

**CONTRIBUTED PAPER**

Maximizing biodiversity conservation through behavior change strategies

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Abstract

Most modern threats to biodiversity are due to human actions. Conservation psychology models provide tools to strategically change human behaviors to reduce these threats; however, behavior change theories have yet to be fully incorporated into conservation strategic planning techniques. The public that may be interested in a conservation issue are often untapped resources to expand a conservation organization's limited reach. Increased public participation could fill a gap between an organization's objectives and the scope of what is feasible for limited staff or budget. This study presents an expanded framework for biodiversity conservation strategic planning using conservation behaviors. Some conservation organizations, such as zoos and aquariums, have access to extensive audiences that could be mobilized to take-action to directly reduce threats to biodiversity or indirectly support others' efforts. To test our expanded planning framework, we evaluated the current status of conservation behavior change techniques used by zoos, which are increasingly identifying as conservation organizations. We used the framework to measure whether zoos are providing conservation behavior opportunities to their audiences of millions. The framework consisting of 12 behaviors nested within five categories includes behaviors in the public and private spheres. We tested the framework using content analyses of 211 zoo's websites across North America, sampled from the Association of Zoos and Aquariums. The methods elicited 2,187 conservation projects for the sample, only 32% of which provided any form of conservation behavior change opportunities to the zoo audiences. We present the range and frequency of conservation behavior strategies in zoos, revealing their current strengths as conservation organizations and opportunities for improved audience activation. The results demonstrate the value of integrating the conservation behavior change framework into biodiversity conservation strategic planning for conservation

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organizations. The framework can be used to facilitate expanded conservation activities, a valuable opportunity to reduce threats to biodiversity.

KEYWORDS

citizen science, classification, conservation behavior, conservation planning, public audiences, strategic planning

1 | INTRODUCTION

Despite extensive activities to conserve biodiversity around the world, the loss of species and functioning ecosystems continues to be a severe threat to the environment (Böhm et al., 2013; Butchart et al., 2004). Every year more species of vertebrates are listed as threatened and endangered (Hoffmann et al., 2010). This addition far outweighs the success stories of those being delisted with effective conservation efforts. Organizations working to save species around the world invest millions of dollars and staff time in their projects (e.g., the Association of Zoos and Aquariums [AZA, 2014], but species continue to be threatened (MacDonald, Milfont, & Gavin, 2015). The field of strategic planning for conservation uses an important structure—frameworks to connect organizational activities to biodiversity threats (e.g., Conservation Measures Partnership [CMP], 2013; IUCN Species Survival Commission, 2005a, 2005b; Salafsky et al., 2008; Kapos et al., 2008), which focuses efforts to address the most direct threats to species survival. However, many projects fail to rally the resources needed to address the direct threats to the species (Hoffmann et al., 2010). Despite numerous conservation efforts by worldwide organizations, many conservation projects are missing the link that would make them more effective. By not directly addressing the most pressing threats to species survival, it is difficult to reverse the decline of species in the wild (Salafsky et al., 2008). Conservation organizations may be more successful if they focus their strategic planning to mobilize larger audiences and link their activities to directly reducing threats to endangered species and their habitats.

Maximizing strategies to address biodiversity threats among conservation organizations is a crucial component for increasing efficacy and realizing institutional goals. In this study, we build on established methods for structuring conservation strategies (e.g., Salafsky et al., 2008) to obviate the threats to biodiversity. Often threats can be daunting to overcome, especially when conservation organizations have limited resources and staff that reduce their potential for impact. Audiences outside a conservation organization could be considered untapped resources to expand a project's reach (Figure 1). Through

conservation behavior change campaigns, ranging from events to help species or their habitats, to social marketing, citizen science, increased sustainability, and directed action, the public can be strategically mobilized to support and act for conservation (Stern, 2000). Building on the lexicon from Salafsky et al. (2008), we present a new component of biodiversity conservation strategic planning with conservation behavior change classifications for widespread, public audiences.

By creating a framework based in the conservation planning and behavior change literature, we propose a method to quantify potential for impact and maximize outcomes. Based on conservation psychology research, we have developed an expanded framework to classify conservation behavior change strategies as a means to evaluate potential for impact. This framework will guide conservation organizations to assess their current strategies to determine if they are (a) positively impacting the survival of a species by reducing its primary threats to survival and (b) engaging people in behaviors that will



FIGURE 1 Visual representation of the potential resources of mobilizing a conservation organization's audience and subsequently the community near to a conservation species or issue

positively impact wildlife. By creating the new conservation behavior classifications for the strategic planning framework, we highlight how the public can be involved in similar actions as the organizations themselves to increase reach and potential for impact. Organizations can enable the public to take-action and promote conservation impact independent of their staff time and capacity.

1.1 | Conservation behavior in zoos

The urgent decline of species and habitats has led numerous conservation organizations to work to conserve biodiversity. Some conservation organizations have access to large audiences that could be engaged and mobilized to take-action to reduce threats to biodiversity. For example, big, international, non-governmental organizations (BINGOs) have extensive membership bases that can be activated to support and join conservation efforts. However, not every BINGO, as well as many smaller NGOs, have a physical space in which to engage the public. Diverse institutions of museums, gardens, zoos, aquariums, and parks uniquely have these spaces where they can interact directly with and include audiences in conservation activities. These organizations use their natural areas and animal collections to bring the public closer to nature. Such experiences are used to educate and inspire visitors to get involved in protecting nature. Yet, despite active organizations, staff, funds, audience engagement efforts, and claims that organizations are leading the way in saving species (AZA, 2014), biodiversity is still in decline. In order to test how to fill the gap of conservation progress through the proposed classification, we selected one of these organizations with extensive audiences for an in-depth case study: zoos.

Zoological parks and aquariums (from hereafter: zoos) are visited by 700 million visitors each year, much more than any other conservation organization (AZA, 2014). Zoos often serve several roles in a community—part museum, theme park, and protected area and thus may host more diverse audiences than compared to more common, single-purpose institutions (Frost, 2011). In recent years, zoos have added the push for biodiversity conservation to their list of roles (Patrick, Mathews, Ayres, & Tunnicliffe, 2007). To date, these organizations have been found to have hundreds of projects for endangered species conservation, including managing ex situ populations, in situ conservation research, and active attempt to engage their visitors in conservation actions (Che-Castaldo, Grow, & Faust, 2018). Zoos share their conservation efforts on their websites, social media, and with annual reports (AZA, 2014). Yet, zoos need to

review their strategies to evaluate if they are effectively using their limited resources to play a role in conservation (Mace et al., 2007). With diverse audiences and opportunities for involvement in diverse wildlife in their collections and beyond, zoos could be leaders in biodiversity conservation (Zimmermann, Hatchwell, Dickie, & West, 2007), if they could leverage additional human capital to support conservation efforts.

Zoo visitors are a prime audience for being engaged about wildlife, conservation issues, and actions they can take to help (Mann, Ballantyne, & Packer, 2014; Skibins, Dunstan, & Pahlow, 2017). Zoos have been found to increase knowledge of biodiversity, emotional connections and concern about the environment, as well as their visitors' understanding of resultant conservation behaviors and their perceived self-efficacy around these actions (Clayton, Prevot, Germain, & Saint-Jalme, 2017; Grajal et al., 2017). Unlike other conservation organizations with remote audiences who subscribe as members, donate, or receive newsletters, zoos have the potential to amplify conservation messages and mobilize their millions of visitors via conservation behavior change strategies. However, many zoos assume passive learning and observation of animals will lead to behavior change on its own, rather than using behavior change strategies (Canzoneri, 2017). This study assesses whether they are providing opportunities for audience involvement in conservation activities. As such, zoos provide an ideal population of organizations to sample and test new behavior change classifications. By collecting this data using the proposed framework, we can assess how zoos are mobilizing their audiences to actively engage in conservation actions that positively impact species conservation.

1.2 | Conservation behavior change strategies

Modern threats to biodiversity are due to human actions. As such, strategically changing human behaviors is necessary to impact these threats (Schultz, 2011). Furthermore, the act of conservation does not need to be restricted to just the activities of the staff of conservation organizations. Conservation strategies need to include expanded engagement of the public, from local communities to widespread audiences, in order to address the global threats to wildlife and the environment (MacDonald et al., 2015; Figure 1). Strategic communications promoting opportunities for the public to take-action to support conservation can expand the reach of an organization's potential. Increased participation could fill the gap between an organization's intended strategy and the scope of what is feasible for their staff and

budget. By strategically engaging audiences, such as members of a community, citizens of a specific region, visitors to an organization, or even readers of a website, a conservation organization can direct this large population toward actions that help to reduce biodiversity threats. Conservation behavior change strategies should entail more than awareness-raising outreach; while informative components of an education program can be helpful, they cannot change behavior by themselves (McKenzie-Mohr, 2011; Schultz, 2011). Additional campaign strategies like those in this study's proposed framework are needed to inspire new conservation actions. By engaging more people to take specific actions related to the focal issue or species for that project, they can help to reduce their threats. This effort will expand beyond the current reach of an organizations' capacity to affect change.

While education and awareness-raising were already components of a framework for conservation strategic planning (Salafsky et al., 2008), without including an intentional plan about the behavioral consequences of these efforts, an effective mobilization of the target audience cannot be expected. Although many organizations are working on many conservation projects, they can improve by solidifying a direct link to the threats facing species and the actions needed to reduce or eliminate these threats. Behavior change is a key outcome on which threat reduction depends (Kapos et al., 2008). Since many of the direct threats that are causing the decline of species are directly related to human behavior, conservationists would benefit from incorporating social psychology and human behavior change theories while developing their plans to maximize their ability to work with diverse audiences to achieve greater impact (Schultz, 2011). Consequently, this study develops and tests a classification of conservation behavior change strategies to complement and build on the past strategic planning frameworks.

The value of conservation behavior change is well-supported with critical social science and evaluation research on a range of behavior change theories (e.g., Stern, Dietz, Abel, Guagnano, & Kalof, 1999), yet, it has yet to be fully incorporated into conservation strategic planning expectations. The CMP (2016) built on the framework from Salafsky et al. (2008), by adding a theme of behavior change activities to their list; however, their activities are very limited to only awareness-raising communications and advocating for protests (CMP, 2016). Audiences are more than receptacles of information via outreach or numbers in a crowd for public demonstrations. Thus, we built on the foundation for an expanded planning framework with increased potential for impact. Through using this tool to design engaging conservation

programs, organizations have the potential for expanded financial and human capital to maximize conservation activities directly related to biodiversity threats; behavior change strategies for audience engagement enable this potential growth.

In this study, we designed and tested new behavior change classifications by evaluating its application as a framework to study zoos' efforts to mobilize audiences to act as conservationists. Similar to the presentation of the original lexicon from Salafsky et al. (2008), this study assesses the application of an expanded conservation strategic planning framework. Based on the organizations' defense of their purpose to engage their large audiences in conservation, we hypothesize that zoos engage their audiences in conservation behavior change opportunities throughout most of their conservation projects. This study evaluates how audience behaviors are currently mobilized in zoos' conservation projects across North America. Using empirical evidence to evaluate zoos' current programs, we will expand and test the inclusion of behavior change classifications in the conservation strategic planning framework.

2 | METHODS

2.1 | Developing the new behavior change classification

This classification was developed building first on the literature of conservation behavior change theories and practices. Expert review by social science researchers and behavior change experts contributed to an iterative improvement and clarification of the final classification presented here.

A range of conservation behaviors are appropriate for an expanded lexicon for biodiversity conservation. Some behaviors lie within the scope of an individuals' behavior in public, and others are behaviors completed at home within a more private sphere. Additionally, conservation behaviors range from direct to indirect behaviors. Some behaviors are opportunities to directly influence a species or habitat, and other indirect behaviors can alter individuals' or community-level decisions, subsequently reducing negative impacts on the environment. In the latter case, the indirect connection to the issue may indicate an intent for impacting the conservation issue, which may or may not be achieved (Stern, 2000). Despite this discrepancy, the indirect opportunities to influence consumption, policy, and social norms are valuable foundations for supporting the likelihood of participating in more direct conservation behaviors in the future (Stern, 2000). Each of these avenues for behavior change was reviewed for the development of the classification.

The selected behaviors were classified and organized to complement the conservation strategic planning structure reporting environmental threats and organizational activities (Salafsky et al., 2008). The classification of threats and activities were used as a content analysis framework for comparison with the proposed behavioral additions. Two additional activities were added to Salafsky et al. (2008) framework of conservation organization activities: research and conservation planning from Kapos et al. (2008) and sustainability efforts at the organization itself, which allows for direct action and increases credibility. Following the methods of Salafsky et al. (2008), we were able to add post hoc presence and absence scores for the deductive content analysis across the three classification schemes. The projects listed on

the organizations' websites without detailed information that were difficult to assign to classifications were excluded (28 were excluded.)

2.2 | Testing the classifications

The sampling frame included the 234 organizations in the AZA. Accreditation in this association is a standard for high quality animal care and organizational activities, including requiring zoos to have conservation projects, about which they can educate and engage their audiences to promote conservation behavior change (AZA, 2017). Sampling from within the AZA supports our research objective focused on conservation projects as the sample

TABLE 1 Classification of conservation behavior change strategies for organization audiences, as an additional component for the framework of Salafsky et al. (2008) with categories from Stern (2000)

Conservation behaviors by level of classification	Definition
1.0 Environmental activism conservation behaviors	Recruitment and activist behaviors in the public sphere
1.1 Spreading information	Spreading information about the project or biodiversity issue with personal networks or using technology (e.g., social media)
1.2 Recruiting others	Recruiting friends, family, and/or close connections for joint action in the conservation behavior or the project.
1.3 Joining a partner organization	Participating in the project by joining in with another organization's efforts on the project, becoming a member, or donating to their role on the cause.
1.4 political advocacy	Supporting policies/law, petition signing, contacting politicians for conservation issues.
2.0 Non-activist conservation behaviors in the public sphere	Engagement behaviors in the public sphere
2.1 Using new learning resources	Engaging with the issue by learning more, exploring additional resources and websites, signing up for listserv and taking other opportunities to learn about project and/or biodiversity issue
2.2 Environmental stewardship	Supporting environmentalism with positive attitudes, developing a sense of responsibility that influences public actions, pro-environment lifestyle
3.0 Private-sphere conservation behaviors	Private consumption and waste behaviors for individuals
3.1 Resource sustainability	Reduce, reuse, recycle; reducing waste, diverting to recycling streams, and maintaining household equipment, driving less
3.2 Sustainable purchases	Sustainable consumer purchases and cause marketing.
4.0 Conservation behaviors direct to species and project	Actions that the public can participate in which directly connect to the species or project
4.1 Citizen science	Citizen science with direct observation of the species or habitat to record species presence, behaviors, habitat health, etc.
4.2 Species or habitat supporting behaviors	Reducing impact on habitat, habitat restoration and protection, collecting resources needed for the project
5.0 Pro-organization conservation behaviors	Behaviors that support the conservation organizations' efforts for the project
5.1 Philanthropic funding	Donating to the organization for the project, species, or issue.
5.2 Volunteering	Volunteering time at the organization to support the project

excludes zoos that do not meet the accreditation and may not prioritize conservation. The final sample for the study was 211 zoos, after combining the organizations that share a single website from the 234 zoos in the AZA population.

Each website was reviewed for descriptions of their conservation projects (see Maynard, Jacobson, Monroe, & Savage, 2019). We used a content analysis framework to examine zoos' websites communication about conservation projects' environmental threats, organizational activities, and conservation behavior change strategies for audience engagement (Table 1). Through deductive content analysis, we recorded the presence and absence of each classification for every project. We followed the process of content analysis using a coding scheme and three coders, which was tested for reliability and consistency across the coders with an acceptable reliability score of Krippendorff's $\alpha = .72$ (for exploratory research, the acceptable threshold for reliability is above .66; Krippendorff, 2004). SPSS Statistics version 24 was used to calculate frequencies and percentages of projects in each of the classifications.

3 | RESULTS

3.1 | Developing the behavior classification

The development of the classification scheme through literature and expert reviews resulted in 12 behaviors nested within five categories of types of behaviors (Table 1). Stern (2000) provided the foundational framework for the first three categories of behaviors in the classification, encompassing conservation behaviors of activist and non-activist behaviors in public, and private sphere behaviors (Table 1 - Classifications 1.0, 2.0, and 3.0). These types of conservation behaviors are reinforced by other researchers (e.g., Skibins et al., 2017). Additionally, we added to the list of behaviors two additional classes of behaviors: direct influences on a biodiversity or conservation issue (Classification 4.0), and those an individual can conduct to support the efforts of the organization itself (Classification 5.0).

3.2 | Testing the classification

The zoo sample elicited 2,187 projects across the 211 institutions. Testing this classification scheme resulted in 2745 threats identified by the zoos, 3,355 organizational conservation activities communicated, and 1,496 conservation behavior change opportunities offered to audiences. Every project reported at least one threat and zoo conservation activity, if not more, but many projects did

not present any behavior activation opportunities to involve their audiences in conservation.

Of the biodiversity conservation threats identified by zoos, direct threats of natural systems modifications, such as habitat degradation, biological resource use, such as poaching, and human intrusions and disturbance were the most common (Figure 2). Zoos' conservation activities ranged across nine categories (Figure 3). Acting as a philanthropic organization to donate to other conservation organizations or provide capacity-building was by far the most common at 55.7% of the projects. Zoos also identified their roles in research and conservation planning, education and awareness-raising, and managing species populations as more widespread conservation activities.

Only 32.2% of the 2,187 projects reported at least one conservation behavior change opportunity for the zoos' audiences. Of the 1,496 calls to action in the zoos' conservation projects, "encouraging their audiences to learn more and explore additional resources" was the most common at 18.5% (Figure 4). This was followed by "behaviors to support the organization itself", such as "philanthropic donations to the organization", as well as "citizen science with direct observations of the species."

4 | DISCUSSION

4.1 | Classification assessment

Strategic planning that addresses threats to wildlife by mobilizing audiences through zoo-organized activities creates an avenue for increased support to maximize potential conservation impact. This study focused on incorporating suggested behavior changes into a conservation strategic planning framework to assess the potential impact of audience engagement. Projects to promote conservation must include changing behavior (Schultz, 2011). If biodiversity conservation efforts are going to succeed with limited resources, this expanded classification paving the way for designing public involvement is a valuable opportunity to better reduce threats. While previous conservation planning frameworks acknowledge the importance of behavior change activities, they are limited to just two conservation behaviors that are undertaken by organization staff (CMP, 2016). Instead, our expanded classification provides many opportunities for organizations to select the appropriate conservation behaviors to promote depending on the focal species in order to engage their visitors and accessible audiences and mobilize their help to reduce threats to biodiversity.

This study demonstrates the value of integrating conservation behavior change classifications into the biodiversity conservation strategic planning framework. Our

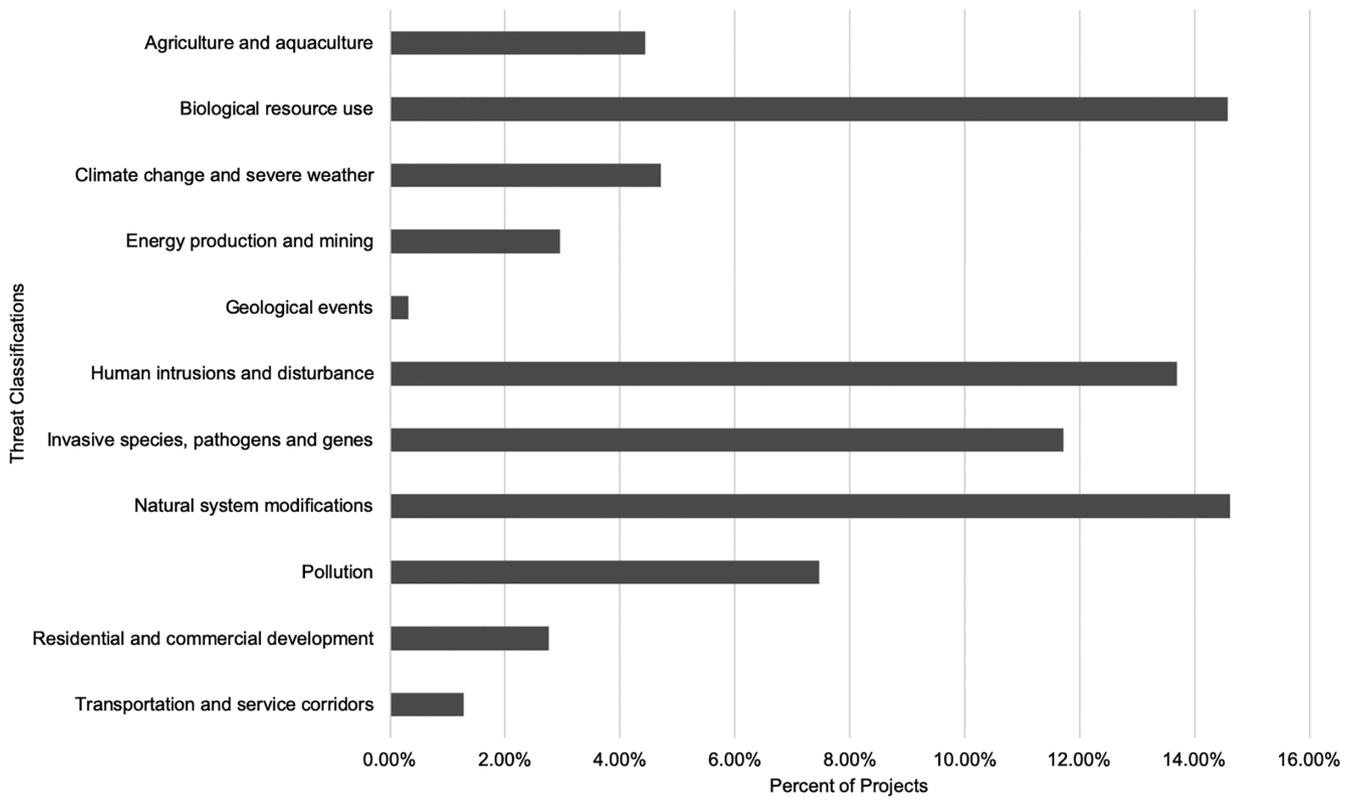


FIGURE 2 Percentage of projects with each threat identified, in the application of the threat classification (Salafsky et al., 2008) to the zoo sample

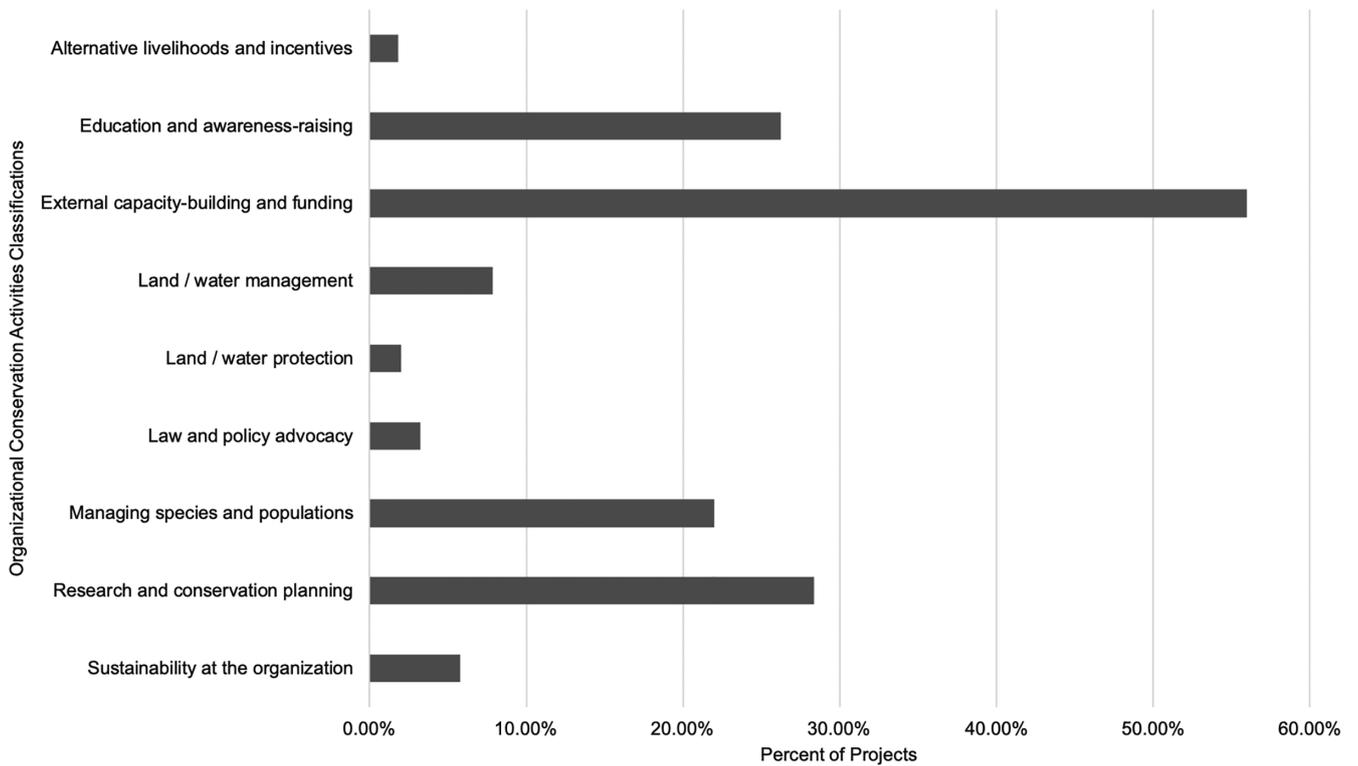


FIGURE 3 Percentage of projects with each organizational activity (from Salafsky et al., 2008) identified from the application of the organizational activities classification to the zoo sample

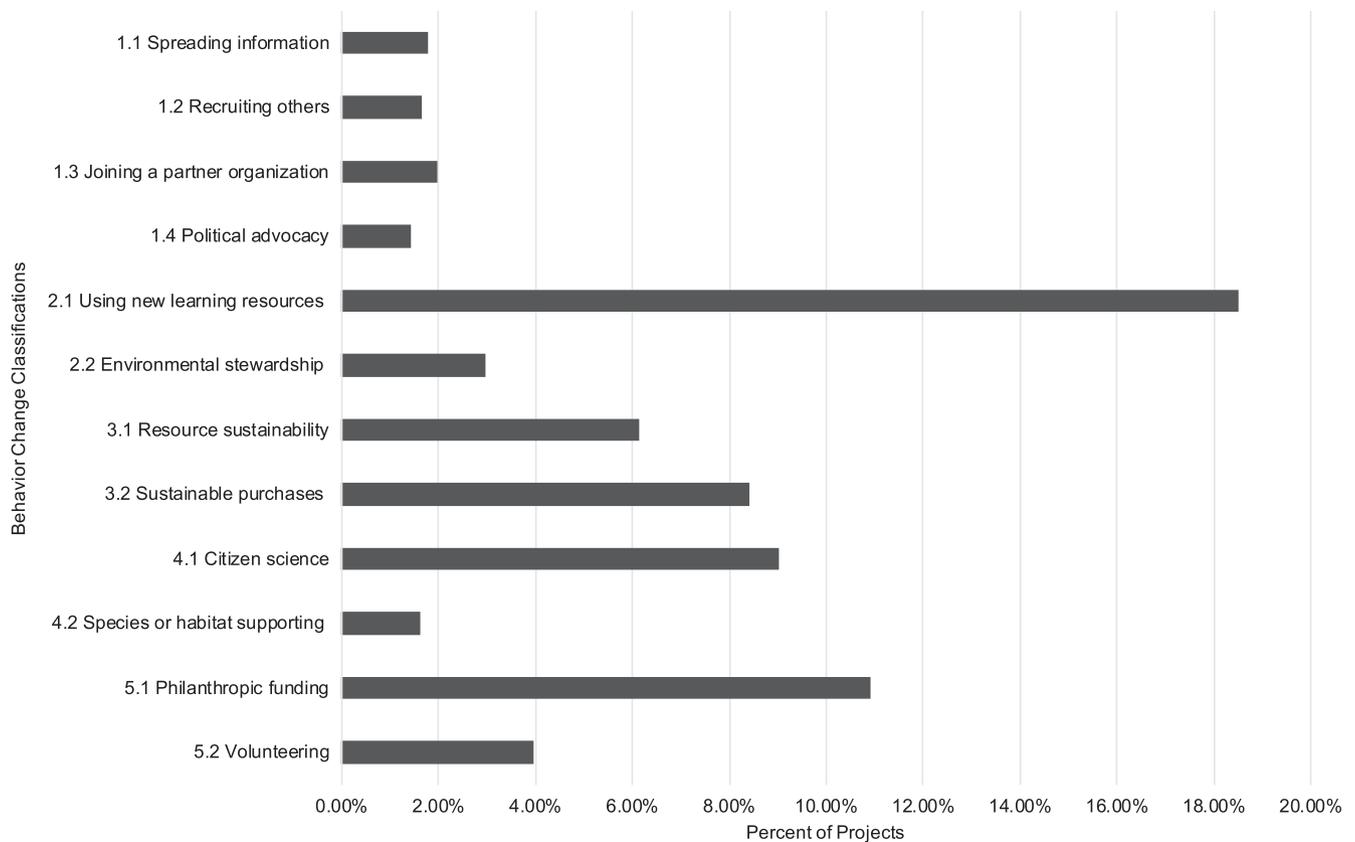


FIGURE 4 Percentage of projects using each conservation behavior from the proposed framework identified in the zoo sample

classification of conservation behavior engagement strategies successfully recorded a range of behaviors. Our expanded behavior classifications categories should be considered for future incorporation to the CMP and IUCN frameworks, as they were prevalent in this exploration of 211 zoos in the United States. However, the frequency of organizations offering conservation action opportunities to their audiences was lower than the frequency of threats and organizational activities. This gap reveals an opportunity for more audience engagement and purposeful selection of appropriate conservation strategies in order to scale up for more conservation impact.

The five categories of conservation behavior classifications allow for different audience engagement strategies. They depend on what is needed to reduce the threats to biodiversity and what strategies will support the conservation organization's goals. We encourage conservation organizations to be conscious of the breadth of the 12 behaviors that we present in the classification. Some behaviors directly connect to conservation issues and others support audience mobilization to build momentum for further involvement. When a conservation issue has need of additional personnel and resources, direct involvement of an organization's audience and nearby communities could be helpful. These behaviors include species observations and citizen science (4.1), resource collection for the project (4.2), political

advocacy (1.4), environmental citizenship and stewardship (2.2), and recruiting others to join the project and participate in the behavior (1.2). Alternatively, other conservation behaviors may not directly reduce biodiversity threats, but they can be the link to engaging audiences for subsequent involvement. These behaviors include spreading information to extended networks (1.1), engaging with the issue by learning more (2.1), and engaging with the organization with philanthropy (5.1) and volunteering (5.2).

With the expanded framework including conservation behavior classifications in project planning, the organization activities have counterparts of complementary actions the public could be engaged in order to amplify the organization's efforts and to reduce biodiversity threats. For example, rather than only an organization's staff working on policy advocacy, the public can be engaged to support policies, sign petitions, and contact politicians (Table 1, behavior 2.3). If conservation organizations reflect on their activities and ways their goals could be achieved with the help of additional community members or engaged audiences, then the conservation behavior change classifications can be pursued in their strategic planning.

An important additional note for practitioners is that a single strategy cannot be expected to effectively reach and mobilize diverse audiences. Audiences' attitudes, beliefs, perceived barriers and benefits, personal capabilities and

their context can influence the likelihood of their adopting a behavior (Stern, 2000). Building on a person's foundational values (Reese, 2013; Schultz & Zelezny, 2003; Yocco, Bruskotter, Wilson, & Heimlich, 2014), motivations (De Young, 2000), behavioral intention (Ajzen, 1985), perceived self-efficacy (Bandura & Adams, 1977), and more can all influence an audience member's intention to engage in a behavior. Furthermore, increasing a person's knowledge about an issue is not enough to get them to change their behavior (McKenzie-Mohr, 2011; Schultz, 2002). Organizations interested in applying effective behavior change strategies should incorporate social and behavioral science into their program design. In short, understanding a specific audience and designing targeted messages that resonate with them structured around behavior theories will increase the likelihood of the success of a conservation behavior change project (e.g., community-based social marketing, McKenzie-Mohr, 2011). Audience evaluation in addition to clear strategic planning is essential for effective conservation strategies.

4.2 | Conservation behavior strategies in zoos

Applying the biodiversity conservation classification framework to zoos demonstrated the breadth of their conservation projects. With so many diverse projects, zoos are committed to conservation. But, there appears to be room for improvement by being more strategic. In a related study, Mace et al. (2007) found that zoos' habitat conservation projects had the most impact on conservation, followed by projects focused on research, species population management, and education. These results mirror many of the more common activities we found for zoos over 10 years later. While Mace et al. (2007) went deeper to assess the conservation impact of the projects, their research was much more time intensive and limited the number of projects covered to just 41 projects. By reviewing over 2,000 projects relatively quickly using the standard lexicon for conservation from Salafsky et al. (2008), we were able to determine the current status of conservation projects across many zoos, as well as their potential for strategic connection that can lead to impact, and identify gaps that can be filled. Categories with low percentages indicate potential areas of opportunity for considering future projects, if applicable, and ways to increase zoos' conservation involvement to reach their potential. For example, most projects focused on small, unsustainable species populations rather than addressing threats to reinforce the populations. Yet, the zoos' projects would find it difficult to mitigate the problem in situ and support a more sustainable population in the wild without addressing the threats that caused the urgent situation

(Salafsky & Margoluis, 1999). Zoos need to have an increased focus on selecting activities that can mitigate direct threats to the species or environmental issues. This is supported by the findings of Che-Castaldo et al. (2018) that zoos need to redirect their efforts on more threatened species, and invest less action in the well-protected species. As such, zoos can be more strategic in the projects they select, when identifying threats, when promoting more purposeful activities to specifically address them, and finally, when encouraging conservation behaviors and public engagement, for which zoos are primed to lead impactful conservation projects. By using the expanded conservation planning framework from this study, zoos and any conservation organization can design programs that activate the necessary steps to achieve conservation mobilization.

Zoos often identify as education institutions, since millions of visitors attend every year (AZA, 2014). However, zoos' programs have yet to demonstrate strong, lasting impacts on their visitors' knowledge, attitudes, and behaviors toward conservation as a result of single visits or brief interactions (Storksdieck, Ellenbogen, & Heimlich, 2005). Zoos have visitors from diverse demographics, attend in different group contexts, and have different motivations and expectations for their visit (Povey & Rios, 2002). The emphasis of conservation as a primary role of zoos requires shifting design and delivery of interpretive and engagement strategies, different from the past focus on education and entertainment (Wijeratne, Van Dijk, Kirk-Brown, & Frost, 2014). Additionally, while some have found too many messages to be problematic and cause decision fatigue (Schwartz, 2004), Smith, Weiler, Smith, and van Dijk (2012) evaluated conservation fatigue in zoo visitors and found that numerous calls to action for conservation in the zoo were not perceived to be excessive by the visitors. This study reinforces the appropriate and important use of conservation behavior strategies to engage zoo audiences and nearby communities.

Prior research on zoos' conservation engagement achievements have mostly been limited to single case studies on solitary exhibits, programs, or institutions, while there also has been a dearth of outcome evaluation beyond measuring knowledge (Dierking, Burtnyk, Buchner, & Falk, 2002). Results from this study addressed this gap in the research with an assessment of thousands of conservation projects, finding a range of zoos' engagement strategies, and yet an opportunity to incorporate more conservation behavior strategies across more of their conservation projects.

Zoos are increasingly identifying as conservation organizations, with new wildlife conservation projects, conservation education programs, sustainability initiatives, and investments in conservation partnerships. Each of these zoo activities has complementary behaviors their audiences and nearby communities can participate in to

expand the reach of the program (Figure 1). For example, engaging families on sustainable behaviors, making animal connections, and discussing local issues at one zoo was directly related to lifestyle changes for sustainable behaviors (Esson & Moss 2016). However, which behaviors are likely to have the greatest impact on the conservation of a species will greatly differ between species, their context, and the current opportunities to address their threats. As a result, we encourage conservation organizations to review all of the behavioral options in the proposed framework for each project to find the most cogent opportunities for conservation impact.

With this study testing the proposed conservation behavior framework, we have documented the current commitment of zoos as conservation organizations. However, classifications with low scores revealed areas for growth to better achieve zoos' conservation goals. These organizations need to more strategically design conservation projects that will engage their audiences with behavior change strategies. If zoos are to realize their conservation potential and inspire even a fraction of their millions of visitors into conservation action, then using these expanded biodiversity conservation strategic planning classifications as a tool to address gaps in their current programs can help them to design more effective projects that mobilize their audiences.

In conclusion, we showed how conservation behavior change classifications could make a valuable contribution to the biodiversity conservation strategic planning framework. Zoos provided a valuable case that is applicable for the range of conservation organizations in the field. With strategic behavior change campaigns, conservation organizations can engage audiences and communities to expand their reach and better mitigate the threats to biodiversity.

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AUTHOR CONTRIBUTIONS

L.M.: Conceptualization, methodology, investigation, data curation, analysis, writing—original draft, visualization. M.M.: Validation, writing—review & editing, supervision. S.J.: Validation, writing—review & editing, supervision. A.S.: Writing—review & editing, supervision.

ETHICS STATEMENT

The research presented in this paper did not require approval from an Institutional Review Board.

DATA AVAILABILITY STATEMENT

All data analyzed for this research were collected from each institutions' website.

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