riverfly Monitoring Initiative (ARMI), a UK-wide citizen science initiative in which trained volunteers monitor river water quality using a standard method to sample river invertebrates, the main aim of this research is to obtain an understanding of the main motivations of volunteers participating in the initiative. Understanding the motivations of volunteers is crucial to aid the recruitment and retention of volunteers (Bruyere and Rappe, 2007). Retaining volunteers is particularly important for citizen science projects, as it creates a core set of fully experienced volunteers who can provide local leadership to new participants, thus producing a more reliable dataset (Cooper *et al*., 2007).

To achieve the aim of this study, the following questions will be answered through the quantitative and qualitative analysis of survey data collected from a representative sample of 253 ARMI volunteers:

1. What are the main demographics of ARMI volunteers and how does this compare to the participant demographic found in other citizen science projects?
2. Which motivations are considered as the most important for ARMI volunteers?
3. Are demographics a determinant of motivation?
4. How have motivations changed over time and which factors are considered as the most important for influencing continued participation in the initiative?
5. Has participation in ARMI increased volunteer participation in further aquatic conservation research, along with suggestions for increased environmental advocacy?

2. Methodology

2.1. The Anglers' Riverfly Monitoring Initiative (ARMI)

Following a concern in the apparent deterioration in the abundance and occurrence of riverfly groups, including the up-winged flies (Ephemeroptera), Caddisflies (Trichoptera) and Stoneflies (Plecoptera), the Riverfly Partnership was formed. This partnership brings together a wide range of stakeholders interested in the conservation of riverfly populations and the protection of river water quality, including anglers, conservationists, entomologists, scientists, waterway managers and relevant authorities (Riverfly Partnership, no date). Bringing together a wide range of interested groups increases the understanding of riverfly populations and their potential cause for decline through enhanced collaboration, therefore establishing methods to address the threats to riverfly populations. Riverfly Monitoring is an initiative organised by the Riverfly Partnership with the aim of encouraging angling and conservation groups to become involved in the protection of their local riverine environment. By recording and monitoring the riverflies that are widely imitated by anglers with their artificial flies, anglers and conservationists are able to protect their local aquatic environment through an understanding of the water quality, since riverfly groups are good biological indicators of the ecological status of freshwater bodies (Riverfly Partnership, no date). Furthermore, a citizen science approach allows for the generation of scientific data underpinning the protection of freshwater, which can then be used to recommend policy actions for the management of catchments (Biggs *et al*., 2017). Currently, there are around 2600 trained, active ARMI volunteers, with 1870 active ARMI sites registered in the online national riverfly database (B. Fitch, pers comm, 19th June 2017). Monitors collect a sample using the standard three-minute kick/sweep sampling method, and the abundances of the eight target groups of riverflies are then determined from the sample and given an ARMI score. Scores are then uploaded to the national riverfly database.

2.2. Data collection: Designing a questionnaire

In social science research, questionnaires can be used to pose 'standardised, formally structured questions to a group of individuals, often to be a sample of a broader population' (McGuirk and O'Neill, 2010, p.191). Although other qualitative data collection methods, such as the use of semi-structured interviews were considered within the initial planning of this project, questionnaires were chosen as the primary source of data collection rather than interviews, as they allow for a larger population size to be sampled (McGuirk and O'Neill, 2010). Furthermore, surveys can collect a large range of primary data sources, especially data related

to people, their opinions, attitudes, and behaviours towards certain topics (Parfitt, 2005). This data can be collected from a defined subset of individuals taken from a broader population of interest (Newman and McNeill, 1998). To obtain information on the motivations of ARMI volunteers, a survey was constructed to collect social data from a sample of 253 riverfly volunteers that was expected to represent the broader ARMI population.

Initial design phase and specifying the intent of the survey

Designing the final survey distributed to ARMI volunteers (included in the appendix) followed the eight steps stated by Newman and McNeil (1998, pg. x) as a requirement for conducting surveys in social research. These steps are highlighted in Figure 1.

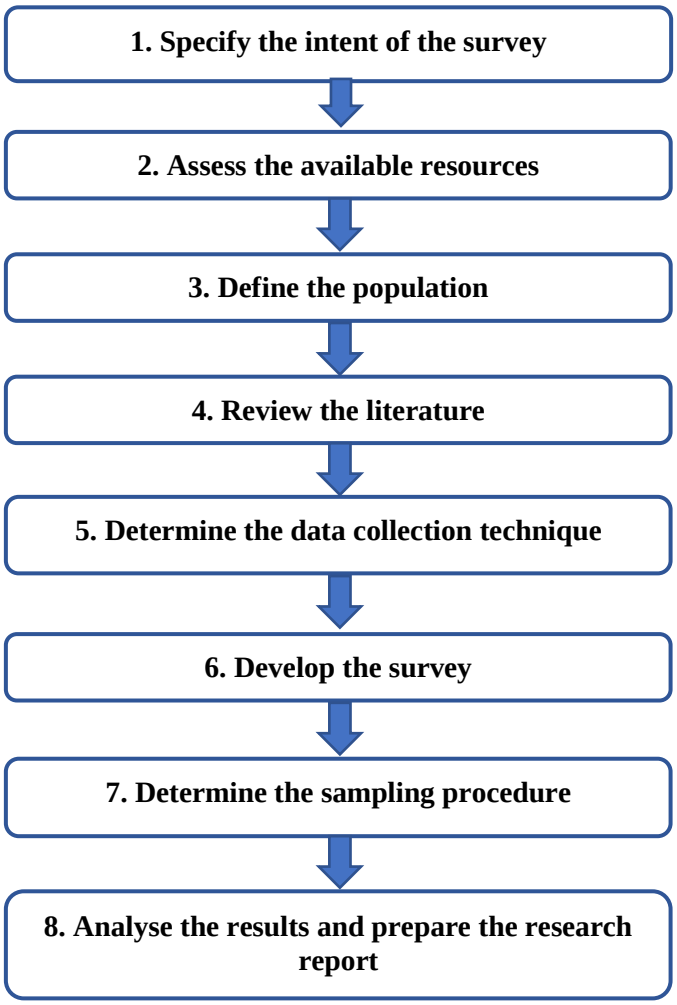

Figure 1: Steps required in the conduction of social survey research, as stated by Newman & McNeil (1998, pg. x).

As part of the initial design phase of creating a survey, it is important to specify the intent of the survey as the first step for undertaking survey research. Questionnaires are carried out with the purpose of identifying in-depth information about a particular subject, and the reliability of the data collected from respondents is highly dependent upon how well the aims and objectives are clearly stated (Newman and McNeill, 1998). During this step, it was important to therefore identify how the responses collected from the survey were to be used, the subject of the information that was to be collected, and finally, to identify the target population (Newman and McNeill, 1998; Fink, 2003). After assessing the intent, main aims, and objectives of the survey, the available resources were then evaluated, focusing on the amount of time needed to complete and fully satisfy the objectives and intent of the survey research.

Defining the population, reviewing the literature, and determining data collection technique

Defining the population, reviewing the literature and determining the methods for data collection were also required steps before the creation of the final survey. When defining the population, it is essential that a sample must be chosen that is representative and reflective of the entire population (Dillman *et al*., 2009). A sample is representative when significant characteristics of the sample group, for example age and gender, are distributed equally between groups (Fink, 2003). Additionally, when defining the population of this research, it was crucial to understand the degree of error or bias within a sample. To ensure a low degree of bias in this research, copies of the final questionnaire were distributed to as many project participants as possible via ARMI project coordinators to obtain as large a sample size as possible. The larger the sample size, the lower the degree of bias in the sample. Since a total of 253 responses were obtained, the degree of error is expected to be around 6%, at a 95% confidence interval.

In collecting survey research, there are four general methods that may be used to collect social data. This includes through mail (post and electronic), direct administration, telephone surveys and via interview (Newman and McNeill, 1998). Through the use of email, electronic copies of the questionnaire created using Microsoft Word were circulated for completion to ARMI volunteers since mailed surveys are cost-effective and can provide an advantage in its ability to effectively collect a large amount of data from a sample that is widely distributed (Chisato *et al*., 1995). However, there are some disadvantages when using mailed surveys as the main mode of distribution. For example, some studies have highlighted low response rates related to mailed surveys (Heberlein and Baumgartner, 1978; Goyder, 1982). However, these studies

refer to post mail distribution and it is unknown whether electronic mail is subject to the same low rate of responses. Additionally, a web questionnaire was created using the online survey tool SurveyMonkey, replicating the emailed version and thus giving respondents further methods to complete the required survey. Furthermore, to improve response rate, a follow-up email was sent to ARMI coordinators to distribute the survey to their volunteers, reinstating the purpose and aim of the survey research, thus minimising non-responses and maximising participation (Floyd and Fowler, 1993). It may also be suggested that higher response rates for online surveys are apparent when surveys are easy to complete through the adoption of a simple design, and when a survey allows participants to remain anonymous (Lumsden and Morgan, 2005). Therefore, these concerns were considered before the creation of the survey to ensure maximum participation by ARMI volunteers.

Development and creation of the survey

Creating good questions underpin the formation of a successful and effective survey. One of the most important issues to consider in the creation of good questions is an understanding of context (Smyth *et al*., 2007). Context can refer to anything relating to the presence or absence of other individuals whilst undertaking the survey, connections between survey respondents, the opinions of an individual during the time of the survey, and the physical environment in which the survey is undertaken (Tourangeau *et al*., 2000). All these factors when in combination, can offer context to interactions that occur from day-to-day. It is this context that can play a part in how individuals may respond to survey questions, thus affecting the way in which simple statements are interpreted (Smyth *et al*., 2007). Furthermore, it is suggested that prior questions may have a significant influence on the responses given to subsequent questions, and the order of questions should also be considered by the researcher (Tourangeau *et al.*, 2000). Additional contextual factors such as the visual layout of survey questions may also be influential in choice of answers (Christian and Dillman, 2004). As Dillman *et al*. (2009) highlights, there is a challenge faced by every survey researcher to design a survey with questions that allows willingness from the respondent to give an accurate answer, interpreting the question in such a way that the researcher intends. If this challenge is not addressed within the design phase of the questionnaire, then there can be crucial impacts upon how a question performs within the survey. Therefore, when creating questions for this survey, it was important to consider factors including the use of open-ended, closed-ended, or both types of question, how to visually present the questions, and to consider the wording of the questions and their subsequent response options (if a closed-ended question was used) (Dillman *et al*.,

2009). Acknowledgement of these factors was important to reduce as much as possible, the role of context in its ability to influence the answers people choose to give survey questions.

Open-ended vs. closed-ended questions

The final survey developed consisted of a range of question types, including open-ended and closed-ended questions. Two types of open-ended questions were used within the survey, including descriptive questions, and numerical response type open-ended questions. In the descriptive type, survey respondents are required to provide an in-depth account of a particular topic suggested within the question, with the researcher requiring as much description and elaboration as possible (Dillman *et al*., 2009). For example, within this survey research, examples of descriptive questions required participants to describe which aspects of training they find most and least useful (see Questions 13 and 14 within Appendix). Open-ended questions therefore provide respondents with the opportunity to freely respond to a question without limiting their answer. This type of question was also used in the survey since it prevents researcher influence on respondent answers that is likely to occur more in closed-ended questions where respondents are provided with a set of answers (Dillman *et al*., 2009).

Despite concerns that open-ended descriptive questions may require respondents to invest greater amounts of time and effort into completing a survey, which could result in poor-quality responses, there is now evidence suggesting that individuals can provide open-responses of higher quality and information when online-based surveys are used compared to pen-and-paper surveys. For example, in a study by Schaeffer and Dillman (1997) email versions of their survey achieved longer responses in open-ended questions compared to a paper version, with an average of 40 words and 10 words for email and paper surveys, respectively. Furthermore, several researchers suggest that through the use of larger answer boxes and appropriately sized spacing provided by the surveyor, longer and more descriptive answers from respondents can be obtained (Christian and Dillman, 2004; Smyth *et al*., 2009) . Therefore, in the creation of open-ended questions within the survey, care was taken to ensure sufficient spacing was used to encourage respondents to give adequate and fully descriptive answers.

Closed-ended questions require a respondent to answer a question based upon a set of answer categories that have been evaluated by the survey researcher prior to distribution of the questionnaire (Dillman *et al*., 2009). Within this survey, both nominal and ordinal scale forms were used. Within nominal scaled closed-ended questions, a group of answer categories are

expected to be compared by the respondent, with the categories having no natural order (Dillman *et al*., 2009). Examples of closed nominal-scaled questions within the completed survey included demographic questions such as age, sex, and nationality. The answer categories within these questions contained no form of order with no variation in the magnitude between the categories. Questions asking respondents to rank motivation categories in terms of importance for their participation in the monitoring initiative is also an example of a closed nominal-scale question. These questions however, require the respondent to undertake a greater amount of effort when answering the questions, since it involves the absorption of greater detail, the identification of differences between given categories, and identification of most to least important catgories. Nonetheless, these type of questions were used within the survey since they can provide the researcher with social data that can easily be analysed quantitatively (Dillman *et al*., 2009). Ordinal scaled closed-ended questions on the other hand, give the respondent ordered categories of answers, requiring individuals to choose where they place along a continnum. These type of closed questions are the most frequently used type used within survey research since they are able to measure degrees of varying levels of behaviours, attitudes and opinions of a respondent (Dillman *et al*., 2009).

2.3. Quantitative data analysis

Closed-ended questions within the survey provided data to be analysed in a quantitative manner. Basic descriptive statistics, such as the use of percentages and proportions, were calculated to analyse demographic data of survey respondents, including age, sex, and educational background, and closed-ended questions related to monitoring experiences. To determine the main motivations of respondents, and the main factors that may influence these motivations, the median ranks for each motivation and factor category were determined. A Kruskal-Wallis test for non-parametric data was then performed using the statistical programming software Minitab v17 to determine whether any of the differences in average ranks were of significance. Studying the relationships between a variety of variables is a significant aspect of any piece of survey research and therefore, it is highly important to determine the strength of association between two variables (Dorofeev and Grant, 2006). As a basic requirement for highlighting association between different variables, contingency tables (or cross-tabulation) can be used to two-dimensionally display a matrix of numbers, with the rows and columns reflecting two separate categories of variables. Within the matrix of each cell, a count of the frequency of occurrences that fall into both the column and row variable is given. A contingency table therefore provides a descriptive means of highlighting whether two

variables are common in a single subject, and was therefore used to study the relationship between the main motivation of ARMI volunteers and their demographic data (including age, sex and education of respondents) and an individuals length of participation in the initiative. To study whether any association between variables were of significance, subsequent Fisher's exact tests (or Fisher Freeman Halton tests for tables greater than 2x2), were carried out using SPSS v22. Although the Pearson chi-squared test is most commonly used to investigate relationships between variables in a contingency table, it should not be calculated if the expected value in any category is less than 5, and within tables containing few counts (Lydersen *et al*., 2007). Since these conditions were true for the survey data collected, the Fisher's Exact Test was therefore used.

2.4. Qualitative data analysis

Since open-ended type questions provide the researcher with a detailed account of a respondent's answer, this type of data must be acknowledged as qualitative and therefore must be analysed using the appropriate qualitative technique. Through organising, evaluating, and making sense of social data, the process of coding allows researchers to be able to analyse qualitatively (Jackson, 2001; Cope, 2010). Coding therefore, is a term that can be described as 'a process of identifying and organising themes in qualitative data' (Cope, 2010, p. 281). Initially, each respondent answer for every open-ended question was read through and annotated. This can be considered as the first step of the coding process. Since reading involves integration and retention of data, the initial reading of open-ended answers allowed for the data to be absorbed, thus preparing the qualitative data for analysis (Dey, 1993). After the initial reading and annotating, each respondents answers were read through a second time, with a code assigned to various parts of respondent answers. A code may be reflective of the primary content of the qualitative data, and is frequently a single word or phrase that captures the essence for a part of any language- or visual-based data (Saldana, 2009). Furthermore, a code is not used to simplify qualitative data, but to summarise and condense information in an effective way (Saldana, 2009). Descriptive codes, themes or patterns stated directly by the respondents, were the main type of codes used (Cope, 2010). In particular, in vivo descriptive codes were used, which arise from commonly found phrases within a text (Saldana, 2009). From these codes, newly formed categories were created, with similar responses grouped together and then assigned one of the new categories.

3. Results and Data Analysis

3.1. Demographic data and monitoring experiences

Overall, 253 responses were collected. However, due to the method of distribution, the number of volunteers sent a copy of the questionnaire for completion could not be determined, and unfortunately, the overall response rate was unable to be calculated. If we take 2600 as our population size (estimated number of trained and active volunteers) and a confidence level of 95%, a sample size of 253 respondents produces around a 6% margin of error. A copy of the final questionnaire, along with overall responses made by ARMI volunteers is given in the appendix. Figure 2 highlights the percentage of respondents in each age group, male and female respondents, their highest level of education and whether individuals are a member of an angling group, conservation group, or a local interest group. The main demographics of the survey respondents are therefore shown to be above the age of 65+ (37%), male (70.8%), and most likely to have a first degree (41%). There is a similar proportion of individuals that belong to a conservation group (34%) and/or an angling group (30%). Furthermore, there was a strong skew towards individuals from a white background (99.2%).

Figure 3 highlights the percentage of respondents in each category from questions related to monitoring experiences. Volunteers are most likely to monitor fewer number of sites (63.4% monitoring just the one site), travel shorter distances to their sites (40.4% travelling less than 15 minutes), and more likely to spend a total between 30 minutes to 2 hours monitoring their site (76.5%). Furthermore, the largest proportion of volunteers have been monitoring between 2-5 years (31.6%), with recent volunteers (i.e. less than 6 months participation) representing 17.3% of the surveyed volunteers. Unsurprisingly, 66.2% stated that they visit the riverfly website or results database monthly, which coincides with the monthly monitoring expected at each site.

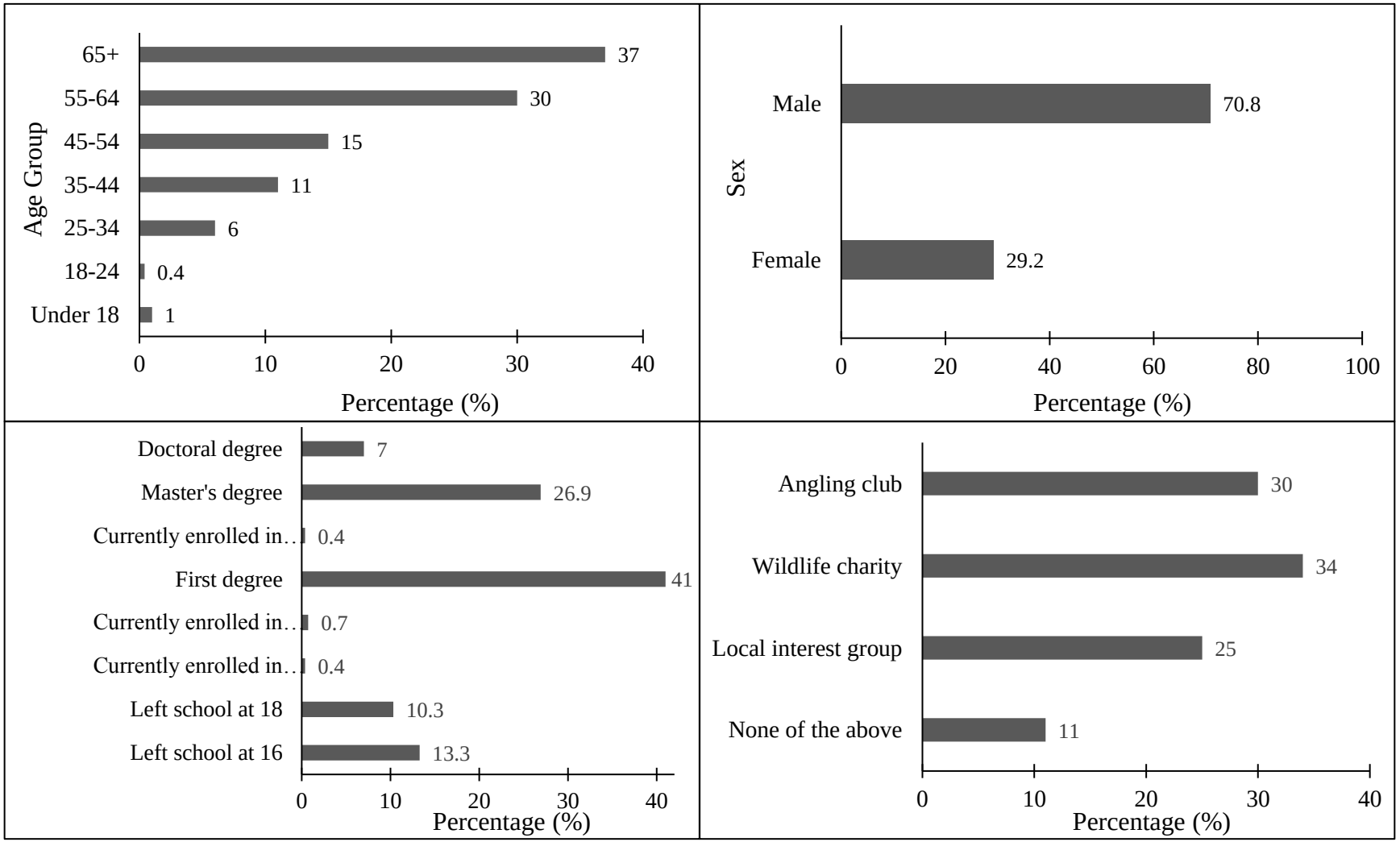

Figure 2: Percentage of respondents in each age group, male and female respondents, their highest level of education, and percentage belonging to an angling, conservation, or local interest group.

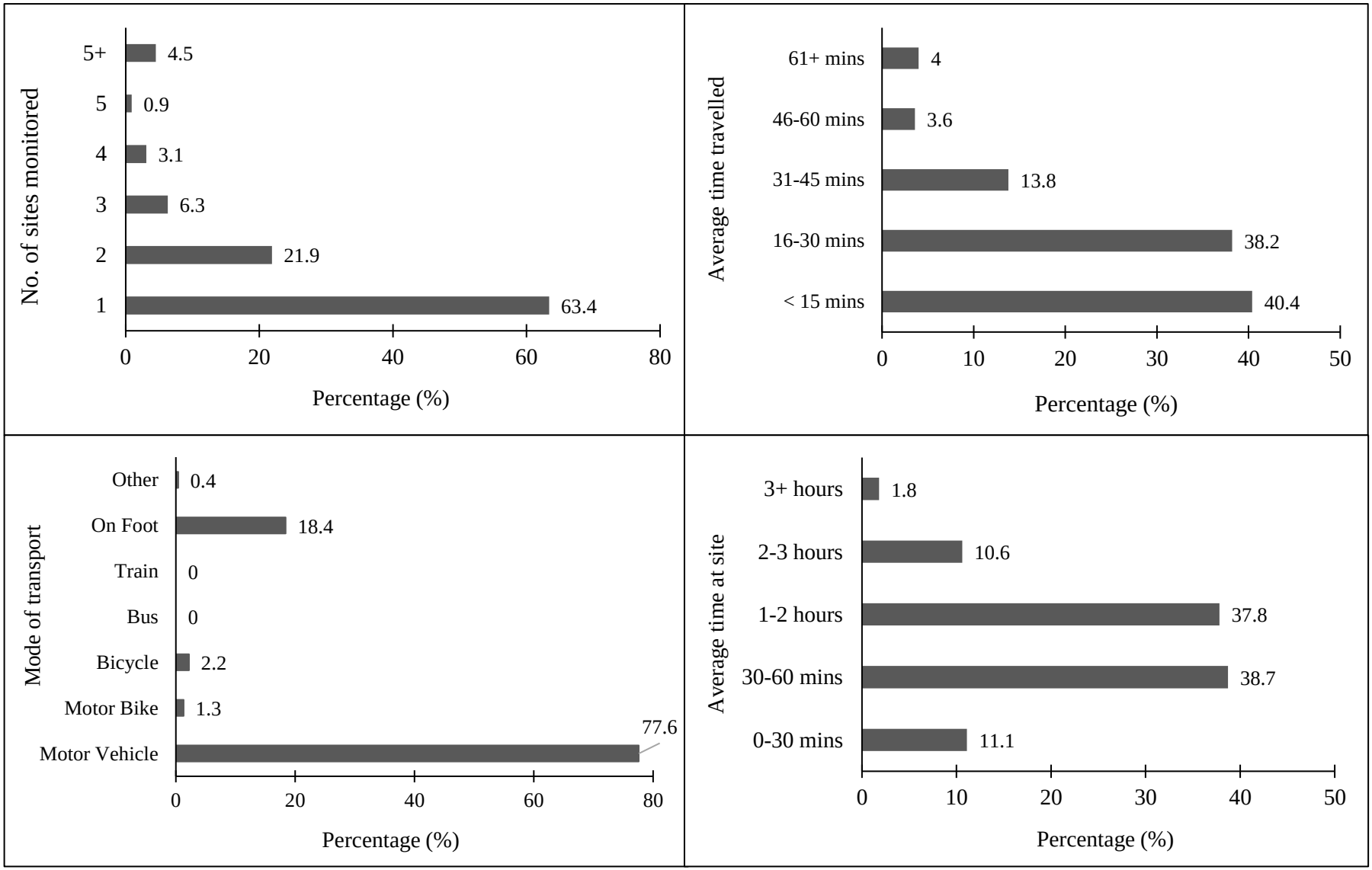

Figure 3: Percentage of respondents in each category from questions related to monitoring experiences.

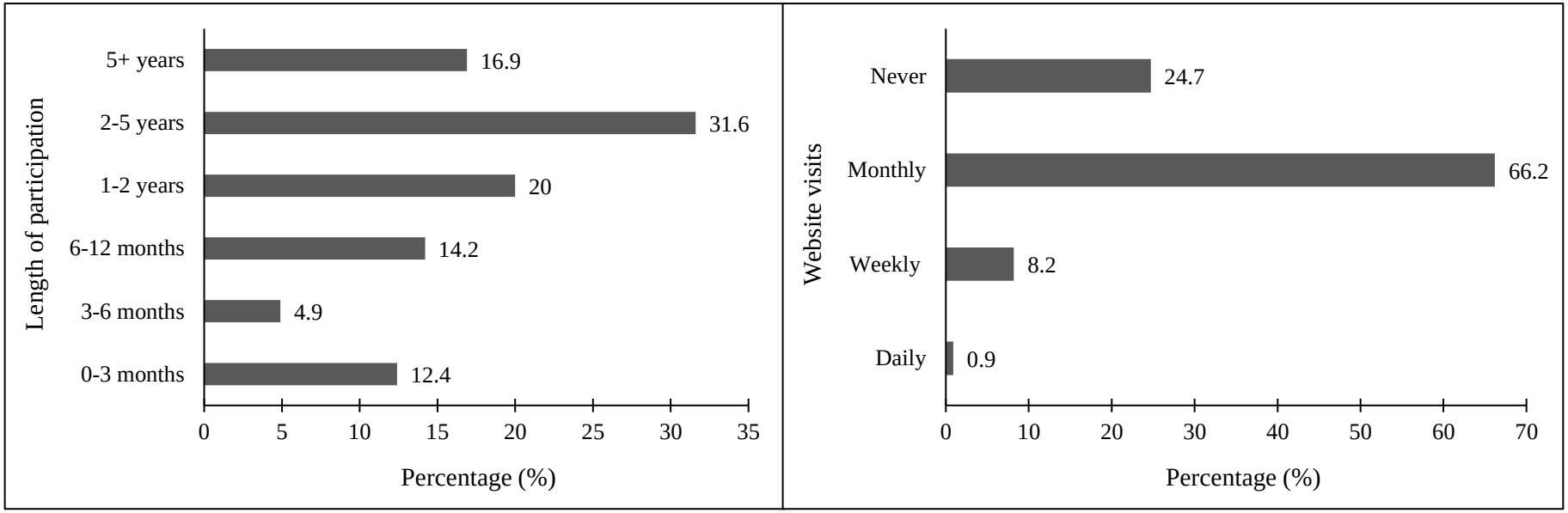

Figure 3 continued

3.2. Motivations of participants

3.2.1. Main Motivations

The categories for main motivations found within the survey are listed in Table 1. The average ranking of each motivation category as determined by the surveyed riverfly volunteers is also given. Of the ranked motivations, concern about the health of their local river (M1), was ranked as the most important motivation for participating in the Riverfly Initiative, highlighted by an average ranking of 2. An interest in aquatic conservation and/or environmental issues (M2) was also ranked highly amongst surveyed volunteers (average ranking of 2). Gaining experience or having an interest in a career within a similar aquatic science or conservation field (M8) was ranked as the least important motivation for participation in the initiative (average rank of 7). Additionally, participation in the initiative to meet new people with similar interests or concerns (M4), and due to health and wellbeing purposes (M5), were also motivations not regarded highly amongst the surveyed population. A non-parametric Kruskal-Wallis test was performed producing a test statistic (H) of 650.21 and a p-value of 0.000, thus highlighting a significant difference in median ranks of each motivation. Furthermore, out of 232 volunteers who answered the question regarding their main motivations for participation, 27 volunteers gave additional motivations not stated within the initial motivation categories. A full list of motivations stated as 'Other' by these individuals and examples are highlighted in Table 2.

Table 1: Main motivations for participating in the Riverfly Monitoring Initiative, and their average rank of importance. 1=most important, 8=least important.

Motivation Category	Average rank
M1: Concern about the health of a local river (i.e. water quality, decline in riverfly populations, presence of invasive species etc.)	2
M2: Interest in aquatic conservation and species, and/or general environmental issues	2
M3: Interest in riverfly species diversity and abundance to aid fisheries/fisheries management or to contribute to an angling club	3
M4: Enjoy meeting new people and interacting with individuals who have similar interest or concerns	6
M5: Health/wellbeing	6
M6: Enjoy being outdoors	4
M7: A desire new skills and/or knowledge (i.e. knowledge of river ecology and species)	4
M8: A desire to gain experience or have an interest in a career in a similar field	7

Table 2: Examples of motivations for participating in ARMI, stated as 'Other' by surveyed volunteers. Answers given in the 'Examples' column were coded and similar answers containing similar codes were grouped together. New motivation categories were then created and assigned to responses containing similar codes.

Motivation Category	Examples stated as 'Other'
M9: Other	
Subcategory	
M9a: Interest in the restoration or management of freshwater habitats and/or monitoring the effects of restoration approaches on the ecological health of a habitat	"Support for ARK" "Water Vole conservation and habitat restoration" "Being part of a team to increase data and understanding to improve habitat management" "My beck had plenty of small trout before a sheep dip killed them. I want to see it restocked" "Monitor the effect of work done to improve the Bulbourne on behalf of the Box Moor Trust" "Desire to support a systematic means of monitoring and understanding the river, leading directly to improvement in its condition" "Interest in catchment management"
M9b: Interest in environmental advocacy, helping to raise awareness of the ecological status of riverine habitats and/or a desire to educate others, including local interest groups, school children and the public	"Promote/raise profile of conservation" "Gain information for my angling website that informs the local community" "Help raise awareness and interest amongst the locals" "Showing local school children what is in their river" "To interest children in environmental issues" "Raise awareness of urban rivers"
M9c: A desire to support and contribute to an initiative that has local significance	"Support local community initiative" "Doing and supporting something of local importance" "It's my garden"

Table 2 continued

M9d: Involvement of the initiative through work or volunteering commitments with an external organisation (e.g. Rivers Trust or wildlife/conservation charity)	"Member of a conservation charity" "Part of my work" "Supporting Forestry Commission project manager" "Volunteer with local Rivers Trust so another way of helping"
M9e: Desire to be involved in the collection of a long-term dataset that can be used to inform both local and national management	"Ongoing monitoring" "Contribute to a database which can be used nationwide"
M9f: General interest in citizen science projects and volunteering opportunities	"Volunteering opportunity: giving something back" "Easily added to voluntary work looking after the River" "Interest in Citizen Science' projects"
M9g: Miscellaneous	"Distrust of official data" "Opportunity to go to places normally not accessible" "Feeling in touch/implicated with local countryside"

3.2.2. Tests of association

Association between demographic data and main motivation

Key demographic data, including age, sex, and educational background of the surveyed volunteers, and their main motivation for participating in the initiative, were cross-tabulated allowing the relationship between the two variables to be inferred (Table 3, 4, and 5). Table 3 highlights the frequency of surveyed ARMI volunteers in each age group and their main motivation for participation. From the table, it could be suggested that the main motivation for many of the age groups was a concern about the health of their local river (M1). The 55-64 age category had the largest proportion of respondents choosing M1 as their main motivation (47%), although this was not much higher than the 65+ category and the 35-44 category (both 44%), and the 45-54 age category (43%). Similar proportions suggest that the age of an individual does not influence their main motivation for participation. The p-value calculated from a Fisher-Freeman-Halton-Test confirmed that there is no association between the age group and their main motivation within the surveyed sample (p=0.162).

Table 3: Cross-tabulation of volunteer age and their main motivation. A Fisher-Freeman-Halton Test highlighted no association between the age group of a volunteer and their main motivation for participation (p-value>0.05).

		Main Motivation									
		M1	M2	M3	M4	M5	M6	M7	M8	M9	Total
Age	0-24	1	1	0	1	0	0	0	0	0	3
	25-34	5	2	0	0	0	0	1	5	0	13
	35-44	8	6	0	0	1	1	1	0	1	18
	45-54	13	10	1	1	0	1	3	1	0	30
	55-64	25	14	4	0	1	4	2	2	1	53
	65+	27	16	9	0	3	2	2	3	0	62
Total		79	49	14	2	5	8	9	11	2	179

*Test statistic: 44.479; p-value: 0.162

Table 4 shows the number of male and female participants and their main motivation. The table highlights that both males and females stated a concern about the health of their local river (M1) as their main reason for participating in the initiative, with a higher proportion of males (48%) stating M1 as their main motivation compared to female participants (37%). A Fishers exact test again inferred no significant association between the sex of a respondent and their main motivation, at a 95% confidence interval (p=0.059).

A contingency table was also created to highlight whether education background is associated with motivation choices (Table 5). As the table demonstrates, the main motivation for participation amongst most of the educational background groups was again the concern for the health of their local river (M1), with the highest proportion occurring in individuals who left school at 18 (58%), followed by individuals with a master's degree (55%). The majority of individuals with a doctoral degree as their highest level of education also chose M1 as their main motivation for participation (43%), although a similar proportion also stated an interest in aquatic conservation and species, and/or general interest in environmental issues (M2) as their main motivation (36%). This also occurs in individuals with a first degree with 38% and 35% choosing M1 or M2 as their main motivation, respectively. Dissimilar to the two other demographic variables tested, age and sex, educational background was found to be associated with an individual's main motivation (p=0.008).

Table 4: Crosstabulation of the number of female and male volunteers and their main motivation for participating in ARMI. A Fisher's Exact Test highlighted no association between sex of a volunteer and their main motivation for participation (p-value>0.05).

		Main Motivation									
		M1	M2	M3	M4	M5	M6	M7	M8	M9	Total
Sex	Female	22	19	2	2	1	5	2	6	0	59
	Male	57	30	12	0	4	3	7	5	2	120
Total		79	49	14	2	5	8	9	11	2	179

*Test statistic: 13.697; p-value: 0.059

Table 5: Crosstabulation of the number of volunteers within each education group and their main motivation for participating in ARMI. A Fisher-Freeman-Halton Test highlighted an association between a volunteers' highest level of education and their main motivation for participation (p-value<0.05).

		Main Motivation									
		M1	M2	M3	M4	M5	M6	M7	M8	M9	Total
Highest level of education	Currently enrolled in degree program	0	0	0	0	0	0	1	1	0	2
	Currently enrolled in postgraduate study	0	0	1	0	0	0	0	0	0	1
	Currently enrolled in secondary school	0	0	0	1	0	0	0	0	0	1
	Doctoral degree	6	5	1	0	0	0	0	2	0	14
	First degree	32	30	6	0	2	7	4	4	0	85
	Left school at 16 (GCSE/O levels)	9	1	4	0	2	0	1	1	0	18
	Left school at 18 (A levels, higher etc.)	11	3	0	1	1	0	2	1	0	19
	Master's degree	18	8	2	0	0	1	1	2	1	33
Total		76	47	14	2	5	8	9	11	1	173

*Test statistic: 88.427; p-value: 0.008

Association between length of participation and main motivations

The length of participation in the initiative was also compared against an individual's main motivation through crosstabulation (Table 6). The table demonstrates that most individuals within each group again stated a concern for the health of their local river as their main motivation for participation, with a general interest in aquatic conservation regarded as the main motivation for the second most number of individuals within in each group. A Fisher-Freeman-Halton test with a p-value greater than 0.05 suggests no significant association between the two variables (p=0.758).

Table 6: Crosstabulation of the number of volunteers within each length of participation group and their main motivation for participating in ARMI. A Fisher-Freeman-Halton Test highlighted no association between a volunteers' length of participation and their main motivation (p-value>0.05).

		Main Motivation									
		M1	M2	M3	M4	M5	M6	M7	M8	M9	Total
Length	0-3 months	9	7	0	1	2	0	2	3	0	24
	3-6 months	4	3	0	1	0	0	0	0	0	8
	6-12 months	12	6	3	0	1	1	1	1	0	25
	1-2 years	16	9	2	0	1	3	4	2	0	37
	2-5 years	24	15	4	0	0	1	2	3	2	51
	5+ years	10	6	4	0	1	0	0	1	0	22
Total		75	46	13	2	5	5	9	10	2	167

*Test statistic: 31.539; p-value: 0.758

3.2.3. Factors influencing motivations

The categories for factors that could have an influence on the long-term participation of ARMI volunteers are listed in Table 7. The table also highlights the average ranking of each factor category as determined by the surveyed individuals. On average, the provision of further guidance and training (F4), and the opportunity to gain further knowledge and/or an understanding of riverfly monitoring data at a broader, national scale (F5) were regarded by individuals as the most important factors in influencing their main motivation for continued participation (average rank of 2). Costs associated with monitoring (F1) and distance to travel sites (F2) were regarded by respondents as the least important factors to influence their main reason for taking part with an average rank of 4. Recognition of committed and reliable volunteers (F3) had an average rank of 3. When a Kruskal-Wallis test was performed, a p-value less than 0.05 was determined (p=0.000), thus suggesting any differences found in the average ranks of each main factor were of significance at a 95% confidence level. Volunteers were also given the opportunity to state any 'other' factors that they felt were important in their decision to continue monitoring, which are highlighted in Table 8.

Table 7: Main factors influencing continued participation in the initiative their average rank. 1=most important, 5=least important.

Factor Category	Average rank
F1: Associated costs of monitoring (e.g. travel cost to monitoring sites, training costs etc.)	4
F2: Distance to monitoring sites	4
F3: Recognition of committed and reliable volunteers	3
F4: Further guidance and training	2
F5: Further knowledge and/or understanding of riverfly monitoring data at a national scale	2

3.2.4. Long-term changes in motivations

Out of 225 individuals who gave a response to the question, 'Have your main motivations for volunteering changed since you have started monitoring?', only 15 (7%) stated that their main motivations differ since participating. A very high proportion (93%) therefore, do not feel that their motivations have changed.

3.3. Riverfly plus and further volunteering

The term 'Riverfly Plus' relates to citizen science based projects focused on freshwater monitoring and research, beyond the Anglers' Riverfly Monitoring Initiative (Riverfly Partnership, no date). With each of these initiatives, improvements to the freshwater environment is aimed for through the use of standardised methods aimed to collect and analyse valuable freshwater data (Riverfly Partnership, no date). Out of 224 surveyed volunteers who gave a response, a large proportion (67%) have not added any riverfly plus monitoring or have become involved in other citizen science initiatives since participating in the Riverfly Initiative. Of the respondents who do not take part in any Riverfly Plus initiatives, a number of factors that may encourage participation were ranked in order of importance and are highlighted in Table 9. Furthermore, if ARMI were to be expanded, the majority of surveyed volunteers were most interested in the inclusion of water chemistry monitoring (39.7%) and invasive species recording (25.4%) alongside the current recording of the basic eight riverfly groups.

Table 8: Examples of factors influencing long-term participation in the Riverfly Monitoring Initiative, stated as 'Other' by surveyed volunteers. Answers given in the 'Examples' column in this Table were coded and similar answers containing similar codes were grouped together. New motivation categories were then created and assigned to responses containing similar codes.

Factor	Examples stated as 'Other'
F6: Other	
Subcategory	
F6a: Health constraints limiting the ability to carry out monitoring	"My own health" "Age and health" "Knee problems" "My own fitness" "Continuing good health and energy – flyfishing tends to attract elderly gentlemen!"
F6b: Time constraints	"Time to undertake regular monitoring" "Change in domestic circumstances" "Simply the time available since weekends also involve fishing and fly-casting instruction and casting practice" "Time available to do three sites – when retired – in 6 years' time – probably" "Retirement is getting closer and I'll have more time" "Paid employment conflicting with volunteering" "Availability (of myself and follow volunteers)"
F6c: Effective use of monitoring data to inform management and conservation decisions, including the contribution of the Environment Agency to respond to trigger level breaches	"Control of farmer actions" "The hope that it will make a difference" "Interest by National Trust in results of Bramble Wood site as water course runs mostly through their land." "The apparent lack of interest in water quality by EA/BART in acting on high Nitrate levels" "Knowing whether my results are of use" "Evidence of the positive impact of the scheme upon the health of the river" "EA contribution to respond to trigger breaches and report back"

Table 8 continued

F6d: Regular access to information, updates, and feedback on results, including the opportunity to attend meetings and conferences	"Access to information and updates" "I would like a lot more feedback" "Opportunity to meet as a larger group – with speakers" "Lack of effective communication" "Brief annual newsletter confirming national findings"
F6e: Ease of use of the Riverfly Partnership website and the online data logging platform	"More user-friendly website. Fewer security hurdles" "Ease of use of logging site"
F6f: The sharing of responsibilities of carrying out monitoring with more than one volunteer	"Being part of a large enough group so that the commitment is not too great" "Other congenial monitors with whom to work"
F6g: Resource constraints	"Availability of funding at a local level to enable support to continue" "The ability of the EA and R. Trust to continue support"
F6h: Miscellaneous	"The need for continual vigilance of vulnerable rivers in the UK" "Number of species present" "Access to site – in the long-term I may have to move" "Weather (long sequence of poor weather for example)"

Table 9: Main factors that may encourage the surveyed ARMI volunteers to participate in Riverfly Plus initiatives and average rank as determined by each respondent is also highlighted.

Factors encouraging individuals to participate in Riverfly Plus initiatives	Average rank
P1: There is no cost involved or cost is minimal	4
P2: There is greater information available regarding riverfly plus (e.g. the different types of projects available, information on how to become involved etc.)	2
P3: A desire to further understand river ecosystems and their related issues	2
P4: A desire to not only monitor the health of a local river, but to become involved in measures to protect it	2
P5: Other	1

Association between participation in Riverfly Plus or similar and length of participation

Using crosstabulation, the length of participation was also compared with an individual's participation in a Riverfly Plus or similar initiative (Table 10). This was to understand whether more experienced volunteers are more inclined to further participate in environmentally based conservation projects due to increased scientific knowledge and environmental awareness. An association between length of participation and participation in Riverfly Plus initiatives was found ($p<0.05$).

Table 10: Crosstabulation between length of participation and involvement in Riverfly Plus initiatives

		Participation in Riverfly Plus or other similar initiatives?		
		No	Yes	Total
Length	0-3 months	27	1	28
	1-2 years	26	19	45
	2-5 years	41	29	70
	3-6 months	7	4	11
	5+ years	21	17	38
	6-12 months	28	4	32
Total		150	74	224

*Test statistic: 26.609; p-value: 0.000

4. Discussion

4.1. Main demographics of volunteers: Under-representation of demographic groups

Survey respondents within this research are more likely to be male, over the age of 55, retired, possess a first degree or master's degree, and from a white background. This therefore suggests that within the Riverfly Monitoring Initiative, women, students, and those from ethnic minority groups face under-representation. This mainly reflects similar surveys on citizen science participation and motivations. For example, in a survey of citizen science motivations conducted by Geoghegan *et al*. (2016), the main demographics of environmental volunteers were most likely to be male and within an older age group. Similarly, demographic data revealed in a citizen science project conducted by the Cornell Laboratory of Ornithology, suggested that volunteers were more likely to be more qualified and older compared to the general population (Trumbull *et al*., 2000).

As Geoghegan *et al*. (2016) discusses, under-representation within projects should not be mistaken for attempts of exclusion, since some groups may willingly choose not to become involved in such initiatives, and that the reason for under-representation of some groups does not indicate discrimination. Some attempts have been made to pinpoint the reasons why some groups face under-representation through the identification of barriers affecting access to nature, especially of individuals with an ethnic minority background. This is because ethnic minorities are considered to face greater barriers to access than individuals from white backgrounds (Jay *et al*., 2012). For example, in the most recent British biennial household-based public opinion of forestry surveys, it was found that although 65% of white British and other white backgrounds have visited forests or woodland areas in the last few years, only 33% of ethnic minority backgrounds had stated similar visits (Forestry Commission, 2017). The most significant barriers are suggested to be economic factors, and/or a lack of awareness regarding natural spaces. Economic barriers for example, may be based upon underlying factors, such as the observation that individuals from ethnic minority groups tend to live in deprived urban environments and therefore cannot afford to travel to rural areas, rather than a barrier associated directly with an individuals ethnicity at first glance (Edwards and Weldon, 2006). However, further explanations of under-representation as a result of barriers to the natural environment that goes beyond the physical, such as the specific meanings and views of nature between various groups have rarely been researched (Jay *et al*., 2012). Agyeman (1990) nonetheless, discusses the view of the countryside as a white landscape construct, thus

promoting the 'othering' of black people. This could therefore lead to negative connotations of natural spaces as areas that promote a sense of being out of place (Agyeman and Spooner, 1997). This research therefore suggests that similar barriers preventing the access to nature may be prevalent in the project and could explain why ethnic minority groups in particular, face under-representation in the monitoring scheme. Further research is needed to therefore address which barriers are in operation. Furthermore, project managers should focus on finding innovative ways to actively target other demographics, which may improve the projects sustainability in the long-term (Wright *et al*., 2015).

4.2. Most important motivations for participation: Altruistic vs egoistic motives

Both egoistic (i.e. self-directed) and altruistic motives are often significant to volunteers participating in environmental and conservation-based citizen science research projects (Kragh, 2016). Table 11 categorises all ARMI motivation categories into self-directed and altruistic motives. In this study, the most important self-directed motives included a concern about the health of a local river and interest in aquatic conservation and species, and/or an interest in general environmental issues (average rank of 2). This confirms the findings in other studies, which tends to suggest that a personal interest in the scientific subject of research is rated as the most important motivation for participating in citizen science programs. For example, Raddick *et al*. (2013) found in their study on the motivations of Galaxy Zoo volunteers, a large proportion motivated by an interest in the programs scientific content. Furthermore, in their survey of volunteers participating in the Great Pollinator Project, Domroese and Johnson (2016) found that an interest the main subject of the project, i.e. learning about the bees, was the strongest motive for participation.

Social factors may also be considered under the self-directed motivation category, with main reasons for participation as a means of increasing one's social network. However, these do not tend to be considered as the most important compared to other self-directed motivations (Kragh, 2016). This again was reflected in this survey, in which the motivation to socialise with new people or interact with those who have similar interests or concerns, was not ranked as highly as some of the other motivations for participation (average rank of 6). This may be a result of the way many environmental projects are designed in which volunteers are expected to carry out monitoring alone, or as Kragh (2016) describes, as an 'individualistic setup' (pg. 34). This is therefore likely to discourage individuals seeking participation in projects where socialising and building their social network is a significant motivation for participation, and

likely to encourage individuals that have a desire to be alone with nature. This desire to be alone with nature brings about a connectedness to the natural world experienced by these individuals. This can subsequently generate a contradictory desire for people to share their experiences of connectedness with other people as suggested by Bell *et al*. (2008). Therefore, although a desire to socialise with others was not ranked as highly by the surveyed participants, an unintentional desire to share experiences with others may be present in many volunteers, therefore subconsciously allowing monitors to expand their social network with like-minded people despite this not being a main motivation at first glance.

Table 11: Self-directed (egoistic) and altruistic motives

Motivation
Self-directed (egoistic)
Concern about the health of a local river (i.e. water quality, decline in riverfly populations, presence of invasive species etc.)
Interest in aquatic conservation and species, and/or general environmental issues
Enjoy meeting new people/interacting with those who have similar interests or concerns
Health/wellbeing
Enjoy being outdoors
Learning new skills and/or knowledge (i.e. knowledge of river ecology and species etc.), and/or to utilise existing skills/knowledge
To gain experience or have an interest in a career in the aquatic conservation field
Involvement of the initiative through work or volunteering commitments with an external organisation (e.g. Rivers Trust, wildlife/conservation charity)
Interest in general citizen science projects and volunteering opportunities
Altruistic
Interest in riverfly species diversity and abundance to aid fisheries/fisheries management
A desire to contribute to the restoration or management of freshwater habitats and/or monitoring the effects of restoration measures
A desire to support and contribute to an initiative of local importance
Interest in environmental advocacy, helping to raise awareness of the ecological status of riverine habitats and/or a desire to educate others
Desire to contribute to the collection of a long-term dataset that can be used to inform both local and national management

Attempts to encourage volunteers to interact and discuss monitoring experiences with fellow participants have been made by the project coordinators, and this is reflected by the 62% of surveyed volunteers stating that they do share their experiences with others. This includes a national database in which volunteers can upload their results, interaction with ARMI hub coordinators that are able to assist with any issues experienced by volunteers, and monthly meetings in some groups to discuss findings. However, there is still over a third of participants that stated that they do not discuss their monitoring experiences with other volunteers, suggesting that some volunteers are not part of a larger social network. Therefore, further attempts to improve social interaction amongst these monitors should be considered.

Of the altruistic motivation categories, an interest in riverfly species diversity and abundance to aid fisheries management or to contribute to an angling club was ranked as the second most important motivation overall (average rank of 3). This may be a result of the high numbers of participants who responded that they were part of an angling club, and therefore keen to use the results of their monitoring to contribute data to a club.

Other motivations

Motivations stated as 'Other' tended to be altruistic in nature rather than self-directed. Some respondents were concerned with volunteering to contribute to the restoration and management of freshwater habitats. For example, one volunteer expressed that their main motivation for participation was to contribute to "water vole conservation and habitat restoration" whereas another volunteer had a "desire to support a systematic means of monitoring and understanding of the river, leading directly to improvement in its condition". Helping to raise awareness of the ecological status of riverine habitats and/or the desire to educate others, including local interest groups, local school children, and the public was also cited as another main reason for participation not included in the initial main motivation categories. These motives suggest that some individuals are not primarily concerned with participation as a result of self-gain, and motives are based upon a desire to help or contribute to a change in something, which may stem from ethical values or the feeling of doing something worthwhile (Rehberg, 2005).

It is highly important that project coordinators are aware of all motivations that influence ARMI volunteers to participate in the initiative, whilst acknowledging that motivations will not be the same for each participant. At the same time, it is evident that all motivations are not going to be met dependent upon the type of project and the main goals for the project. However,

by providing different means of satisfying a variety of motivations and by providing feedback, acknowledgement and the opportunity for volunteers to increase their knowledge, it is possible to provide an experience to all volunteers that is both positive and fulfilling (Bruyere and Rappe, 2007).

4.3. Are demographics a determinant of motivation?

Certain demographic characteristics have been highlighted by many researchers to be consistently associated with the desire to participate in volunteering activities (Penner, 2004). Education in particular, is considered to be the most common demographic associated with the act of volunteering (McPherson and Rotolo, 1996; Wilson, 2000). Demographics such as gender on the otherhand, does not show a constant relationship and may differ between places, and an individual's stage in life. For example, young females are expected to volunteer more compared to young males, whereas older males are shown to participate more than their older counterparts (Penner, 2004). However, there needs to be an understanding that demographics are not the immediate cause of volunteering (Penner, 2004). People do not choose to volunteer because they are male or female, are of a certain age, or have a specific qualification for example. It is more likely to be a result of an indirect relationship; an older person in retirement may participate in such initiatives due to the greater amounts of free time compared to someone in full-time work, or a person with a certain qualification may have specific interest in the chosen area, are therefore more aware of environmental problems, and subsequently would like to spend their free time helping the environment or a specific scientific cause.

What about the association between volunteer demographics and their main motivation for participation? Can this same link between demographics and the decision to volunteer be applied to these two variables? It could be suggested that in terms of age, older people who are already working or in retirement may be less inclined to participate in a project as a reason to further their career, compared to a younger person who is probably more likely to participate to gain experience. Participation in ARMI to gain experience or because of an interest in a career in a similar aquatic conservation field was not ranked highly amongst the surveyed volunteers (average rank of 7), and may be a result of a heavy skew towards retired participants. This was also highlighted by Wright *et al*. (2015) who also found a heavy skew towards retired individuals in their study which is likely to reflect their finding of 'enhancing career prospects' as the least important motivator. However, when a significance test was performed to test for association, none was found between age and sex, and an individual's main motivation (Tables

3 and 4). On the other hand, significant evidence was found to suggest an association between main motivation and an individual's highest level of education (Table 5). As stated by Wilson (2000), education 'heightens awareness of problems, increases empathy and builds self-confidence' (pg 219). It could therefore be argued that those with higher levels of education, could have a greater awareness of the problems affecting their local area and are more likely to indicate having a concern for the health of their local river, or a general interest in aquatic conservation and environmental issues as their main motivations for participation.

4.4. Changes in motivation over time

When asked the question 'Have your main motivations for volunteering changed since you have started monitoring?', a large percentage of volunteers suggested that their main motivation has not changed, with 93% of respondents stating 'No'. This does not reflect the literature which suggests that motivations are multifaceted and will differ along a time gradient (Clary and Snyder, 1999) For example, Rotman *et al*. (2012) found evidence suggesting that there are two pivotal points associated with an individual's participation in a scientific project, including the initial choice to take part, and over the long-term, the decision to keep participating. It was further suggested that motivations will play a huge role in these choices and will change with time, and changes are likely to occur from initial egoistic-based motivations to secondary motivational factors, such as the recognition of volunteers and feedback addressing the outcomes of the project, which are important factors in the decision to continue volunteering (Rotman *et al*., 2012). This was also confirmed by Ryan, *et al*. (2001) who found that although motivations such as helping the environment and learning were most significant as reasons for initial participation, it was factors such as the effective organisation of initiatives and social motivators that influenced continued participation in volunteers.

The reason for this difference in findings could lie in respondent bias, especially in the more experienced volunteers who may find it harder to remember why they participated in the first place compared to their main motivations at the present time. Furthermore, the nature of survey research may not provide the best approach to understanding how motivations may have changed in the ARMI volunteers, since volunteers were asked to respond in a fixed point in time. Therefore, determining whether motivations have changed and how they have changed, remains inconclusive. This is where further research may be needed, by comparing the motivations of recently trained ARMI participants, with the main motivations of more experienced volunteers participating over a longer timeframe.

Factors influencing continued participation

Of the factor categories given in a closed-ended question, the factors that were ranked as the most important for determining continued participation in riverfly monitoring, were the delivery of further guidance and training, and the delivery of further knowledge to aid the understanding of riverfly monitoring data at a national scale, both with an average rank of 2[1]. Any associated costs to monitoring and distance to monitoring sites were regarded as the least important factors that would influence continued participation in the initiative. This suggests that if the initiative is to retain volunteers, there should be a focus from all riverfly co-ordinators to continue delivering up-to-date training, and to provide a platform for volunteers to increase their knowledge of riverfly populations that go beyond the local scale.

A range of further factors were stated as 'Other' by several ARMI volunteers as barriers that may prevent them from continuing their participation in riverfly monitoring. Time and health constraints were two of the most mentioned factors. Participating in conservation and environmentally-based citizen science projects requires a large time commitment by volunteers, and other commitments such as "paid employment conflicting with volunteering" or a "change in domestic circumstances" may hinder the ability to continue participation, as stated by two ARMI volunteers. Social interaction could be a key to overcoming the barriers associated with time, as this could increase the number of volunteers who are able to monitor at a particular site in the likelihood another volunteer is unable to carry out their monthly monitoring. This was reflected by one volunteer who stated the benefit of "being part of a large enough group so that the commitment is not too great". Regular access to information, updates, and feedback on results, is also an important factor to sustain long-term participation in volunteers and several respondents stated this as a factor.

The Riverfly Partnership offer a website that can be accessed by volunteers which allows participants to be kept up to date with information regarding riverfly monitoring, and ARMI hub coordinators can be the first point of contact regarding any concerns associated with volunteers. However, when asked 'How often do you visit the riverfly website and database?', nearly a quarter of respondents (24.7%) reported that they have never visited the site. It is evident that the resources to provide riverfly monitors with regular access to national information exists. However, some individuals may not be fully aware of the resources

[1] A ranking of 1 represents the most important factor; a ranking of 5 represents the least important factor.

available to them and there should be an effort to address this. In terms of the provision of local monitoring information, it should be the responsibility of the riverfly coordinator to ensure regular updates are provided to their volunteers. There is no doubt that coordinators are extremely aware of the importance of providing regular information, with some coordinators stating that they send out monthly riverfly updates, or organise periodic meetings, to "keep volunteers engaged and up to date". Another coordinator also recognises the importance of providing continued support to their volunteers to highlight how much their contribution is appreciated.

4.5. Increased participation in aquatic-based conservation and environmental advocacy

The participation in citizen science projects provides the opportunity for volunteers to improve their awareness for environmental issues. This subsequently creates an increasing number of individuals who become advocates for the environment, increasingly aware of issues affecting their local area, thus sharing their newfound knowledge within their social networks (Johnson *et al*., 2014). Within the study, some of the main motivations stated as 'other' by surveyed volunteers included helping to "raise awareness and interest amongst locals", to "raise awareness of urban rivers", and to "show local children what is in their river", thus suggesting the importance of environmental education and advocacy in the initiative. Furthermore, improved environmental awareness is suggested to increase participation in similar conservation or environmental-based citizen science projects, and in this survey sample, 33% of ARMI volunteers responded that they do participate in Riverfly Plus or similar aquatic conservation projects (Lewandowski and Oberhauser, 2017). Although this only equates to a third of respondents, what is important to note is that an association was found between the length of participation in ARMI, and participation in further projects ($p<0.05$) and in respondents who do participate further, a significant proportion have participated longer than a year (88%). This suggests that there may be a positive relationship between the length of participation and the level of engagement in further aquatic conservation projects, which may be a result of increased experience and access to information regarding aquatic conservation issues (Merenlender *et al*., 2016). This potentially increases the confidence in citizen scientists to conserve the environment (Lewandowski and Oberhauser, 2017).

5. Conclusion

This survey research has found that the main demographic groups represented by ARMI volunteers are male, retired, and from a white background, and there is an under-representation of certain demographic groups, including women, young volunteers, and individuals from an ethnic minority background. Secondly, demographics were found to influence main motivations in some variables including educational background, but not in others. In terms of main motivations, an interest in the health of local rivers, and an interest in aquatic conservation or general environmental issues, were the two main motives for the participation of volunteers in the Anglers' Riverfly Monitoring Initiative. Gaining experience or having an interest in a career in aquatic conservation, participation to improve health or wellbeing, and social motivations, were not ranked as highly by the sampled volunteers, thus suggesting that these are not as important in motivating the public to participate. Other motivations listed by ARMI volunteers included an interest in contributing to the restoration and management of freshwater habitats, a desire to support and contribute to an initiative of local significance, a desire to contribute to the collection of a long-term dataset, and an interest in environmental advocacy, helping to raise awareness of the ecological status of riverine habitats through the education of others. These motivations suggest that reasons for participation are not only dependent upon egoistic, self-directed motives, but also as a result of altruistic behaviours. For continued participation in the long-term, volunteers are most likely to be influenced by the provision of further guidance and training, and the opportunity to gain further knowledge and understanding of riverfly monitoring data at a national scale, rather than factors related to the associated costs of monitoring and distance to monitoring sites.

Although there has been a lot of research into the motivations of volunteering, reasons into the motivations of citizen scientists in particular, has been under-researched. By identifying the main motivations of ARMI volunteers and the main factors that influence their decisions to continue participation, approaches can be put in place to ensure that the goals of the project align with the needs of these volunteers. Not all projects will satisfy the motivations of all volunteers. However, project coordinators are in the ideal position to provide a range of activities that attempts to recognise all potential motivations since this is likely to enhance engagement, effectively retaining a set of diverse, well-informed, and experienced individuals, thus contributing to the long-term sustainability of the project.

Suggestions for further study

As already acknowledged, changes in motivations are likely to occur over time, determined by an individuals' initial decision to participate, and the decision to continue participation in the long-term. Although the main motivations of ARMI volunteers have been identified in this research alongside the main factors that influence continued participation, survey research only provides a snapshot of motivations in a specific point in time. This provides further scope for research into whether ARMI volunteer motivations have changed over the long-term, and if so, how these motivations have changed. To track future fluctuations in motivation, the inclusion of regular surveys within the project should be considered. This could result in the collection of a long-term dataset, which will enable project co-ordinators to respond to such changes, therefore allowing methods to be put in place to keep individuals engaged and willing to continue their participation. Furthermore, the demographic data suggests the under-representation of certain groups within the initiative. An in-depth study should therefore be undertaken into the barriers facing participation of certain demographic groups, which may provide crucial insight into how their participation within the initiative may be encouraged.

Auto-critique

Having previously participated in citizen science programs specifically related to aquatic monitoring and conservation, such as the Thames River Watch project conducted by Thames21, and the elver monitoring survey conducted by ZSL, I have experienced first-hand the importance of trained volunteers in their contribution of collecting reliable data to aid aquatic conservation and management research. Therefore, in the initial discussion with Steve Brooks about potential research ideas, a project based on the understanding of the main reasons why volunteers participate in such initiatives immediately resonated with me. The Riverfly Partnership has over 2600 trained volunteers participating in their Riverfly Monitoring Initiative, with volunteers ranging from anglers, conservationists, and local interest groups who monitor local waterways from all across the UK, making it a truly nationwide aquatic monitoring effort. This provided the perfect base of which to conduct my research.

Overall, I think this study has been beneficial in determining why ARMI volunteers are motivated to participate in the initiative, highlighting factors that may act as barriers to continued participation, which are the main aims of this study. It has also identified how some demographic groups face under-representation, reflecting the majority of citizen science projects. If this study were to be continued over a longer time frame, a preliminary survey or interviews with a number of ARMI volunteers would ideally be undertaken, to further aid in the development of answer categories within the closed-ended opinion questions. Nonetheless, an opportunity for respondents to give 'Other' answers to those not listed, attempted to mitigate the potential effects of researcher influence on respondent answers. In hindsight, I would have included a space for respondents to optionally leave their contact details within the final survey, to allow for any follow-up questions or the clarification of answers. Finally, the nature of survey research means that responses were provided within a single, fixed-point in time, which is the weakness of this research. An understanding of how main motivations have changed over the long-term in ARMI volunteers is inconclusive and further research should be conducted in this area. Nonetheless, this survey could be seen as the first step towards creating a long-term dataset related to ARMI volunteer motivations, and project co-ordinators should look into annual surveys (or otherwise) to track changes in motives, allowing them to adjust the project accordingly to match these changes.

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Appendix

Final Anglers' Riverfly Monitoring Survey, with overall response data

Riverfly Monitoring Motivations Survey

By completing this survey, you will be helping research into the main factors contributing to the participation of volunteers in water quality monitoring. The findings of this research will help towards the retention and recruitment of volunteers participating in the Anglers' Riverfly Monitoring Initiative.
Please note that the completion of this survey is with anonymity. The survey should take around 15 minutes to complete. Completed questionnaires should be sent to amanda.isaacs.16@ucl.ac.uk by **Thursday 22nd June 2017**. Thank you for your participation.

Demographic Information

1. Age

_1%_ Under 18
_0.4%_ 18-24
_6%_ 25-34
_11%_ 35-44
_15%_ 45-54
_30%_ 55-64
_37%_ 65+

2. Sex

_70.8%_ Male
_29.2%_ Female

3. Job Description

Majority of respondents (104) stated retirement. Aquatic, environmental, and science occupations, including project/river/catchment officers, environmental managers, geologists etc. were also stated by a large number of respondents (48).
Other occupations listed included educational, engineering, health and management professionals, civil service, and arts, design, and media jobs.

4. Highest level of education

_13.3%_ Left school at 16 (GCSE/O levels)
_10.3%_ Left school at 18 (A levels etc.)
_0.4%_ Currently enrolled in secondary school
_0.7%_ Currently enrolled in degree program
_41%_ First degree
_0.4%_ Currently enrolled in postgraduate study
_26.9%_ Master's degree
_7%_ Doctoral degree

5. Please enter the first three or four digits of your postcode (This will enable us to estimate how far different volunteers travel to take part in monitoring. Using the first 3-4 digits will only highlight the general area that you live in, and not reveal your home location to us).

Click or tap here to enter text.

6. Nationality

White

_97.6%_ English / Welsh / Scottish / Northern Irish / British
_0.4%_ Irish
☐ Gypsy or Irish Traveller
_1.2%_ Any other White background
Click or tap here to enter text.

Mixed / Multiple ethnic groups

☐ White and Black Caribbean
☐ White and Black African
_0.4%_ White and Asian
☐ Any other Mixed / Multiple ethnic background
Click or tap here to enter text.

Asian / Asian British

☐ Indian
☐ Pakistani
☐ Bangladeshi
_0.4%_ Chinese
☐ Any other Asian background
Click or tap here to enter text.

Other ethnic group

☐ Arab
☐ Any other ethnic group
Click or tap here to enter text.

Black / African / Caribbean / Black British

☐ African
☐ Caribbean
☐ Any other Black / African / Caribbean background
Click or tap here to enter text.

7. Which of the following apply to you?

_30%_ Member of an angling club
_34%_ Member of a wildlife charity (e.g. Wildlife Trust)
_25%_ Member of a local interest group (e.g. Friends of the river group)
_11%_ None of the above

Background and Motivations

8. Please rank the following factors as a reason for **joining** the Riverfly Monitoring Initiative, with 1 = most important and 8 = least important/no importance (If your main motivation(s) do not appear within the list, please specify them using Other 1, 2, 3, …. and so on. Please include them within your rankings).

Concern about the health of your local river (i.e. water quality, decline in riverfly populations etc.)	Choose a rank	**(2)**
Interest in aquatic conservation and/or environmental issues	Choose a rank	**(2)**
Interest in understanding riverfly species diversity and abundance to aid fishing/fisheries management	Choose a rank	**(3)**
Meeting new people with similar interests/concerns	Choose a rank	**(6)**
Health/Wellbeing	Choose a rank	**(6)**
Enjoy being outdoors	Choose a rank	**(4)**
Learning new skills	Choose a rank	**(4)**
Gain experience/Interest in a career in similar field	Choose a rank	**(7)**
Other 1 (Please Specify) *Click or tap here to enter text.*	Choose a rank	**(5)**
Other 2 (Please Specify) *Click or tap here to enter text.*	Choose a rank	
Other 3 (Please Specify) *Click or tap here to enter text.*	Choose a rank	
Other 4 (Please Specify) *Click or tap here to enter text.*	Choose a rank	
Other 5 (Please Specify) *Click or tap here to enter text.*	Choose a rank	

9. How did you hear about the initiative?

Mainly through a Wildlife Trust, a Rivers Trust, local interest groups, angling club, friends and family, online sources, newspaper articles, and through work.

10. Did you have any prior knowledge and/or experience of biological monitoring before undertaking the training day?

_**42%**_ Yes _**58%**_ No

If no, please go to question 12

11. If yes, please give details of prior knowledge and/or experience

1. Prior educational experiences, including the attainment of knowledge through degree studies, freshwater management and identification courses, and a general knowledge of similar subject areas.
2. Prior work experience, including job occupations within similar fields.
3. Involvement in other similar citizen science programs or surveys.
4. Participation in angling and fly fishing activities.

12. Did you have any prior knowledge and/or experience of riverfly identification (or other freshwater invertebrates) before the training day?

_**41%**_ Yes _**59%**_ No

If no, please go to question 14

13. If yes, please give details of prior knowledge and/or experience

1. Experience in angling and fly fishing.
2. Prior educational experience, including the attainment of knowledge from degree studies, freshwater management and identification courses, and a general knowledge of similar subject areas.
3. Prior work experience, including job occupations within similar fields.
4. Self-research and interest in subject area.
5. Discussions and talks with others with a similar interest.

Training Experiences

14. What aspects of the training did you find **most** useful? Why?

1. Practical-based activities since theory is put into practice – enhances knowledge and understanding; improves identification skills, such as the ability to distinguish between two similar looking riverfly groups.
2. Resources to aid learning were very useful, including use of identification guides and microscopes.
3. Learning the correct sampling technique – creates self-confidence in the ability to undertake procedure on their own; creates awareness of how sampling technique could alter reliability of results
4. Learning from individuals who have a wealth of experience in the field
5. The ability to learn and train with other monitors

15. What aspects of the training did you find **least** useful? Why?

1. Health and safety – some volunteers found this aspect to be overemphasised, especially if that volunteer had previous experience working in or around water. Nonetheless, volunteers were aware of the risks involved, and therefore understanding health and safety needs to be included within training.
2. Classroom-based learning – more focus needs to be placed on practical exercises. Although this is contradictory to the many volunteers who expressed that the training day was well-balanced between classroom-based and practical-based exercises, highlighting a degree of subjectivity of opinions within respondent answers.

16. How confident did you feel in your ability to undertake the monitoring process, after training? (1 = Very confident, 2 = Confident, 3 = Neither Confident or Unconfident, 4 = Unconfident, 5 = Very Unconfident)

1	2	3	4	5
_34.1%_	**_55.6%_**	**_10.3%_**	**_0%_**	**_0%_**

17. How confident did you feel in your ability to identify riverflies, after training?
(1 = Very confident, 2 = Confident, 3 = Neither Confident or Unconfident, 4 = Unconfident, 5 = Very Unconfident)

1	2	3	4	5
_22.6%_	**_54.7%_**	**_20.1%_**	**_1.7%_**	**_0.9%_**

Monitoring Experiences

18. How many sites do you currently monitor?

_63.4%_	1
_21.9%_	2
_6.3%_	3
_3.1%_	4
_0.9%_	5
_4.5%_	5+

19. Have you increased the number of sites you monitor since you have started volunteering?

Yes **_19.6%_** No **_80.4%_**

20. Which river(s) do you monitor?

Click or tap here to enter text.

21. How long does it take on average, to get to your monitoring site? (Please mark **one** box only).

_**40.4%**_ Less than 15 mins
_**38.2%**_ 16-30 mins
_**13.8%**_ 31-45 mins
_**3.6%**_ 46-60 mins
_**4%**_ 61+ mins

22. What mode of transport do you **most frequently** take to get to your monitoring site? (Please mark **one** box only).

_**77.6%**_ Motor Vehicle (e.g. Car/Van)
_**1.3%**_ Motorbike
_**2.2%**_ Bicycle
_**0.4%**_ Other (Please Specify) **"Site within my property. No travel required"**
_**0%**_ Bus
_**0%**_ Train
_**18.4%**_ On Foot

23. How long have you been participating in riverfly monitoring? (Please mark **one** box only).

_**12.4%**_ 0-3 months
_**4.9%**_ 3-6 months
_**14.2%**_ 6-12 months
_**20%**_ 1-2 years
_**31.6%**_ 2-5 years
_**16.9%**_ 5+ years

24. Have your main motivations for volunteering (i.e. those ranked as your most important factors in Q8), changed since you have started monitoring?

Yes _**7%**_ No _**93%**_

If no, please go to question 26

25. If yes, please rank the following factors in order of importance as motivations to **keep volunteering** in the Riverfly Monitoring Initiative, with 1 = most important and 8 = least important/no importance (If you previously specified Other(s) in question 8, please use them again here).

Concern about the health of your local river (i.e. water quality, decline in riverfly populations etc.)	Choose a rank
Interest in aquatic conservation and/or environmental issues	Choose a rank
Interest in understanding riverfly species diversity and abundance to aid fishing/fisheries management	Choose a rank
Meeting new people with similar interests/concerns	Choose a rank
Health/Wellbeing	Choose a rank
Enjoy being outdoors	Choose a rank

Learning new skills	Choose a rank
Gain experience/Interest in a career in similar field	Choose a rank
Other 1 (Please Specify) *Click or tap here to enter text.*	Choose a rank
Other 2 (Please Specify) *Click or tap here to enter text.*	Choose a rank
Other 3 (Please Specify) *Click or tap here to enter text.*	Choose a rank
Other 4 (Please Specify) *Click or tap here to enter text.*	Choose a rank
Other 5 (Please Specify) *Click or tap here to enter text.*	Choose a rank

26. Which of the following factors are **most likely** to influence your motivations and ability to participate in riverfly monitoring in the long-term? Please rank the following factors, with 1 = most likely to influence motivations and 5 = least likely to influence motivations. (If you can think of other influential factors not appearing in the list, please specify them using Other 1, 2, 3. Please include them within your rankings).

Associated costs of monitoring (e.g. travel costs to monitoring sites, training etc.)	Choose a rank	**(4)**
Distance to monitoring site	Choose a rank	**(4)**
Recognition of committed and reliable volunteers	Choose a rank	**(3)**
Further guidance and training	Choose a rank	**(2)**
Further knowledge and/or understanding of riverfly monitoring data and information at a national scale	Choose a rank	**(2)**
Other 1 (Please Specify) *Click or tap here to enter text.*	Choose a rank	
Other 2 (Please Specify) *Click or tap here to enter text.*	Choose a rank	
Other 3 (Please Specify) *Click or tap here to enter text.*	Choose a rank	

27. How long do you spend on average, monitoring at your site? (Please mark **one** box only).

_**11.1%**_ 0-30 mins
_**38.7%**_ 30-60 mins
_**37.8%**_ 1-2 hours
_**10.6%**_ 2-3 hours
_**1.8%**_ 3+ hours

28. What aspects of monitoring do you enjoy the **most**? Why?

1. Gaining an improved knowledge of riverfly species, river ecology, and local catchment issues
2. Observing improvements in the river; observing temporal changes in the dataset
3. The ability to contribute to protecting nature
4. Discussing observations with like-minded people
5. Being outside and in and around water
6. Identifying the invertebrates; finding as many as possible and discovering new ones
7. Understanding what is present in the river to aid fly-fishing
8. Contributing to a long-term dataset

29. What aspects of monitoring do you enjoy the **least**? Why?

1. The weather, especially in the winter when it is cold and wet, or the summer when it is too hot – can make collecting samples difficult
2. Counting large numbers of invertebrates
3. Uploading data to the online database
4. Finding pollution incidents
5. Monitoring alone
6. Carrying equipment to and from the site
7. Sterilising the equipment
8. Lack of feedback

30. Do you share your experiences in monitoring with other volunteers?

Yes **_62%_** No **_38%_**

If no, please go to question 32

31. If yes, please give details of the type of information you share with other volunteers and how often you share this information with them.

Information is shared via a range of platforms, including face-to-face conservations, meetings, online club websites, social media, and email correspondence.
The types of information shared include the results of monitoring, including findings and temporal changes, any issues or problems arising from monitoring, and unusual findings or hard to identify species.

32. Do you feel that you are a valued member of your local monitoring group?

Yes **_94%_** No **_6%_**

If yes, please go to question 34

33. If no, what improvements could be made to increase your inclusion within your local group?

1. More training events
2. Provision of newsletters
3. More feedback relating to questions or concerns raised, and acknowledgement that results have been received
4. Regular meetings or local events
5. Increased support and encouragement in monitoring

34. Do you feel part of the national riverfly monitoring group? (e.g. you interact with monitors from different parts of the country, you understand issues affecting riverfly populations nationally etc.)

Yes _**49.8%**_ No _**50.2%**_

If yes, please go to question 36

35. If no, what improvements could be made to make you feel a part of the national group?

1. Regular updates and feedback on national trends through emails or occasional e-newsletters for example
2. Increase in training opportunities
3. Development of more local riverfly hubs
4. Improvements the distribution of information to as many volunteers as possible

36. How often do you visit the riverfly website and records database?

_**0.9%**_ Daily
_**8.2%**_ Weekly
_**66.2%**_ Monthly
_**24.7%**_ I have never visited the website and/or the records database

37. Since participating in riverfly monitoring, how confident do you feel in your ability in understanding river ecology and/or factors affecting water quality?
(1 = Very confident, 2 = Confident, 3 = Neither Confident or Unconfident, 4 = Unconfident, 5 = Very Unconfident)

1	2	3	4	5
_15.6%_	**_56.7%_**	**_24.1%_**	**_3.6%_**	**_0%_**

Riverfly Plus and Further Volunteering

38. Since you have started volunteering, have you added any riverfly plus monitoring and/or become involved in other citizen science river initiatives?

Yes _**33%**_ No _**67%**_

If no, please go to question 40

39. If yes, which projects or initiatives do you take part in?

Click or tap here to enter text.

Please now go to Question 41

40. If no, please rank the following in order of importance as factors that could encourage you to include riverfly plus monitoring, with 1 = most important and 4 = least important/no importance (If there are any other factors that do not appear within the list, please specify them using Other 1, 2, 3, …. and so on. Please include them within your rankings).

There is no cost involved or cost is minimal	Choose a rank	**(4)**
There is greater information available regarding riverfly plus (e.g. the different types of projects available, information on how to become involved etc.)	Choose a rank	**(2)**
A desire to further understand river ecosystems and their related issues	Choose a rank	**(2)**
A desire to not only monitor the health of a local river, but to become involved in measures to protect it	Choose a rank	**(2)**
Other 1 (Please Specify) *Click or tap here to enter text.*	Choose a rank	**(1)**
Other 2 (Please Specify) *Click or tap here to enter text.*	Choose a rank	
Other 3 (Please Specify) *Click or tap here to enter text.*	Choose a rank	
Other 4 (Please Specify) *Click or tap here to enter text.*	Choose a rank	
Other 5 (Please Specify) *Click or tap here to enter text.*	Choose a rank	

41. If riverfly monitoring could be expanded, which of the following would you be **most** interested in? (Please mark **one** box only)

_**17.9**%_ Increasing the number of riverfly groups within monitoring, beyond the basic 8 groups
_**25.4%**_ The inclusion of invasive species recording
_**39.7%**_ Water chemistry monitoring
_**8%**_ I am satisfied with current monitoring and do not believe it should be expanded

_**20%**_ Other (please specify) **Included a range of activities including the measuring of water flow and sedimentation, and workshops to aid understanding of contributing factors of river degradation.**

You have now reached the end of the questionnaire. Thank-you for your help.

If you have any questions regarding the questionnaire, research, or any other concerns, please feel free to contact Amanda Isaacs at amanda.isaacs.16@ucl.ac.uk