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Approaches and typologies of citizen science, associations in Italy and influence on professional education systems

More and more specialized researchers and the funds available to the scientific community are limited and, in any case, insufficient to tackle the problems associated with the monitoring and conservation of biodiversity at both local and regional levels. The direct involvement of citizens in the study and active conservation of biodiversity represents, from this point of view, a new, promising frontier. The acquisition of detailed knowledge on the biodiversity of an area can now be represented by the participation of a growing number of different subjects. One of the strengths of this process is represented by the environmental sensitivity of the citizens involved in data collection in the field: people who share the desire to learn, participate and contribute.

But what is the motivation of a citizen scientist in the environmental field? Investigations conducted in contexts with a certain tradition in this field show that there are many reasons why one can decide to join a Citizen Science project (from now on CS). Most citizen scientists carry out their activity for the benefit of the community, being primarily motivated by the opportunity to socialize, make new friends and work in a team.

Globally, thousands of projects currently involve millions of individuals in the collection, organization, transcription and analysis of a huge amount of scientific data relating to many different topics, from microbiomes to insects, from water quality to galaxies. In this process, natural history museums play a central role in promoting participatory science activities and developing new forms of public involvement (Sforzi et al. 2018).

Finally, a wrong perception of the economic aspects connected to the subject must be corrected: the SC, although based on the involvement of volunteers, is not free. In fact, in order to function correctly, it needs to maintain a more or less complex system of relationships, communication, feed-back, analysis, which guarantee its effectiveness. In some contexts, the number and breadth of data collected from citizens (just think, for example, of projects on sound pollution or air quality) is far greater than what could be achieved with human resources and funds ordinaries available to research institutions.

How many kinds of *Citizen Science exist?*

By their very nature, CS projects can be placed along a gradient that goes from pure scientific research to popularization. They are able to provide a valuable contribution to improving and increasing the level of knowledge and individual cultural growth, in a historical moment characterized by an unprecedented crisis of the biosphere. Facilitating the scientific process and bringing the public closer to science are in fact two strictly interconnected and functional purposes.

Recent studies have suggested various criteria for describing the different types of CS. Among these, one of the most popular schemes identifies four types of projects, based on the growing involvement of participants: contributory (contributory), collaborative (collaborative), shared (co-creative) and extreme (extreme). Those projects in which citizens simply make themselves

available to collect observations, to wear sensors capable of recording environmental parameters during their usual movements or to enter data into the PC following precise indications, fall into the CS contributive. In collaborative CS, citizens are more involved and are potentially able to interpret some scientific phenomena, while in shared CS, involvement includes both the problem definition phase and the data collection phase (Bonney et al. 2009). Finally, in extreme CS the involvement of the participants includes every phase of the project, from the definition of the problem to the collection of data, to the analysis and interpretation of the results.

There is now a growing number of applications of the different types of CS, from environmental monitoring projects in metropolitan areas to the co-creation and management of projects with indigenous tribes in remote areas of the planet, based on the use of idioms. In such a vast panorama of solutions it is not easy to orient oneself and fully evaluate the effectiveness and applicability of CS to the various contexts. The concept is increasingly gaining ground that the creativity of scientists can still produce many solutions, using what technology proposes new, but also what tradition and the knowledge of local experts can offer, to devise ever-changing solutions. In any case, the scientific method is always placed at the base of every activity, which remains the essential and central element of the discourse.

The international associations of *Citizen Science*

In 2014, ECSA (European Citizen Science Association) was established, the European Association of Citizen Science, based in Berlin. ECSA aims to identify, develop and promote best practices and excellence in CS, develop and support a common approach at the European level and expand political support in Europe, working closely with existing governments and realities and supporting the growth of national CS communities. In the immediate future there is also the will to develop CS programs with a transnational dimension. Today ECSA is a rapidly growing reality, with over 260 institutional members from 30 countries.

In the same period, the CSA Citizen Science Association (international network) and the ACSA Australian Citizen Science Association were formed in the USA. ECSA works closely with other international associations in the promotion of projects and in the development of operational procedures and standards. This collaboration considerably strengthens the organizational and political capacity of SC and lays the foundations for its ever-greater consolidation, meaning not only the strengthening of scientific processes and standards, but also the ability to interact with the political component and direct choices based on data sets collected in a participatory and reliable way. The first international scientific journal in the sector, Citizen Science: Theory & Practice, was also recently born within the ACSA. Open access and peer-reviewed, and is proposed as a reference point for scientific works that aim to advance the CS sector. The journal is open to researchers, computer technicians, conservation biologists, educators, urban planners, etc. with the aim of sharing best practices to conceive, develop, implement, evaluate and support projects that facilitate public participation in science, in any discipline. As the promoters' state, the ultimate aim is to create a new container of

academic information accessible to all, as an alternative to traditional publications, accessible only to professionals in the sector.

The principles of *Citizen Science*

One of the first actions promoted by ECSA through its working group "Sharing best practice and building capacity", coordinated by the Natural History Museum in London, was the drafting of the 10 principles of Citizen Science, now translated into 27 languages for ensure the maximum possible dissemination:

1. CS projects actively involve citizens in scientific activities that generate new knowledge or understanding. Citizens can act as contributors, collaborators or project managers and play a significant role in the project.
2. CS projects produce an original scientific result**.** For example, providing an answer to a research question or implementing conservation actions, management decisions or environmental policies.
3. Both professional scientists and involved citizens benefit from taking part in CS projects. Benefits may include publication of research results, learning opportunities, personal pleasure, social benefits, satisfaction with helping to provide scientific evidence to, for example, find answers to issues of local, national and international relevance and, through these, have the opportunity to influence sector policies.
4. People involved in CS processes can, if they wish, take part in several stages of the scientific process. This can include developing research questions, developing a method, collecting and analyzing data, and communicating results.
5. People involved in CS processes receive feedback. For example, how their data is used and what the results are in the research, political and social fields.
6. CS is considered a research methodology like any other**,** with limits and margins of error that must be considered and kept under control. However, unlike traditional research methodologies, SC provides opportunities for broad public engagement and the democratization of science.
7. Data and metadata from CS projects are made publicly available and, where possible, the results are published in an open access format. Data sharing can take place during or after the project, unless there are security or privacy reasons that prevent it.
8. The contribution of people involved in CS projects is officially recognized in the results of the projects and publications.
9. CS programs are evaluated for their scientific result, for the quality of the data, the experience of the participants and the extent of the social impact and on sector policies**.**
10. CS project managers consider legal and ethical aspects related to copyright, intellectual property, data sharing agreements, confidentiality, attribution and environmental impact of each activity**.**

The *Citizen Science in Italy*

In recent years, also in Italy there has been a growing interest in CS among various stakeholder groups. A recent survey (Bartoccioni, 2015) analyzed some aspects related to SC, such as the nature of citizen involvement, their motivations and the main tools used. Since 2005 there has been an exponential growth in projects (85% of which have been developed in the last

ten years), most of which are dedicated to biodiversity. At the national level, about a thousand participants were overall engaged in the LIFE MIPP and CS-MON projects and in the InNat project. Locally, thousands of people actively participated in the annual Bioblitz in Maremma, Lombardy and some other areas of Italy.

The first Italian Citizen Science Conference organized on 23-25 November 2017 in Rome created an opportunity for the visibility of the projects and for meetings between CS experts present at national level. The Horizon 2020 project "Doing It Together Science" (DITOs), as part of its engagement strategy for Responsible Research and Innovation, subsequently made possible a series of meetings, which saw the participation of over fifty university experts, research centers, scientific museums, associations, Italian public bodies with various levels of experience in the CS sector (Agnello et al., 2018).

The National Academy of Sciences and the Maremma Natural History Museum hosted a series of meetings, promoted in collaboration with ECSA, which led to the drafting of the "Guidelines for a national strategy for citizen science in Italy" (DITOs Consortium, 2019). This process has gained international visibility, placing our country among the realities at a European level that are working hard to equip itself with concrete tools for developing SC at a national level.

Achievements, actors and role of citizen science in education

Achievements of citizen science

For those in Italy who have the time and passion to devote to research, there is only the problem of choosing between possible CS activities; these range from observing new celestial bodies, to collecting information on animal and plant species, to monitoring air and water quality. Sharing ideas and communicating them is the programmatic basis of CS processes, and it is crucial that official science is increasingly convinced of the importance of this highly heuristic approach (Bartocci, 2014). CS has established itself in northern Europe and the United States where such activities have long since passed the embryonic stage. The involvement of large masses engaged in local and/or national projects represents a now standardised methodological approach. It is sufficient to recall the activity of OPAL - Open Air Laboratories Network extended to the entire territory of the United Kingdom since 2007. This network includes museums, universities, environmental organisations and government agencies coordinated by Imperial College London. Its initiatives are numerous, from surveying soil and earthworm quality (Soil and Earthworm Survey), to air and water quality (Air Survey, Water Survey), biodiversity and climate data collection (Climate Survey, Biodiversity Survey), counting possible insect pests (bug count), and surveying tree health conditions (tree health survey). At the beginning of 2013, OPAL presented a review of its first five years of activity; more than half a million people were involved, most of them at their first experience of field monitoring; the amount of data collected made it possible to obtain useful information that could not have been obtained in any other way. In Italy, a project entitled 'Occhio alla Medusa' (Eye on the Jellyfish) started in 2009, considered globally to be the most successful CS activity in the marine environment. The project started from the assumption that 'jellyfish' (all representatives of the gelatinous macrozooplankton) are steadily increasing in the Mediterranean, i.e., that their current abundance is not the result of more or less periodic swarming, and that a certain number of alien species, which are continually increasing, have reached the waters of the 'mare nostrum' via Suez and Gibraltar. The major concern of this often-massive increase is not only the risks of bathing - although incidents of stinging species can be counted in the hundreds of thousands - and/or the clogging of desalination plant pipelines, but also the predation of eggs, larvae and juvenile stages of fish, exacerbating the effect of fishing and causing a dangerous short-circuit; less fish, more 'jellyfish'. In order to unequivocally document the increase in 'jellyfish' in the Mediterranean, in view of the fact that Italian specialists in gelatinous macrozooplankton are very few and that the extension of the coastal area to be monitored is enormous, over 8000 km, it was deemed appropriate to activate a CS project targeting citizens. Thanks to targeted information campaigns, e.g. appeals in the mass media, the distribution of hundreds of thousands of ad hoc posters and the creation of a specific app for smartphones, it was possible to collect a progressively increasing number of reports (many thousands) between 2010 and 2014; in the latter year, not only was the invasion of *Pelagia* and *Velella*, dangerous stingers, documented, but also the presence of a species new to science, christened *Pelagia benovici*, thus demonstrating the importance of CS practices applied to problems of this nature (Boero, 2014). However, a tool with such a high potential in the education of citizens has not yet been

fully expressed in Italy, it is appropriate to work to ensure that its diffusion increases in the short and medium term.

Citizen Science actors

Specialist researchers and the funds available to the scientific community are limited and, in any case, insufficient to tackle the problems associated with the census and conservation of biodiversity at both local and regional levels. Therefore, the direct involvement of citizens in the census and in the active conservation of biodiversity represents, from this point of view, a new frontier. The rapid acquisition of precise knowledge on the biodiversity of an area is now entrusted to the guided participation of a growing number of subjects involved. It is based on the environmental sensitivity of citizens engaged in the census of wild species or in the collection of data in the field; people who are informed and who wish to be informed, united by the desire to learn, participate and contribute. The active and conscious participation of citizens in monitoring biodiversity will require interfacing with the political referent and with the academic institutions called upon to carry out the irreplaceable function of supervision of all the main activities as well as validation of the collected data. That said, some of the main categories of participants are identified: a) first and second grade elementary and middle school students (age group 6-18 years) or even high school and professional students possibly organized in associations scout, parish, etc.; b) school operators, in particular teachers of Natural Sciences, also for the purpose of pursuing the objectives of effective information and dissemination of CS activities; c) professionals and other structured workers who constantly carry out activities that do not have a close relationship with the natural sciences, including architects and engineers, who, due to their cultural background, are naturally the subjects in charge of solving management problems; but also fishermen and divers, farmers and boaters; d) retired adults with high availability of free time, among which qualified amateurs are not rare (mycologists, florists, entomologists, bird-watchers).

The CS projects, in fact, thanks to the involvement of specialized researchers, represent an example of innovative teaching that allows students and teachers to deal with real and current scientific issues, in a way that cannot be achieved with any other type of activity. As seen in the two previous chapters, we can say that CS activities in the school environment offer excellent examples of a “reality task”, in order to develop in the students - and therefore evaluate - some of the competences foreseen in the disciplinary goals. For example, in the case of science for lower secondary school:

- He explores and experiments, in the laboratory and outdoors, the unfolding of the most common phenomena, imagines and verifies their causes; seeks solutions to problems, using the knowledge acquired.
- Develop simple schematizations and modeling of facts and phenomena, resorting, when appropriate, to appropriate measures and simple formalizations.

- Having a vision of the complexity of the system of living beings and their evolution over time; recognizes in their diversity the basic needs of animals and plants, and the ways of satisfying them in specific environmental contexts.
- Be aware of the role of the human community on Earth, of the finite nature of resources, as well as of the inequality of access to them, and adopt environmentally responsible ways of life.
- He has curiosity and interest in the main problems related to the use of science in the field of scientific and technological development.

In this chapter we will try to contextualize CS activities in the school environment, to better understand their educational potential and to elaborate a series of criteria for the analysis and classification of projects carried out in educational institutions.

The role of citizen science in education

The last few years have been characterized by an increase in the number of CS projects carried out by universities and research institutions and by an evolution of teaching methods towards greater contact with reality and greater awareness, preferably derived from experiences made in first person, of the scientific method. Thinking of VET teachers and VET students as potential participants in CS activities therefore seems natural: research institutions can find in training institutions a large number of volunteers to be employed in projects and, at the same time, the participation of a class in activities of CS can prove to be a highly beneficial and formative time for both teachers and students.

Firstly, the interaction with scientists and participation in research projects provides pupils and teachers with the opportunity to directly access up-to-date and accurate information on the topics covered by the activity and represents an example of practical application of concepts studied only in an abstract and theoretical way, favoring a deeper and more lasting understanding. In fact, several studies have shown that introducing interactive and inquiry-based educational models (Inquiry Based Science Education) can significantly improve the academic results of participating pupils.

Participation in real experiments also helps to better understand the characteristics and spirit of scientific research, in which there are not always precise procedures to be followed and in which the conclusions are not always those expected. Participating in a research activity therefore mobilizes in the students a series of skills, abilities and personal resources that go beyond the disciplinary field of reference, in accordance with what is required of teachers by the National Guidelines.

Furthermore, the students participating in this type of projects increase their interest in the topics addressed and the CS activity can be an opportunity to sensitize them on social or ecological issues. Finally, the involvement of students in CS projects introduces them to the

different professional figures employed in the world of research and may push some to pursue a professional career in this field in the future.

However, creating an effective and student-friendly CS activity is not an easy task. Although the network and social media favor communication between scientific institutions and schools, and the various mobile devices (smartphones, tablets ...) in many cases simplify the process of collecting and sharing data, the design of an effective activity for students is a delicate task. It is in fact necessary to take into consideration the different needs of the figures involved, scientists and researchers on the one hand, teachers and students on the other: on the one hand the quality of the experiment and of the data collected cannot be compromised, on the other hand it is necessary to take into account the learning needs of the participants and the educational aspects of the activity must be prioritized. Furthermore,

Finally, it is essential to adequately prepare students and, above all, teachers who, otherwise, could feel inadequate and fearful of not being up to the situation, to carry out the experimental procedures. For this purpose, seminars or workshops for teachers can be organized in a period prior to the activity in the classroom and it is important that researchers guarantee constant support to teachers throughout the duration of the project and that they are available to answer questions or resolve doubts.

Realizing a CS project dedicated to students is therefore undoubtedly a heavy task, which requires time and organization. However, the results that can be achieved in terms of both student involvement and learning level are considerable. Furthermore, the activity is also formative for teachers who, in some cases for the first time, find themselves confronted with a real research project; the result is that teachers, seeing their skills increase, can be pushed to detach themselves more and more from traditional teaching and undertake more innovative paths.

However, despite the potential advantages that teachers and pupils can derive from participating in CS activities, at the moment the number of classes involved in such projects on the Italian territory is still rather limited. It is not easy to give a precise quantification due to the large number of projects currently underway in Italy, at national or local level, at the moment only a fraction between 10% and 20% of science teachers are actively engaged in projects of innovative teaching and of these only some are participating or have participated in CS activities.

Community composting and new professionals

The diffusion of project experiences on a small territorial scale includes community composting, which is configured as a very participatory technique of citizens directly involved in a good practice of circular economy. Composting is an aerobic biological process controlled by man that transforms biodegradable vegetable residues (green, woody and even animal) through the action of bacteria and fungi, into a mixture of humified substances, precisely

compost. The advantage of this technique is that it can be applied to different territorial scales or urban realities. Community composting represents an efficient alternative that involves citizens in an eco-sustainable practice that reduces waste, closes the circuit in the territory, it decreases the production of atmospheric pollutants that are generated by the combustion of waste and transport to the plants, as well as limits the purchase and use of chemical fertilizers. The diffusion of small electromechanical equipment is today supported by many regional tenders aimed at supporting the diffusion of electromechanical composting, which therefore concretely implement the principle of subsidiarity, but also by the commitment of large companies and by important regulatory innovations implemented and being implemented. for the transposition of the EU Directive 851/2018. At the national level, Law 221/2015 encourages composting practices of organic waste carried out on the place of production itself, such as self-composting and "community composting";

This legislation has generated the need to train a new professional figure with a similar path to what happened, for example, for boiler operators, leading to the issue of a certification such as the license. The tenant is required by community composting, regulated by the decree of 29 December 2016, n. 266. Article 214 of 152/2006 (Characteristics of waste for admission to simplified procedures) in paragraph 7 bis also provides for what can be defined as local composting for equipment with a capacity up to 80 t / year that can be installed and put into operation with notification of the start of business, subject to ARPA opinion and the appointment of a tenant.

Case studies and best practices

Below is a list of good practices and experiences at national level.

The Maremma Natural History Museum and the Citizen Science

Among the precursors of SC in Italy, the Maremma Natural History Museum (MSNM) has been organizing public participation initiatives for the collection of naturalistic data for several years. The activities carried out have also led the museum to be one of the founding members of the European CS Association, with an important role in the Board of Directors since its establishment. Nature and Social Mapping is the stable CS project of the MSNM, which consists of a series of activities and functions, described below.

www.naturaesocialmapping.it

Through the web platform https://www.naturaesocialmapping.it/it is possible not only to enter observations of animals, plants and fungi, but also to access specific sections, such as those dedicated to CS meetings and some target species, for which maps have been produced at national level, updated in real time. The aim of the project is to involve citizens of all ages (with particular attention to young people) in a direct (hands-on) exploration of our natural world. Although the main area of reference is the Maremma and, more generally, Tuscany, there are no spatial limits to the reports, which can come from various areas of our country and beyond. The museum intends to contribute in the long term to the fight to stop the loss of biodiversity, increasing knowledge and awareness of this central theme for our very existence.

Citizen science meetings. These are real thematic training courses with experts, free and open to all, to learn to recognize animal and plant species in nature and understand their ecological role. At the end of each meeting, a final test is performed, a certificate of attendance is issued and specific materials are provided, to be used to put into practice what has been learned in the field. Each encounter is accompanied by an outing in nature.

Polli: Bright (https://www.museonaturalemaremma.it/pollibright/) is a CS project on pollinating insects in Tuscany promoted by the MSNM and aimed at schools (from the last years of primary to early secondary school). It derives from an adaptation of the English project Polli: Nation, developed by the OPAL (Imperial College) team and the *Learning Through Landscapes association*. All three Tuscan universities are partners of the project, which is linked to Bright, the night of research in Tuscany. During the 2018 edition, the project was promoted in each of the cities involved (Florence, Siena, Pisa, Grosseto), giving the participants the opportunity to build a bug-hotel, in order to make people understand the importance of the pollination phenomenon. The teachers and students of the classes involved participated in training sessions on the pollination phenomenon and on sampling methods, then taking part in the field surveys, according to a precise scheme described in specially created field manuals. At school, the students rearranged the collected data, which was then fed into an online format.

The collected data were then analyzed and a final report was drawn up; the results were presented at Bright 2019.

X-Polli: Nation (https://www.opalexplorenature.org/xpollination) is configured as an evolution of Polli: Bright and Polli: Nation. It is a CS project on pollinating insects funded by National Geographic USA and developed by the MSNM in collaboration with Imperial College, Open University, University of Aberdeen, Learning Through Landscape and St. Alban School (GB). In Italy, the Maremma Natural History Museum is the coordinating subject of the three Tuscan university partners, as well as other partners in other regions. The collection of data on pollinating insects is combined with a seeding action (planting for pollinators) of flowering plant essences selected to attract the main species,

Nature on the Walls the monitoring of biodiversity can also take place in urban contexts, for the production of databases that make it possible to evaluate the animal and plant communities present and to make citizens aware of the nature present in the city. Grosseto is among the very few Italian cities with a wall that is still almost intact, consisting of large embankments and green areas. Nature on the walls is an event promoted by the MSNM which provides for free registration in the museum, an hour of field surveys through photos taken of every spontaneous living form, the return to the museum for the determinations and small final prizes of a naturalistic nature (guides, free participation in paid museum events).

Talytrus project the project designed for students in the first, second and third grades of the 1st grade secondary school of the Istituto Comprensivo Civinini di Fonteblanda (GR), aims to combine the study of science with the application of the scientific method. of research.

The multi-year course includes experience in the field followed by formulations of scientific hypotheses to be verified with processing of the data collected, supported by researchers and operators belonging to the MSNM. The project proposes CS activities dedicated to coastal environments and, in particular, to the species that colonize the Posidonia stalls and to those that characterize the beach-dune ecosystems. These are very interesting biocoenoses, particularly at risk both for the accumulation of harmful substances and plastic materials, and for the strong environmental pressure exerted by mass tourism and the erosive action of the sea. In a first phase, the students, helped by experts from the Museum, elaborate research hypotheses and fine-tune the samples. Field surveys are carried out both in spring and autumn, in order to verify the differences caused by the anthropic impact of the summer period. The collected data are processed in the classroom with the advice of the researchers, to then arrive at the production of a final report and a scientific publication.

BioBlitz It is a challenge to identify within a defined period of time (usually 24 hours) the largest number of species present in a given area. It is an informal and fun way to collect data on the variety of life forms that we can find in nature and to learn to recognize and record the main species. It makes it possible to raise awareness of the importance of biodiversity and its monitoring, while at the same time allowing the collection of original and useful scientific data

for conservation. Scientists and citizens collaborate side by side in data collection. A mix of researchers and the public is in fact the key to the initiative; everyone can take part in it in a different way: children, families, schools, adults of all ages, as long as they share a passion for nature. Participants are divided into groups, coordinated by expert researchers, to carry out scientific data collection activities (bird censuses, vegetation surveys, insect samplings, etc.). Not all species can be identified in the field: at the end of the activities the working groups move to the Base Camp, where the identification of the species takes place using guides, dichotomous keys and microscopes. All data collected during the bioblitz and field trips are then entered on the website www.naturaesocialmapping.it at the end of the activities the working groups move towards the Base Camp, where the identification of the species takes place by means of guides, dichotomous keys and microscopes. All data collected during the bioblitz and field trips are then entered on the website www.naturaesocialmapping.it

BioBlitzes therefore offer the opportunity for professional scientists, amateur naturalists and local communities to explore and learn together. They help raise awareness of the importance of biodiversity and biological monitoring, while generating an inventory of 'snapshots' of the species present at a given site (Robinson et al., 2013).

MNHM has organized numerous 24-hour BioBlitzes (Efforts 2017), each located within a Natura 2000 site, a European network of Sites of Community Importance. On average, 30 different types of activities are carried out for each BioBlitz, with over 1,800 participants contributing over the past seven years. This level of participation is encouraging, especially considering the geographic location and low population density of the survey areas. The final species lists vary between 450 and 700 terrestrial and freshwater species (with, in some cases, marine species). The results of the BioBlitz are then summarized in specific reports, distributed to all participants (see, for example, Sforzi et al., 2013).

Summary and recommendations

SC includes a wide range of projects in which ordinary citizens can take an active part in scientific research, in many fields of science. In recent years, the increase in IT and technological solutions has provided an important impetus, favoring an important development of this way of doing science.

The main criticism by the component of the scientific world still not persuaded of the validity of the SC is given by the perception that the data collected are not reliable; however, volunteers who have acquired some experiences are able to gather ever more accurate and reliable information. In addition, especially within international associations, work is being done for a constant improvement of quality standards, of data validation processes, training of participants and production of tools capable of guaranteeing increasingly reliable data.

To date, CS has therefore proved capable of producing (validated and verified) databases useful for research, generating large amounts of data in a relatively short time and helping to identify trends, differences or similarities of parameters or observations over time and space. . It seems certain that this process is destined to strengthen, and this will lead to the acquisition of greater participation and awareness, capable of also changing the way of dealing with emerging environmental issues in the near future. In this perspective, SC represents a process of high civic and cultural value, which (in particular in the environmental sector), can have numerous effects and results:

- to sensitize society in a participatory way towards scientific issues;
- (re) bring people into direct contact with nature;
- To train VET students and adults, providing cognitive tools of the natural environment and enabling them to contribute personally and effectively to the monitoring, protection and safeguarding of habitats and species;
- develop a greater civic sense and more environmentally friendly attitudes;
- go beyond the meritorious experiences of environmental education, involving citizens in direct participation in monitoring and conservation actions;
- encourage researchers to collaborate through the development of simplified dichotomous keys for the recognition of the main species of animals and plants, the implementation of ad hoc projects and the processing of data collected by citizens to enhance their work;
- create a strong awareness of the need to contribute to the knowledge and safeguard of the territory, through “the power of knowledge”.

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