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Citizen Science in protected areas: best practices for project formulation and implementation

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Abstract: Citizen science is recognized as a promising research approach. Conducted in protected areas, it can generate sound and useful data to inform decision-making that enhances inclusion and participation in their governance. While there are general guidelines guiding citizen science initiatives, little has been explored regarding best practices or lessons learned in their design and implementation in protected areas. Accordingly, the objective of this study is to describe citizen science projects in protected areas and to identify best practices in their design and implementation. A systematic literature review identified 45 best practices in 7 categories: Financing; Governance; Project Design; Methodology; Citizen Scientist Engagement; Dissemination of Findings and Evaluation. These practices can serve as an invaluable guide for coordinators of citizen science projects, strengthening the development of successful initiatives in protected areas.

Keywords: Participation; lessons learned; monitoring; governance; decision-making.

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Introduction

Protected areas (PAs) can be defined as "clearly defined geographical spaces, recognized and managed through legal instruments and other effective means, to achieve long-term conservation of nature and associated ecosystem and cultural services" (DUDLEY, 2008, p.8). They are considered one of the primary strategies for biodiversity conservation (UNEP-WCMC; IUCN; NGS, 2018). Nevertheless, their management continues to be challenged by chronic funding deficits (UNEP-WCMC; UNEP; IUCN, 2021), a situation that has often been exacerbated by the COVID-19 pandemic (HOCKINGS *et al.*, 2020; SPENCELEY *et al.*, 2021). A global effort is being undertaken to attain the ambitious targets of the Post-2020 Biodiversity Framework (CBD, 2021).

A lack of comprehensive, up-to-date information on ecosystems, species, and services intended to expand protected areas adversely impacts their effective management (DI MININ; TOIVONEN, 2015) and limits their contribution to decision-making (DANIELSEN *et al.*; 2010; PEGLER; CATOJO; MACHADO, 2021). Highlighting the gap between research and implementation and practice, several studies affirm that the societal impact of science can be measured by its ultimate results (PULLIN; KNIGHT, 2009; ARLETTAZ *et al.*, 2010), overlooking the range of impacts generated when scientists and public interact (TOOMEY, 2016).

Citizen science has been gaining recognition as a pillar of open science, facilitating scientific collaboration beneficial to science and society (WEHN *et al.*, 2020). It is presented as a flexible and adaptable concept to different contexts and fields of academic research (ECSA, 2015; HAKLAY *et al.*, 2021). This is reflected in the variety of existing definitions (e.g., CONH, 2008; BONNEY *et al.*, 2009; McKINLEY *et al.*, 2017).

It is a promising research approach, in which volunteers use scientific methods to contribute data to researchers, and environmental managers, and other decision -makers that informs decision-making and formulation of public policies that conserve natural resources and the environment (CONRAD; HILCHEY, 2011; BURGESS *et al.*, 2016; McKINLEY *et al.*, 2017).

For the purposes of this work, we will adopt the definition provided by the European Citizen Science Association, which describes citizen science as active public participation in scientific and research activities. According to the association, it is an open and inclusive approach where citizens are directly engaged in the investigative process, leading to outcomes such as new scientific knowledge, conservation efforts, and policy changes (ECSA, 2024).

Hierarchical systems of governance related to environmental management have been migrating to more inclusive, participatory approaches for some time (UNEP, 1992; MAUERHOFER, 2016; CVITANOVIC *et al.*, 2018). This shift is also evident in the context of protected natural areas, where citizen science can serve as an additional tool to promote social inclusion and participation in decision-making processes within these spaces (RANIERI *et al.*, 2022). As noted by Borrini *et al.* (2013), the involvement of diverse participants in decision-making provides different perspectives on governance issues, challenges, and opportunities, while augmenting social support.

In the Brazilian context, the National System of Conservation Units (SNUC), established by Federal Law 9985/2000, emphasizes social participation as a key component in the establishment, implementation, and management of protected areas[1]. The law outlines that:

> "The SNUC shall be governed by principles that:
>
> Ensure the active involvement of local communities in the creation, implementation, and management of conservation units;
>
> Encourage the support and collaboration of NGOs, private organizations, and individuals in conducting studies, scientific research, environmental education, recreational activities, ecotourism, monitoring, maintenance, and other management tasks related to conservation units; (...)" (BRASIL, 2000).

Furthermore, citizen science can enhance trust between protected area managers and the community (CVITANOVIC *et al.*, 2018), which is noteworthy since high levels of trust affect public perception of decisions' legitimacy, resulting in improved environmental results (TURNER *et al.*, 2016).

It is worth noting that those involved in a citizen science initiative can gain a range of benefits (ECSA, 2015). These benefits are often tied to the motivations participants have when contributing to a project (LAND-ZANDSTRA; AGNELLO; GULTEKIN, 2021), which may also align with the goals set by the initiative's creators regarding the expected outcomes for participants, such as technological learning (MULLEN; NEWMAN; THOMPSON, 2013; BAUMBACH *et al.*, 2019); scientific education (MERLINO *et al.*, 2015); financial and other material incentives (POULSEN; LUANGLATH, 2005; CARPANETO *et al.*, 2017); contributing to the natural resource management (BENCHIMOL; VON MUHLEN; VENTICINQUE, 2017; WEST; PATERMAN; DYKE, 2015), and local incentives, related to the participants' intrinsic motivations (NORRIS; MICHALSKI; GIBBS, 2018; TURREIRA-GARCÍA *et al.*, 2018), among others.

Several guidelines shape the overall development of citizen science projects, ranging from aspects related to the quality of data generated to the engagement of interested parties (BONNEY *et al.*, 2009; PMMP, 2015; PETTIBONE *et al.*, 2016; LEPCZYK, 2020; US GSA, 2022). However, guidelines, best practices and lessons learned that can specifically guide their design and implementation in protected areas and enhance their interconnection with the management of these areas have been insufficiently explored. Accordingly, this study characterizes citizen science initiatives in protected natural areas and identifies best practices in their

1 - Territorial space and its environmental resources, including jurisdictional waters, with significant natural characteristics, legally established by the government, with conservation objectives and defined boundaries, under a special management regime, to which adequate protection guarantees apply.

design and implementation.

Methodology

Systematic Literature Review

Data were derived from a Systematic Literature Review (SLR). To this end, recommendations in Guidelines and Standards for the Synthesis of Evidence in Environmental Management, version 5.0 of 2018 and Guidelines for Systematic Reviews in Environmental Management, version 4.2 of 2013, the two documents from the Collaboration for Environmental Evidence (CEE).

The review addressed the following guiding question: what are the best practices for citizen science projects in protected areas?

The search terms were selected based on the elements of the guiding question and were as follows: ("community-based monitoring" OR "community monitoring" OR "citizen monitoring" OR "citizen science") AND ("best practice*" OR "good practice*" OR "guideline*" OR "recommendation*" OR "lesson*") AND (protected area* OR "park*")[2]. The searches were conducted on the two principal platforms for environmental and engineering sciences, SciVerse Scopus and Clarivate Analytics Web of Science, through March 2020.

Articles identified in the searches were filtered in two consecutive stages. In the first, they were evaluated according to title, abstract, and keywords, and those with potential to meet the study's eligibility criteria were selected (Table 1).

In the second, articles selected in the first stage were read in their entirety for adherence to the study's eligibility criteria in their objectives, material, methods, results, discussion, and conclusions.

2 - An asterisk (*) following the term enables the search to use derivations. It should be noted that the search terms selected encompass a broad spectrum of monitoring initiatives that adopt a citizen science approach and are not restricted to community-based monitoring.

Table 1 – Criteria for article eligibility in the Systematic Literature Review.

Criterion	Inclusion	Exclusion
Language	English*	Other
Accessibility	Entire text accessible	Entire text not accessible
Document type	Periodical articles	Books; conference papers
Academic discipline	Environmental and social sciences	Other
Study objective	Original works that provide best practices to implement citizen science initiatives	Review works or articles that do not provide best practices to implement citizen science initiatives
Research sites	Entirely or partially in protected areas	Wholly outside protected areas

* Portuguese and Spanish languages were excluded in view of their relatively low relevance in pilot tests that captured an insignificant number of articles.

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CEE, 2013 and 2018 recommend that coding and data extraction follow the search for and selection of articles. To this end, the reference chart was devised to include elements to identify results presented by articles relative to this study, including (1) authors, journal, and year of publication, (2) research sites, (3) study objectives, (4) monitoring focus in regard to environmental components, (5) data collection and analysis methods. (6) participants, such as, researchers, employees of protected areas, visitors, recreational divers, and local communities, among others, and (7) best practices and recommendations.

This study uses a narrative synthesis to provide an overview and context and to discuss their implications (CEE, 2018). The synthesis follows recommendations in Popay *et al.* (2006).

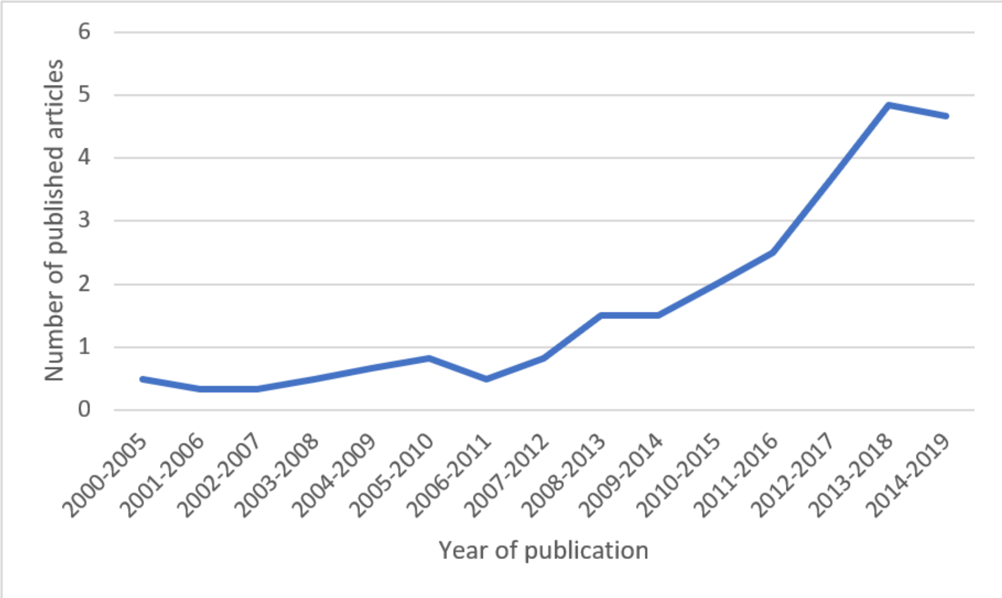
Results and Discussion

Using the search terms noted in Table 1, 397 articles were captured on the SciVerse Scopus platform and 161 on Clarivate Analytics Web of Science, totaling 558 papers. In the first stage of filtering, as previously described, 113 works were selected for further review. Following the second stage, as previous described, 40 articles were selected as meeting the study's inclusion criteria3.

Figure 1 depicts the rising mean trend for articles published (articles ultimately selected in the study's systematic literature review) over five-year intervals from 2000 though 2019. The fact that eighty-eight percent were published in the last half of this period, indicates increased interest in the citizen science approach in protected areas.

3 - The scope of the articles ultimately selected in the study's systematic literature review can be accessed at the following link: https://docs.google.com/spreadsheets/d/1lM69Mt914Ya7oLQEOzOYBPVCyYgcWou9/edit?usp=sharing&ouid=103288410254890493961&rtpof=true&sd=true

Figure 1 – Mean trend of number of published articles.



Font: the authors, 2024.

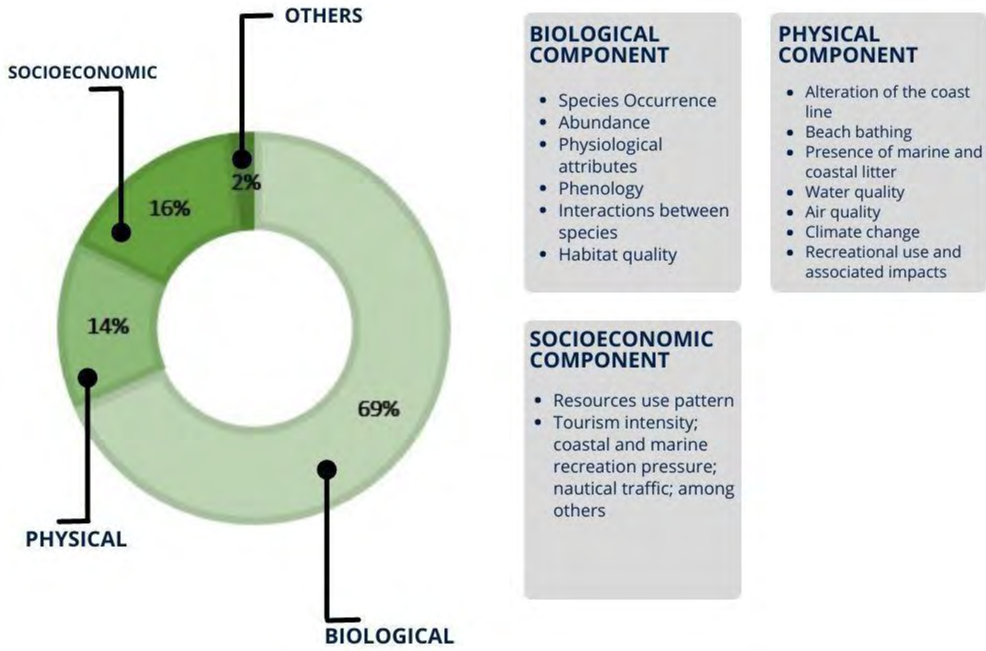
Among the 19 countries in which citizen science research was conducted, the following citations stand out: United States (12 articles), Brazil (6), Australia (4), and Italy (3), with the remaining 2 or less. Note that this analysis references the sites where the research was conducted and not the location of the institutions with which the authors were affiliated. Moreover, some studies conducted research in more than one country.

Monitoring focuses

More than half the articles (26) describe projects and share lessons learned. Eight identified objectives regarding the quality of data collected by citizen scientists, comparing its accuracy with data collected by professional scientists to evaluate the suitability of using citizen science in a specific context. Only two studies focused on the motivations of citizen scientists, and just four explored the potential of this approach in the management of protected areas. It is worth noting that all articles, directly or indirectly, discuss implications or lessons learned in the implementation of such projects.

Figure 2 depicts the percent of articles according to their monitoring focuses, considering their biological, physical, and socioeconomic components. Note that some articles described more than one citizen science initiative, and some projects had more than one monitoring focus.

Figure 2 – Percent of articles according to monitoring focus.



Font: the authors, 2024.

It is not surprising that the focus of monitoring in most of the projects/programs described in the articles captured was on biodiversity (the biological component of the environment). Citizen science has demonstrated great potential in filling knowledge gaps related to the occurrence of species (POCOCK *et al.*, 2018).

Among the citizen science initiatives focusing on physical components, those monitoring water quality predominate (LÉVESQUE *et al.*, 2017; MARQUES *et al.*, 2013; PITT; SCHULTZ, 2018). Projects examining diverse chemical, physical, and biological water parameters have become increasingly common (CAPDEVILA *et al.*, 2020). Citizen science has also enhanced research on local and global patterns of climate change, ranging from indications of its effects to early warnings of the dangers it poses that aid the assessment and management of its impacts (ALBAGLI; IWAMA, 2022).

Initiatives focusing on socioeconomic components involve nonscientists, such as members of local communities and employees of protected areas, in monitoring patterns of resource use (COSTA *et al.*, 2018; DANIELSEN *et al.*, 2000; HALLAC *et al.*, 2013; KALLIMANIS; PANITSA; DIMOPOULOS, 2017; MARIONI; BOTERO-ARIAS; FONSECA JUNIOR, 2013; MARQUES *et al.*, 2013; PIMENTA *et al.*, 2018; POULSEN;

LUANGLATH, 2005; TURREIRA-GARCÍA *et al.*, 2018). Promoting the participation of direct users of biodiversity in monitoring programs, in addition to serving pedagogical purposes, facilitates discussion of convergent and divergent interests between local communities and conservationists (FERNANDEZ-GIMENEZ; BALLARD; STURTEVANT, 2008), making the management of protected areas more dynamic and inclusive (LEVREL *et al.*, 2010).

Best Citizen Science practices in protected areas

Best practices identified in this study concern general aspects of citizen science initiatives. Specific contributions and lessons directly related to methods used, for example, "use both direct methods and sign surveys to detect species" (BENCHIMOL; MUHLEN; VENTICINQUE, 2017, p. 482), are not treated in the study since it focuses on those that can be replicated in different contexts. It should be noted that the analytical categories presented herein were determined after reading the selected articles.

Forty-five best practices, encompassing seven categories were identified. Brief descriptions of the categories follow.

1) Financing: Notwithstanding its capacity to lower costs in data collection (COHN, 2008; McKINLEY *et al.*, 2017), citizen science is not exempt from the need for funding. Thus, practices under this category relate to actions that optimize available resources.

2) Governance: Governance is crucial in the context of protected areas as it addresses such critical matters as who has authority, who decides, what are the objectives, how they can be attained, and who is, or, should be, held responsible (BORRINI-FEYERABEND *et al.*, 2013). Practices under this category concern how responsibilities and benefits can be shared among interested parties and include the creation of partnerships.

3) Project Design: Effective monitoring programs require sound design (MILLER; TWINING-WARD, 2005; GITZEN *et al.*, 2012). Practices under this category involve actions that optimize incremental implementation of citizen science in stages, such as those established by Bonney (2007) and Fraisl *et al.* (2022).

4) Methodology: To generate usable data that yields significant scientific results, the quality of data collected by citizen scientists is a vital methodological issue (BALÁZS *et al.*, 2021). Accordingly, this category encompasses practices related to the use of technologies and those that ensure data quality control.

5) Citizen Scientist Engagement: Understanding what motivates someone to take part in citizen science initiatives can help coordinators recruit and retain participants (LAND-ZANDSTRA; AGNELLO; GULTEKIN, 2021). Practices under this category contribute to the engagement of citizen scientists and keep them motivated.

6) Dissemination of Findings: Broad dissemination of research results is a fundamental premise of citizen science initiatives, and practices under this category address such matters as disclosure formats, data accessibility, and intellectual property issues.

7) Evaluation: Evaluation is an essential step in scientific research and can serve diverse purposes. In citizen science initiatives, these include assessing not only aspects

related to the scientific process and results, also the project's effects on participants and society (SCHAEFER *et al.*, 2021). Practices under this category optimize this step.

Table 2 presents the best practices of citizen science projects/programs developed in protected areas.

Table 2 – Best practices of citizen science projects/programs in protected areas identified through a Systematic Literature Review (the numbers in parentheses indicate the number of publications in which the practice was cited).

BEST PRACTICE	
Category	
Financing	- Evaluating cost/benefits of adopting citizen science (1); - Using cost-efficient means of data collection and systematization (2); - Considering committed time of citizen scientists in addressing project needs to reduce recruitment and training costs (1); - Optimizing monitoring by integrating tasks with activities conducted by the protected area team (2); - Optimizing financial, material, and human resources when partners are involved (7).
Governance	- Creating partnerships and encouraging multisector collaboration (11); - Ensuring the involvement of credible partners (5); - Creating partnerships with diverse expertise (2); - Formalizing partnerships to ensure fulfillment of commitments (2); - Clarifying responsibilities and duties of parties (2); - Including relevant parties in planning (2).
Project Design	- Identify facilitating and restrictive conditions for project implementation stages (identifying problems; defining objectives; involving citizen scientists; collecting and analyzing data; disseminating results and evaluating) (3); - Identifying priority areas for conservation project development (1); - Using knowledge gaps to define project priorities (1); - Setting well-defined schedules (3); - Maintaining constant teams where appropriate (3); - Matching the profiles of potential citizen scientists to project needs in terms of age, education, and motivation (1); - Taking heterogeneity into account in designing citizen scientist teems based on required skills (4); - Keeping tasks simple and site appropriate (3); - Promoting adaptability in designing monitoring schematics (4); - Integrating project actions with protected area management instruments (2); - Consider the possibility of integrating local knowledge as a source of data and useful information for the project (1).

Methodology	- Knowing the skills of citizen scientists before selection (3); - Training and qualifying citizen scientists when appropriate (13); - Adapting training and data collection to the specifics of citizen scientists and the context of project development (5); - Providing opportunities for dialogue between citizen scientists and protected area staff to enhance learning opportunities (10); - Using standard protocols (6); - Adopting ideas from existing monitoring protocols as appropriate (1); - Adapting demands of data collection protocols to participants' time and skills attainable with available training resources (1); - Consider using or integrating diverse monitoring formats, such as opportunistic or focused, as appropriate (1); - Verifying the accuracy of data collected by citizen scientists whenever the method requires or permits (8); - Considering sampling bias as appropriate (4).
Citizen Scientist Engagement	- Providing incentives for participating in citizen science (18); - Providing a variety of opportunities to participate in citizen science (8); - Reinforcing the value of citizen scientists' contributions (8); - Monitoring the motivation levels of citizen scientists throughout the project (6); - Encouraging citizen scientists to reevaluate their commitments, which may conflict with those required by the project (1).
Dissemination of Findings	- Disseminating project results to citizen scientists and public (6); - Ensuring that data analyzed and interpreted by participants is accessible for decision-making (7); - Disseminating results on Citizen Science Platforms (1); - Seeking partners to disseminate the results at different scales of interest (1); - Communicating identified priority research topics (1); - Addressing issues related to data anonymity (1).
Evaluation	- Providing methods to evaluate project effectiveness (7); - Using monitoring results to enhance subsequent project cycles (3).

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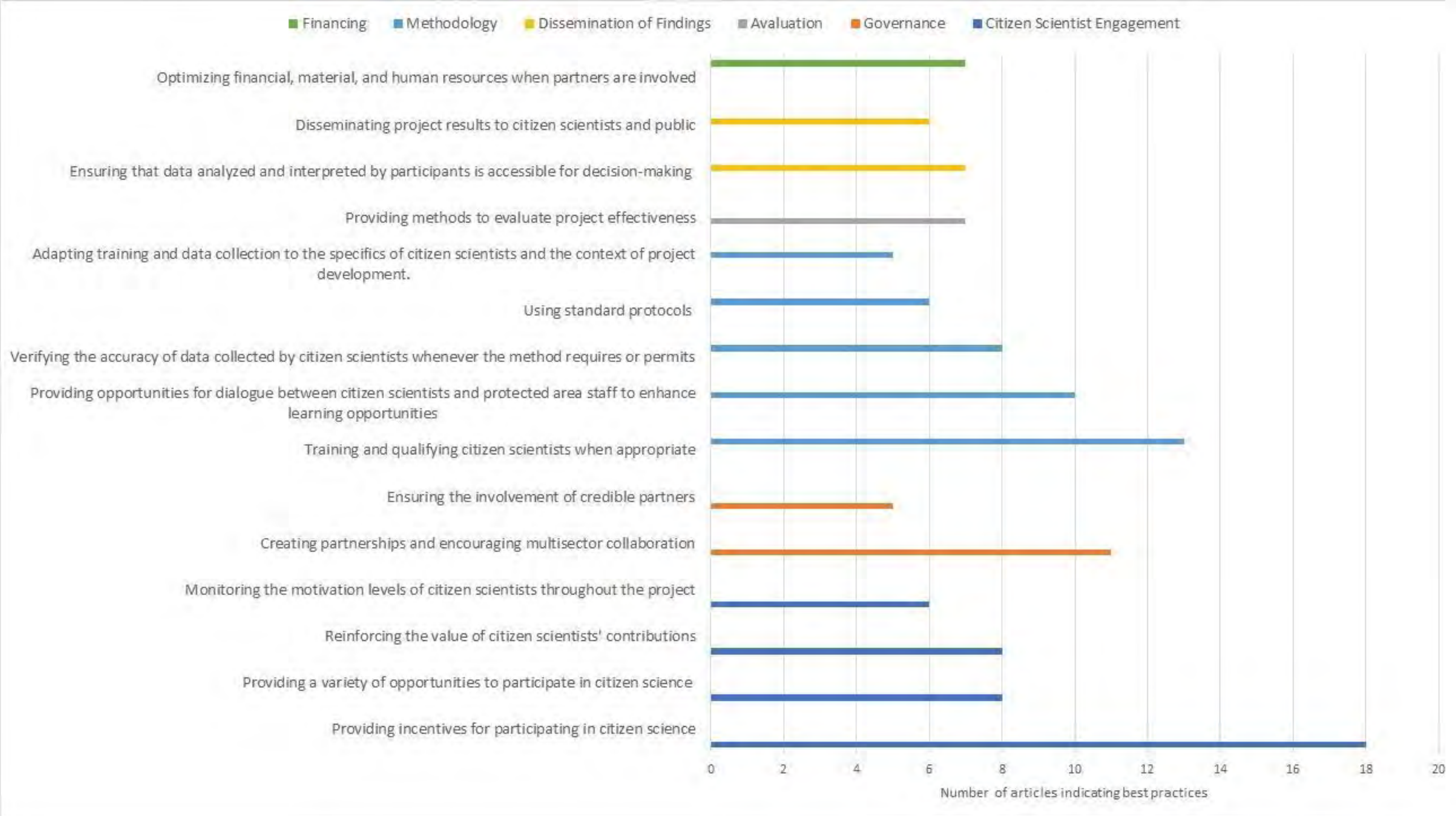
Best practices most frequently cited in the review address themes well explored in citizen science literature: "Provide incentives for the participation of citizen scientists" (18), "Carry out training/qualification of citizen scientists when relevant" (13), and "Seek partnerships and multisectoral collaboration" (11). The practice "Provide opportunities for constant dialogue between citizen scientists and the protected area team to expand learning opportunities" was often cited (10), and, despite having a more specific applicability, is included under the methodology category as it seeks to ensure the control and quality of data collected by citizen scientists.

The engagement and methodology categories stood out, presenting four and five best practices with five or more indications, respectively. The quality of data generated from citizen science has become a highly debated methodological issue in recent years but its complexity and the diverse connotations that "quality" can have for different stakeholders in such initiatives should be born in mind (BALÁZS *et al.*, 2021).

Issues related to participant engagement are also worth highlighting, bearing in mind that citizen science initiatives are diversifying, from projects where participants spend significant time outdoors to those that provide for limited training and little or no direct interaction with experts or other citizen scientists before forwarding data through online platforms (MAUND *et al.*, 2020). Moreover, the motivations of participants are also diverse.

Figure 3 presents the number of articles that indicate best practices by category of analysis. It is worth noting that the chart only shows best practices with five or more citations.

Figure 3 – Number of articles captured in the Systematic Literature Review that indicate best practices. Only best practices with five or more mentions are presented in the graph. Each color represents a category of analysis.



Source: the authors, 2024.

The diversity of best practices captured in the literature review is evident. As its eligibility criteria only included articles involving citizen science initiatives implemented solely or partially in protected areas, the study identified best practices with a focused application pertinent to the management of protected areas.

It is well-known, for instance, that implementing citizen science initiatives in protected areas can pose significant challenges, such as a lack of adequate financial resources (MAXWELL *et al.*, 2020; UNEP-WCMC; IUCN, 2021). In the case of initiatives that include protected area employees among citizen scientists, it may be advantageous to optimize monitoring activities, reconciling them with activities already carried out by protected area staff (POULSEN; LUANGLATH, 2005; UYCHIAOCO *et al.*, 2005).

Poulsen and Luanglath (2005), assess a biodiversity monitoring system in a protected area in Xe Pian, Laos, which involves public officials and local residents in data collection. Such methods as patrolling and discussions with local communities could reduce project implementation costs if they constitute regular activities of the protected area team.

Other exemple stress the importance of using research results to inform decision-making that advances evidence-based management of protected areas (COOK; HOCKINGS; CARTER, 2010; PEGLER; CATOJO; MACHADO, 2021). Therefore, it seems reasonable to consider knowledge gaps as a criterion for defining priority themes for project/program development (HALLAC *et al.*, 2013). Hallac *et al.* (2013) point out that project coordinators should prioritize research topics to maximize the ability of projects to respond to high priority issues identified by the protected area manager.

A best practice that exemplifies this focus is integrating citizen science tasks with protected area management instruments (POULSEN; LUANGLATH, 2005; UYCHIAOCO *et al.*, 2005). Instruments such as the management plan that establishes internal zoning and the norms governing their use tend to be specific and developed from a local planning perspective.

On the other hand, some best practices transcend the boundaries of protected areas and could be applied in different contexts, such as those included under the governance category, which address citizen science partnerships. The creation of partnerships that promote collaboration among project coordinators, communities, universities, research centers, and government and nongovernment organizations, among others, can generate multiple mutual benefits.

In addition to providing new perspectives to decision-making (JOSEPH *et al.*, 2019; PIMENTA *et al.*, 2018), a positive correlation between the creation of partnerships and the success of initiatives has been noted (MILLER; LEUNG; LU, 2012; PITT; SCHULTZ, 2018).

The topic of partnerships is also discussed from the perspective of negotiation among stakeholders (ANTHONY; SWEMMER, 2015; CIGLIANO *et al.*, 2015; TURREIRA-GARCÍA *et al.*, 2018). Turreira-García *et al.* (2018) note that "working with organizations, such as NGOs and universities, can connect local communities, policy-makers, and governments and align their values and interests" (p. 1028).

Still other studies stress the importance of involving well-regarded partners (BENCHIMOL; VON MUHLEN; VENTICINQUE, 2017; CIGLIANO *et al.*, 2015; MARIONI; BOTERO-ARIAS; FONSECA-JUNIOR, 2013; UYCHIAOCO *et al.*, 2005) to enhance credibility (CIGLIA NO *et al.*, 2015), and gain social and stakeholder support.

Strategic partnerships with the government, for example, can increase the likelihood of the project being sustained (BENCHIMOL; VON MUHLEN; VENTICINQUE, 2017); promote the project's prestige (UYCHIAOCO *et al.*, 2005), and motivate participation by citizen scientists (MARIONI; BOTERO-ARIAS; FONSECA-JUNIOR, 2013).

Partnerships can also boost funding for citizen science initiatives as the best practice "Optimize resources (financial, material, and/or human) when different partners are involved" under the finance category reflects.

In developing a citizen science water quality monitoring project for Montreal's public parks, Lévesque *et al.* (2017) created partnerships among volunteers, specialists, and corporate sponsors. The authors note that corporations can enhance their image by sponsoring citizen science initiatives and raising employee awareness of environmental concerns. It is noteworthy that many corporations use green marketing to publicize their environmental performance at the product, service, or company level (FREITAS NETTO, 2020). Accordingly, project coordinators should be cognizant of corporate intentions in sponsoring initiatives.

Another potential funding source for citizen science projects involves establishing partnerships with the volunteers themselves. Uychiaoco *et al.*, 2005, suggest user fees as a means of funding monitoring expenses. Entrance fees are commonly charged recreational visitors to protected areas and could be used to improve or expand these areas (WEAVER; LAWTON, 2017). Accordingly, linking user fees to citizen science projects in protected areas can be a relevant strategy.

With the intention of avoiding an exhaustive discussion of the identified best practices and mindful of the spatial constraints of this article, we have chosen to highlight best practices that consistently exemplify actions tailored to the context of protected areas. Additionally, we have included those that have a broad applicability, which can and should be observed for the development of citizen science projects/programs in protected areas.

Final considerations

Protected natural areas require reliable practical information that informs evidence-based management, and citizen science can generate such data.

Moreover, citizen science projects/programs conducted in protected areas can attract people to these spaces, making citizen scientists allies in conservation efforts. Volunteers can also engage in and contribute to decision-making processes, making the governance of these areas more inclusive and participatory.

Whether project coordination is under the responsibility of protected area management or external researchers, the best practices provided in this study can guide the design and implementation of citizen science initiatives in protected areas. The study has identified 45 best practices classified under seven categories: Financing, Governance, Project Design, Methodology, Citizen Scientist Engagement, Dissemination of Findings, and Evaluation. It should be noted that these practices could be used in monitoring biological, physical, and socioeconomic factors in land and water environments, providing lessons that could be replicated in diverse contexts.

Future research should focus on interconnection between citizen science research and the management of protected areas. Such matters as the potential benefits of citizen science in reducing monitoring costs and the ways volunteer programs can expand citizen science initiatives so that they transcend research and monitoring guidelines are examples of relevant topics that could be addressed.

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Ciência cidadã em áreas protegidas: boas práticas para formulação e implementação de projetos

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Artigo Original

Resumo: Em iniciativas realizadas em áreas protegidas, a ciência cidadã pode gerar dados úteis para as tomadas de decisão, além de tornar a governança dessas áreas mais inclusiva e participativa. Embora existam diretrizes gerais que orientam os projetos de ciência cidadã, pouco se explorou em termos de boas práticas para a concepção e implementação dessas iniciativas em áreas protegidas. Este trabalho teve como objetivo caracterizar projetos/programas de ciência cidadã desenvolvidos em áreas naturais protegidas e identificar boas práticas relacionadas a sua concepção e implementação. A partir de uma Revisão Bibliográfica Sistemática foi possível identificar 45 boas práticas, distribuídas em 7 categorias de análise: Aspectos financeiros; Governança; Design do projeto; Aspectos metodológicos; Engajamento dos cientistas cidadãos; Divulgação dos resultados e Avaliação. Concluiu-se que as boas práticas identificadas podem servir como uma orientação valiosa para os coordenadores dos projetos de ciência cidadã, fortalecendo o desenvolvimento de iniciativas bem-sucedidas nas áreas protegidas.

***Palavras-chave*:** Participação; lições aprendidas; monitoramento; governança; tomadas de decisão.

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Ciencia Ciudadana en áreas protegidas: buenas prácticas para la formulación e implementación de proyectos

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Artículo Original

Resumen: En iniciativas llevadas a cabo en áreas protegidas, la ciencia ciudadana puede generar datos útiles para la toma de decisiones, además de hacer que la gobernanza de estas áreas sea más inclusiva y participativa. Aunque existen pautas generales que guían los proyectos de ciencia ciudadana, se ha explorado poco en términos de buenas prácticas para la concepción e implementación de estas iniciativas en áreas protegidas. Este trabajo tuvo como objetivo caracterizar proyectos/programas de ciencia ciudadana desarrollados en áreas naturales protegidas e identificar buenas prácticas relacionadas con su concepción e implementación. A través de una Revisión Bibliográfica Sistemática, fue posible identificar 45 buenas prácticas, distribuidas en 7 categorías de análisis: Aspectos financieros; Gobernanza; Diseño del proyecto; Aspectos metodológicos; Participación; Difusión de resultados; Evaluación. Se concluyó que las prácticas identificadas pueden servir como valiosa guía para los coordinadores de proyectos de ciencia ciudadana, fortaleciendo el desarrollo de iniciativas exitosas en áreas protegidas.

***Palabras-clave*:** Participación; lecciones aprendidas; monitoreo; gobernanza; toma de decisiones.