



Self-Reported Reasons for Participating in Pro-environmental Citizen Science Activities: A Case Study of Butterfly Monitoring in Israel

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The current study examines the common characteristics of citizen science volunteers and the reasons that lead them to participate in pro-environmental conservation-related activities, specifically in monitoring butterflies. The research was conducted as a case study and involved the use of qualitative and quantitative methods for gathering and analyzing the data. Findings indicate a complex system of self-reported reasons, mostly internal, reflecting participants' desire to contribute to society, meet with other people, and increase their range of knowledge on the topic. Furthermore, findings indicated that there are shared characteristics among the profiles of citizen science volunteers, which included growing up in a rural setting and encountering significant figures and/or events that led to their love of nature, their strong and deep sense of commitment and concern for nature, and their desire to take active steps to preserve it.

Keywords: citizen science, pro-environmental behavior, environmental education, conservation-related projects, butterfly monitoring

INTRODUCTION

Significant changes to the ecological system have led people to a deeper understanding that a global crisis is unfolding and that human beings must begin to take action and change their behavior towards nature and its resources. As part of this process of ever-increasing awareness, citizens have begun to take action, a response that is referred to as *environmental citizenship*. The goals of this initiative are to increase the global public awareness, actively pursue pro-environmental actions in a responsible and respectful manner, and be an inherent part of the environment (Chawla and Cushing, 2007).

Environmental citizenship is manifested in terms of environmental behavior that is associated with a shift in people's attitudes towards the environment; more specifically, it requires people to reflect – vis-à-vis the notions of justice and injustice – on the attitudes that inform their behavior (Dobson, 2007). It reflects a sense of belonging to a national and civil society that works to increase global environmental awareness, especially in light of the risk of environmental degradation resulting from global climate changes and related effects. The goal of environmental citizenship is to create a process of globalization based on human rights and the rights of Nature (Jelin, 2000). Lim (2008) refers to environmental citizenship as global, because we all share a common fate, i.e., changes in one place have an effect on other places, and because nature does not recognize (national) borders. In that sense, Earth is a global village and there are many issues that are common to populations all over the world. Hence, according to Houser (2009), it is important that the citizens of the entire world make it their global goal to show concern not only for themselves and their local society but also for the environment as a whole, given that all societies share this environment, which consequently links them in a relationship of interdependence.

Indeed, in recent years, public involvement in environmental activities has increased, and this includes the development of the civic science initiative, also referred to as *citizen science* (Rauws, 2015). Citizen science allows for productive cooperation between professional scientists and volunteers from the general public (Cohn, 2008); it enables citizens to take action, by participating in scientific research in a broad range of fields (Irwin, 2001). There are currently hundreds of research studies originating from various scientific institutes and universities from around the world that are being conducted in cooperation with citizen scientists (Bonney et al., 2014). The development of citizen science constitutes a valuable contribution to our biological and ecological understanding of processes on Earth as well as to finding creative and appropriate ways to conserve nature (Cooper et al., 2007; Theobald et al., 2015). Given that citizen science has positive outcomes for science, society, and individuals (Shirk et al., 2012), it has become increasingly popular, especially in the field of ecology and environmental studies (Dickinson et al., 2012; Follett and Strezov, 2015). Citizen science volunteers now participate in projects on climate change, invasive species, conservation biology, ecological restoration, water quality monitoring, population ecology, and all kinds of monitoring activities (Silvertown, 2009).

The most significant influence of citizen science on ecological research is in the realm of biological monitoring of various species (Lepczyk et al., 2009). Although the monitoring of organisms – and particularly that of butterflies – has enjoyed increased popularity (Lewandowski and Oberhauser, 2017) in the realm of conservation-related citizen science activities, very few studies have been conducted to determine the factors that lead citizens to participate in this endeavor (Domroese and Johnson, 2017). Kühn et al. (2008) shows that the motivation of volunteers is the key for the successful establishment of a volunteer-based monitoring activity. Previous studies have found that volunteers who participate in nature-based citizen science projects tend to be interested in learning about nature and protecting the environment in their local communities (Bell et al., 2008; Rotman et al., 2012). In addition, it was found that volunteers are likely to feel personally attached to their local environment, believe that their contributions help solve environmental problems, and enjoy being part of community efforts (Dresner et al., 2015). Using the survey, Domroese and Johnson (2017) found that interest in learning about the subject of the conservation-related study (bees, in their case) was the top motivational factor of the citizen science volunteers.

Nevertheless, the reasons that lead individuals to take an active role as citizen science volunteers have not been studied in depth and there is a need for additional studies to investigate the plethora of available scientific data related to pro-environmental behavior (Quimby and Angeliq, 2011; Larson et al., 2015) and environmental volunteerism (Bruyere and Rappe, 2007) in the context of conservation-related citizen science. The current study aims to address this issue. To conduct the study, I selected one of the well-known models in the field of pro-environmental behavior, namely, that of Kollmuss and Agyeman (2002). According to this model, there are three types of variables related to this behavior: demographic variables (e.g., gender), external

reasons (e.g., social institutions or the economy), and internal reasons (e.g., personal motives, environmental knowledge, or values). This model guided the construction of the theoretical framework for the current study, as well as the choice of data collection instruments. In particular, my focus in this study was on the following research questions:

- Do demographic variables influence the reasons reported by volunteers for participating in this project?
- What were the external and internal reasons that led citizen science volunteers to get involved in the monitoring of butterflies?
- Is there any correlation between the demographic variables and either the internal or external reasons reported by volunteers for participating in this project?
- What –if any– are the characteristics that citizen science volunteers involved in the monitoring of butterflies have in common?

MATERIALS AND METHODS

The Context of the Study and the Participants

The focus of this study is on butterfly monitoring at the site of Ramat Hanadiv, Israel. Butterfly monitoring is one of the most popular forms of citizen science, both in Israel (The Butterflies Association, 2019) and throughout the world (Lewandowski and Oberhauser, 2017). The presence of butterflies can provide evidence regarding the status of open spaces and can serve as a bio indicator (Van Swaay et al., 2012). Butterflies also provide a means for measuring the effects of ecological systems and biological variability on changes in nature. Furthermore, in-depth research on the presence of butterflies can also reflect the status of flora and other fauna in Israel, thus expanding the perspective from the local to the global view (Thomas, 2005).

In 2009, a national protocol was established for butterfly monitoring in Israel and ever since, volunteers from around the country have been marking short transects (of ~300 m) to be used for butterfly monitoring and have been going out into the field twice a month during the period between October and the end of June. The butterfly monitoring protocol contains three subprotocols: incidental monitoring, monitoring on predetermined transects, and monitoring of rare species. As of 2018, there are 104 butterfly monitoring transects in Israel and the data collected are uploaded to an archive of sightings and are used for research and for finding answers to questions pertaining to nature preservation (The Butterflies Association, 2019). All of these activities are conducted in cooperation with the Israeli Lepidopterists Society.

The study participants were members of the two volunteer groups at Ramat Hanadiv Park in Zichron Yaacov, Israel. In this framework, they devote part of their free time to contribute to the butterfly monitoring efforts. The volunteers are dedicated to studying the subject and once they have been trained, they regularly devote time to monitor the butterflies on transects that were set up in proximity to their area of residence. All of the

group members ($N = 60$) were recruited through the national butterfly monitoring coordinator for Ramat Hanadiv Park and the response rate was 100%. A description of the participants' characteristics is provided in **Table 1**.

All of the participants signed informed consent forms, indicating the voluntary nature of their participation in this study. The study was approved by the Technion's Ethics Committee.

The Research Approach

This study was conducted according to the case study approach (Swanborn, 2010), which is based on the phenomenological-qualitative paradigm. The goal of this approach is to gain an understanding of participants' experiences in terms of the significance and interpretations that they attribute to phenomena and situations encountered, as well as to their personal views (Patton, 1990; Rosenblatt and Fischer, 1993). As regards the methodological approach, a mixed method was used in the current study, combining the two complementary approaches of qualitative and quantitative analysis.

Data Collection Tools

Data were collected using two different tools, namely, semistructured interviews and questionnaires that included both open-ended and Likert-like questions. Interviews with 20 participants were conducted at the location of the butterfly monitoring training-seminars and each interview lasted ~40 min. The questions that guided the interview can be found in **Appendix 1**. The questionnaire was based on the theory of Kollmuss and Agyeman (2002) regarding the variables related to pro-environmental behaviors, and included questions regarding participants' demographic background, as well as questions pertaining to internal and external reasons (**Appendix 2**). Additionally, there were questions regarding other types of pro-environmental behaviors in which the participants engaged. The questionnaire had four parts, as follows.

- (A) Demographic information: gender, age, education, and occupation.
- (B) Five open-ended questions, focusing on the reasons that lead individuals to become environmental activists in general and to participate in the butterfly monitoring initiative in particular and questions regarding other types of pro-environmental activities that the participants engage in.

- (C) Twenty-one Likert-like questions that addressed the reasons that lead people to become environmental activists. The focus of this section of the questionnaire was on participants' perceptions of their reasons for engaging in pro-environmental behavior. In contrast to the questions in the second section of the questionnaire (which were of a personal nature and were intended to gain an understanding of participants' personal reasons for volunteering as citizen scientists), the questions in this section were intended to gain a general understanding of participants' attitudes regarding the subject of this study. The statements in this section were divided into four topics: environmental knowledge (numbers 1, 15–18), environmental and personal characteristics (numbers 2–7), attitudes and values (numbers 8–14), and the significance of citizen science for the community at large (numbers 19–21). Participants were asked to indicate the degree to which they agree with the statements, using a scale ranging from 1 (strongly opposed) to 5 (completely agree). Internal consistency of these Likert-like questions was 0.69 Cronbach's alpha.
- (D) A total of 15 Likert-like questions that addressed aspects of pro-environmental behavior; the statements in this section were divided into three topics: interest in the topic (numbers 1, 3, 8, 12), related activities conducted in a personal framework (numbers 2, 4, 5, 6, 9, 10, 13, 14), and related activities conducted in a public framework (numbers 7, 11, 15). Participants were asked to indicate the frequency with which they engaged in the activities described in the statements, using a scale from 1 (never) to 5 (very frequently). Internal consistency of these questions was 0.7 Cronbach's alpha.

Data Analysis

Responses to the Likert-like questions were analyzed using descriptive statistics (means and standard distribution), and Mann-Whitney test for examining differences by gender, age, education, and occupation. Additionally, to determine whether there were any correlations between the responses regarding the reasons that lead people to become environmental activists (part C of the questionnaire) and the responses regarding aspects of pro-environmental behavior (part D of the questionnaire), a Pearson's correlation coefficient analysis was conducted.

The interviews were analyzed using the content analysis method (Mayring, 2004), which assumes the existence of shared social and psychological patterns that are expressed through central themes; hence, identifying central themes in a given content can provide a comprehensive explanation of the examined phenomenon. The analysis included several stages.

Following the initial review of the data, I identified primary categories for initial coding. The initial categorization of the transcribed interviews was performed according to the overall categories of *common characteristics of citizen science volunteers* and *the self-reported reasons that led them to participate in pro-environmental activities*. The careful selection of categories created a focal framework. In the second stage, a mapping analysis was conducted, which involved attributing meaningful

TABLE 1 | Participants' Characteristics ($n = 60$).

Participants' characteristics		n
Gender	Male	23
	Female	37
Education	Nonacademic, post high-school	16
	Undergraduate degree	34
	Graduate or postgraduate degree	10
Occupation	Social Science/Education	43
	Engineering and/or economics	17

units to the various thematic categories and identifying the relationship between the categories. The next stage was conducted along with a review of the literature and involved selecting the categories that were deemed essential in terms of their relation to and ability to shed light on the research questions; hence, unrelated themes were dropped. The thematic categories selected were those that related to the reasons for participating in pro-environmental citizen science activities in general and in butterfly monitoring in particular, as well as the characteristics that were common among the participants. In the final stage, I formed a narrative summarizing the findings, which took into account the professional literature, and highlighted a selection of excerpts from the interviews.

The trustworthiness of the study was maintained by triangulating multiple data sources. In addition, a random sample of 20% of the interviews was analyzed by an outside rater. Interrater reliability was assessed using Cohen's kappa. The agreement between raters was substantial (Cohen's kappa = 0.91).

FINDINGS

Self-Reported Reasons That Led Citizen Scientists to Engage in Butterfly Monitoring

The qualitative analysis revealed that the participants' reported reasons for engaging in a citizen science project of butterfly monitoring were all related to internal reasons. The participants indicated similar reasons behind their decision to volunteer and participate in any citizen-science project. Thus, for example, one of the reasons reported by participants referred to the *encounter with other people*: "On a social level, I find it important to meet new people." Another common reason was the *desire to contribute to a cause*: "Butterfly monitoring is a type of contribution that I am happy to take part in. This year I retired from my job and I was looking for issues in which I could get involved and contribute;" "I came because I wanted to volunteer and contribute."

I chose to come because the topic sounded magical – the connection with nature – a perfect "excuse" for getting out into nature, increasing awareness, learning, and the opportunity to become deeply engaged in a voluntary activity that contributes to research – that is doubly rewarding!!

Additionally, the research participants referred to the *aspect of leisure*: "I retired and thought about volunteering;" "My motivation for joining this activity is my strong connection to nature and my early retirement, which makes it possible." All of the participants explained that they perceived butterfly monitoring as a *source of pleasure*: "I feel very strongly about this. I'm very involved; I enjoy myself and I love to be in nature." "I had already taken the first steps: I went out with my children and a butterfly net and thoroughly enjoyed the experience; it's a wonderful feeling. I'm glad I joined – it fills me with joy." Another reason reported by the participants referred to the opportunity to

enhance their knowledge: "I had never studied this and I wanted to learn more about it; it's important to meet researchers;" "I wanted to gain knowledge – excellent, in-depth knowledge."

I am filled with awe at their beauty and I'm happy to learn more about them; it's a wonderful part of nature and it's important to contribute positively on issues of sustainability—to be aware and preserve the environment in which we live.

Analysis of the closed questions regarding the reasons leading to this pro-environmental behavior revealed that each of the four topics on the questionnaire received a very high mean score (on a scale of five): environmental knowledge – 4.26, environmental and personal characteristics – 3.55, attitudes and values – 4.40, and the importance of citizen science – 4.56; hence, citizen science received the highest score. **Table 2** summarizes the main statistical results regarding the self-reported reasons leading to pro-environmental behavior.

The Mann-Whitney test revealed no significant difference when comparing reasons by gender, age, education, or occupation, indicating that none of these demographic variables significantly influenced the participants' reasons for engaging in pro-environmental behavior.

To determine whether there were any links between the self-reported reasons, I tested the quantitative data (from part C of the questionnaire) for (positive or negative) correlations. A statistically significant and positive correlation of moderate strength was found between attitudes regarding the importance of knowledge and the importance of attitudes and values (0.58, $p < 0.01$). This finding suggests that the greater the importance attributed to knowledge as a reason for engaging in pro-environmental behavior, the greater too will be the importance attributed to attitudes and values as reasons that lead to pro-environmental behavior.

Characteristics Shared by the Butterfly Monitoring Volunteers

Analysis of the qualitative data revealed four characteristics that were shared by the study participants. The first characteristic was *growing up in an environment that is close to nature*. All of the participants mentioned spending their childhood years in an environment that was close to nature, for example, growing up in a rural community, such as a kibbutz or a cooperative agricultural community (*moshav*): "I was born and raised on a *moshav*; nature played a very significant role;" "I was born and raised on a kibbutz, which in itself indicates living in nature." Participants also noted that throughout their childhood they had spent time playing in nature and being in an unmediated natural environment.

I remember that in elementary school, we went on a hike every week; growing up as children on a kibbutz, we did lots of things alone in nature without the accompaniment of adults: wandering far from the residential area, exploring nature. We grew up in this environment and loved having secret hiding places and building camps outdoors.

TABLE 2 | Statistical results regarding the factors driving pro-environmental behavior.

Topic	Questionnaire statement	Mean	Standard deviation
Environmental knowledge	#1 Knowledge about environmental issues influences pro-environmental behavior	4.75	0.44
	#15 The fact that environmental changes are not immediate or palpable, but rather take years to evolve (we cannot see the hole in the ozone layer, global warming, the extinction of species, or greenhouse gases and radiation), has an effect on people's perception of the complexity and extent of the problem	4.15	0.88
	#16 Emotional involvement requires a certain degree of environmental knowledge and awareness; lack of knowledge regarding the factors that are harmful to the environment can lead to feeling uninvolved	4.22	0.54
	#17 People tend to ignore information regarding environmental problems because they either contradict or undermine their beliefs and their basic assumptions about quality of life, economic prosperity, and material needs	4.00	0.79
	#18 Once we experience direct harm, feelings, such as fear, sadness, and anger could spur pro-environmental behavior	4.15	0.75
	Total	4.26	0.68
	Environmental and personal characteristics	#2 People who are able to focus on anything beyond themselves will be preoccupied with the well-being of the community at large	4.20
#3 A person with a strong internal locus of control will believe that his or her actions can create change		3.30	0.82
#4 People whose needs are fulfilled (for example, money, time, energy) tend to exhibit pro-environmental behavior		2.80	1.06
#5 Pro-environmental behavior is possible only when the necessary interest structures available		2.90	0.45
#6 Economic, social, and institutional factors can be an obstacle to pro-environmental behavior		3.50	0.56
#7 Women are more emotionally involved and exhibit a greater concern for the environment than do men		4.40	0.34
Total		3.55	0.62
Attitudes and values	#8 Close friends and family are the most significant factors that fashion one's values, particularly in regard to pro-environmental behavior	4.15	0.81
	#9 Life experiences such as learning in nature or absorbing family values that communicate either appreciation for or alternatively disregard for the destruction of nature can have an effect on environmental behavior	4.50	0.51
	#10 Organizational activities or role models, such as teachers and friends, can have an effect on environmental behavior	4.55	0.67
	#11 An attachment to nature inspires and encourages pro-environmental concern and awareness	3.90	0.51
	#12 Childhood experiences that took place in nature, through the educational framework; nature walks and hikes with family; play time and free time spent in nature; and a curiosity about nature can lead to pro-environmental behavior	4.68	0.98
	#13 Attitudes and beliefs can affect pro-environmental behavior	4.10	0.15
	#14 Knowing that technological developments could solve environmental problems would lead to fewer people believing in the need to change their way of life to include pro-environmental behavior	4.92	0.54
Total	4.40	0.59	
Significance of citizen science for the community at large	#19 Citizen science makes it possible to learn about new topics such as butterfly monitoring, to collaborate with scientists, join social groups, and become pro-environmentally active	4.65	0.49
	#20 Citizen science can change attitudes towards science and the environment by involving people directly in research, providing a platform for high-level learning and for interacting with scientists	4.58	0.61
	#21 The individual's connection with researchers and the monitoring activity influences the transmission of knowledge to the public at large, affects environmental attitudes, raises awareness, and creates public discourse	4.45	0.51
	Total	4.56	0.53

The second characteristic was related to *figures and events that influenced participants' relationship with nature*. All members of the group mentioned various types of figures whose influence throughout their childhood had an impact on their relationship with nature, as well as influential events. For example, they referred to the educational framework during childhood: "In the kibbutz, we studied in a holistic manner, so that you learn everything about a topic and it all takes place in nature."

At Beit Berl, a significant part of our studies took place in nature. We had a counselor named... who was involved in birdwatching and through him, I learned to love it. He was really a significant figure who inspired my love for the activity.

Participants also mentioned that the people who had a strong influence on them also had strong attitudes and values regarding the environment. "... And I remember that in elementary school, we went on a nature walk every week and there was one teacher who I will never forget, who taught me the love of lepidoptery." "As a child, I fell in love with birds and my mother had a strong influence, because she too loved the topic." Additionally, participants referred to the various events that occurred throughout their childhood and in nature. "As part of our youth group activity, I went on a lot of hikes, which I loved very much. And, of course, once in a while I went on trips and picnics with my parents."

I would go out into the woods with my friends and we would identify flora and fauna, which was more scientific. That was what I loved doing. As I grew up, nature became a central theme, in extracurricular activities, taking hikes and trips in the Negev, an area that I grew attached to.

"During my military service, I worked a guide at a field school, where activity in nature takes central stage, and I loved it."

The third characteristic that participants had in common was the *importance attributed to nature in their personal lives and the emotions that nature evokes* for them. All members of the group reported a strong emotional connection to nature. They also referred to the emotions that nature evokes: "Wonderment and awe;" "Respect for its grandeur;" "Joy, happiness, and excitement;" "An elated, spiritual feeling;" "Revival of the spirit, calm, and interest;" "A multisensual experience, a strong and deep connection, a sense of freedom, space, and vitality." Similarly, participants spoke of their personal love and attachment to nature: "I feel a strong link to nature; I write poetry about nature; I feel an attachment to nature in every possible way." "Nature is dear to me and plays a central role in my life." In addition, participants mentioned intergenerational teaching of their love of nature, their familiarity with and time spent in nature, in an unmediated manner. "I taught my children to love insects and reptiles. As a child, I always had various animals and reptiles as pets and later I taught my children about them."

I had the amazing opportunity to meet – completely by chance – the person who oversees forestry teaching [in

schools] and I suggested the subject of butterflies. She put me in touch with an elementary school, where I taught a few tutorials on the subject to children in grades 1–3. Some lessons took place in the classroom and others – outdoors, and it's been absolutely wonderful for the students and for me. I hope it will be included in next year's curriculum as well and that the initiative will be allowed to continue.

The fourth characteristic that the participants had in common was *being involved in an additional volunteering framework* for either the community or the environment. Some were involved in volunteering for educational purposes: "For a few years now, I've been volunteering at a community center in a disadvantaged neighborhood in my town – I regularly teach reading skills to children;" "When I was working as a kindergarten teacher, I participated in several seminars on nature-related topics and I established a butterfly garden in the kindergartens." Others were involved on a voluntary basis in social community projects: "I participate in the community activity for promoting urban sustainability;" "For the past four years, I have been volunteering as a companion of a Holocaust survivor, which is part of a community project;" "I am a member on the social activities committee of the community where I live – we initiate all kinds of projects." Some of the participants volunteered in environmental-related activities: "Over the last few years, I've been coordinating the issue of separating recycling materials, working on a national-level publicity project."

Analysis of the responses to the Likert-like questions regarding pro-environmental behavior demonstrated that participants were primarily involved in personal affairs in their daily life (mean 4.41), and were interested in the topic (mean 4.08). The mean scores regarding public pro-environmental activity were relatively low (2.86). **Table 3** summarizes the main statistical results regarding pro-environmental behavior.

The Mann-Whitney revealed no significant differences between the various reasons when organized by gender, place of residence, education, or occupation; in other words, the demographic variables had no effect in terms of participants' reported reasons for engaging in pro-environmental behavior. Pearson's coefficient correlation test was used to examine the relationships between the various topics in part D in the questionnaire; findings indicated a strong and positive correlation (0.61; $p < 0.01$) between pro-environmental related activities conducted in a personal framework and related activities conducted in a public framework. This suggests that individuals who engage in pro-environmental behavior in the personal realm are likely to engage in the same behavior in the public realm. Pearson's coefficient correlation test was used also to determine whether there is any correlation between the topics of the self-reported reasons (part C of the questionnaire) and the topics of the pro-environmental behavior questions (part D of the questionnaire). Findings indicated a positive and moderate correlation (0.53; $p < 0.01$) between attitudes regarding the importance of citizen science and public pro-environmental behavior. This suggests that participants for whom involvement in citizen science is a reason are likely to become actively involved in public pro-environmental initiatives.

TABLE 3 | Statistical results regarding the pro-environmental behavior.

Topic	Questionnaire statement	Mean	Standard deviation
Related activities conducted in a public framework	#1 Report environmental problems to the authorities	3.60	1.27
	#3 Send letters to the press informing them of environmental problems	2.30	0.63
	#8 Participate in initiatives for cleaning and improving public areas	2.15	0.81
	#12 Collect and throw into the trash bottles and cans found in public areas	3.40	1.14
	Total	2.86	0.96
Related activities conducted in a personal framework	#2 Take my trash to a recycling center (for example, newspapers, plastic bottles, etc.)	4.45	0.89
	#4 Return glass bottles for the deposit	4.05	1.43
	#5 Use scrap or recycled paper for notes and drafts	3.75	1.29
	#6 Recycle plastic bags for shopping	4.90	0.31
	#9 Conserve energy by turning off lights and electrical appliances when they are not in use	4.65	0.59
	#10 Conserve water use in the home (for example, turning off the faucet while brushing teeth or washing dishes)	4.60	0.82
	#13 Deposit used batteries in the appropriate bin rather than in the general garbage can leave the air-conditioning on when I leave the room	4.00	1.38
	#14 Leave the air-conditioning on when I leave the room	4.90	0.31
Interest in the topic	Total	4.41	0.87
	#7 Consume environmentally friendly products (for example, sprays that are not harm the ozone layer, products with recyclable packaging, etc.)	4.08	0.86
	#11 Watch programs about nature and the environment	4.15	0.99
	#15 Read articles about environmental issues in the press, the daily newspapers, or magazines	4.00	0.92
	Total	4.08	0.92

DISCUSSION AND CONCLUSION

The two research questions examined in this study examined the self-reported reasons that lead participants to engage in pro-environmental behavior in the context of citizen science, specifically on the topic of butterfly monitoring; and the relevant characteristics that all of the participants had in common. As regards the self-reported reasons, qualitative and quantitative findings alike indicated that rather than one major reason, there are numerous interrelated reasons that influence pro-environmental behavior. These findings coincide with those of previous studies that examined the variables and reasons that influence pro-environmental behavior in other contexts (Kollmuss and Agyeman, 2002). Given the current study's focus on conservation-related citizen science, it is not surprising that internal reasons (meeting other people, the desire to contribute, to become more informed, to pursue a leisure activity, and to find pleasure and a sense of personal satisfaction) were more significant than external or demographic reasons. It would be interesting to examine this further in future studies. Two of the self-reported reasons identified in the current study were found also in other studies that focused on citizen science: the desire to learn new things and expand one's current knowledge (Bell et al., 2008; Rotman et al., 2012; Domroese and Johnson, 2017) and the desire to give and contribute to society (Dresner et al., 2015). The remaining reasons (meeting other people, filling one's leisure time, and pleasure, and personal satisfaction), were not mentioned in the professional literature to date. Hence, this is one of the current study's contributions to this field of knowledge.

As regards the characteristics that all of the participants had in common, findings pointed to a familiarity with and love of nature, unmediated activity and time spent in nature, intergenerational teaching of the love of nature, and the emotions that nature evokes in the participants. Thus, it appears that a strong connection to nature is a basic and significant aspect that characterizes people who engage in voluntary-based, citizen science activities. These findings are in line with those presented in the study of Nisbet et al. (2009), which demonstrated that "Nature relatedness" is able to predict certain types of environmental activism better than other factors do. The same was found in the studies conducted by Chawla (1998, 1999), which also pointed to the immense importance of an attachment to nature and its effect on promoting environmental awareness and concern.

When asked to rank the reasons that led them to engage in pro-environmental activity, participants noted the importance of knowledge, values, and attitudes, as well as the significance of citizen science. Of lesser importance were reasons related to background characteristics, such as socioeconomic status, or the existence of infrastructure for environmental protection in their area of residence. The most important reason was the significance of citizen science. In addition, a significant, strong and positive correlation was found between attitudes regarding the importance of knowledge and attitudes regarding the importance of values. In other words, the greater the importance that citizens attributed to knowledge as a reason for pro-environmental behavior, the greater too was the importance attributed to the reasons of values and attitudes. All of the

participants' profiles included a combination of knowledge, values, and attitudes.

Additionally, findings pointed to a major aspect that was common among all of the participants, namely, recognition of the link between pro-environmental behavior and their childhood experiences, which included two themes: (a) spending the early years of childhood in a natural, rural environment, such as a kibbutz, community settlement, or rural village; (b) spending time and playing in nature in an unmediated fashion. All of the participants noted that this period in their lives was significant and had a crucial effect on who they were today, and they underscored the effect that various figures and events had on their curiosity about and love of nature, which they continued to feel as adults. Their encounter with people who had a high awareness of the environment served as a personal inspiration for the participants.

These findings were in line with those of previous studies, which found that the bond with nature that was formed in childhood created a sense of environmental awareness, concern, and care. Thus, Nisbet et al. (2009) noted that the bond with nature that forms through spending time and finding personal links with nature is also the reason that leads people to become concerned about the fate of nature and to actively engage in its preservation. Likewise, Trevors and Saier (2010) attributed substantial importance to an individual's connection with nature as a reason that promotes the desire to contribute and find holistic solutions to the problems that humanity faces, vis-a-vis its relationship to Earth. They found that the opposite was also true: feeling emotionally distant from nature makes it difficult to find solutions for its preservation. This claim was confirmed by Sobel (2004), who noted that significant learning takes place in the individual's immediate surrounding. Hence, learning that takes place in nature and is encouraged by the local community, which considers the environment to be a point of departure for any learning, can nurture a love of nature and the desire to explore and understand it. This type of learning process can then lead to an understanding of the broader environment and to pro-environmental behavior. Such a profound approach to the subject establishes a sense of commitment, whereby citizens feel compelled to take an active role in the preservation of the environment. Also Chawla (1999) attributes a great deal of importance to the emotional connection to nature as a factor that nurtures environmental awareness and concern. She elaborates that this connection does not stem from a single experience, but rather from learning in nature, absorbing pro-environmental family values, participating in pro-environmental organizations, and having role models such as friends and teachers from the field of education. Consequently, the most important childhood experiences are those that take place outdoors, in nature, with family throughout childhood. At a later stage in life, the most important reason is education and having friends with a similar fondness for nature, and finally, as adults, the most influential reason is the link with environmental organizations.

In the pro-environmental behavior questionnaire, the mean scores for personal daily activity related to pro-environmental issues, as well as the scores conveying an interest in the field, were high. There was a strong and positive correlation between environmental activity and public activity, which again

indicates that people who engage in pro-environmental behavior in their personal sphere would also be willing to be active in the public sphere. These findings were confirmed also through the interviews, wherein participants described their reasons for choosing to participate in butterfly monitoring. Participants noted that they felt it was important to meet other people, especially when the common denominator is a love of nature. They also mentioned another reason, namely, a personal and moral commitment to volunteer and contribute to the effort, driven by their pro-environmental attitudes that involve a concern for the preservation of nature. The desire to enhance their knowledge, pleasure, and leisure activity was another reason reported by the participants, as was the spiritual impact that spending time in nature had on their quality of life. All of the interviewees were intensively involved in public and social volunteer activities. This finding was complemented by the quantitative analysis, which examined the correlation between participants' attitudes regarding the importance of citizen science and their public pro-environmental activity, which was found to be strong and positive. This indicates that participants who view citizen science as a reason for pro-environmental behavior are likely to be actively involved in such activities in the public sphere. These findings coincide with those of previous studies, which indicated that environmental knowledge, along with values, perceptions, attitudes, and emotional involvement, create a basis for environmental awareness. This awareness is related to personal values and is formed throughout life and through the individual's experiences. Environmental awareness is also defined as civic environmentalism and serves as the basis for all environmental activities (Kollmuss and Agyeman, 2002; Chawla and Cushing, 2007; Dobson, 2007; Houser, 2009). These findings also provide an answer to the research question regarding the reasons behind participants' decision to engage in pro-environmental behavior, as it becomes clear that there is a strong common denominator among the participants, related to the values of volunteering and contributing to society, as well as to a profound understanding and awareness of the environment. Hence, it is evident that the efforts to create change and increase environmental awareness must be rooted in an intense love of – and connection to – nature.

The current study had several limitations. First, because of its qualitative approach, I am unable to draw direct and significant conclusions regarding the effect of observed reasons the participants' pro-environmental behavior. The current study only illuminates this link and describes it. Additional quantitative studies are needed to examine whether the link observed in the current study is statistically significant. Second, because of the relatively small number of informants (60), who were limited to two volunteer groups in the same site, the findings cannot be generalized to the entire population of adults. Furthermore, given that the participants in the current study were individuals from a north geographical region in Israel, findings cannot be generalized to adults from other cultures and from other geographical areas. Additional studies are needed to address these limitations. Nonetheless, I believe that their findings will still be valid to other cultures and nationalities and may serve a

good value for the areas aimed to promote such environmental involvements and practices.

The current study contributes to the discourse regarding the factors and reasons that lead to people's participation in conservation-related citizen science and the identification of the characteristics that these people have in common. The main insight from this study pertains to the importance of environmental-science education. It is clear that education (at all levels) that promotes love of nature and develops student's appreciation for environmental values is the crucial reason that serves as a precondition to the formation of a civic identity of people who are concerned for and take action to preserve the environment. In light of these findings, educators and curricula designers should make an effort to increase activities that get students involved in a variety of pro-environmental activities. There are numerous and diverse conservation-related citizen science projects (e.g., Ballard et al., 2017) in which students can participate which, as shown, have an enormous potential for inculcating the pro-environmental values that lead to nature conservation and pro-environmental commitment and involvement.

DATA AVAILABILITY STATEMENT

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation, to any qualified researcher.

ETHICS STATEMENT

The studies involving human participants were reviewed and approved by the Technion. The patients/participants provided their written informed consent to participate in this study.

AUTHOR CONTRIBUTIONS

DT contributed to the design and implementation of the research, analysis of the results, and writing of the manuscript.

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SUPPLEMENTARY MATERIAL

The Supplementary Material for this article can be found online at: <https://www.frontiersin.org/articles/10.3389/feduc.2020.00116/full#supplementary-material>

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Conflict of Interest: The author declares that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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