Biodiversity Loss: Call for Behavioral Change

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Abstract

Biodiversity loss is a significant and growing problem that has tremendous implications for our environment and quality of life. Humans play a significant contributing role to biodiversity loss through their behaviors and outputs. The primary mechanisms by which humans degrade the environment and therefore cause biodiversity loss, include: destructing habitats, exploiting resources, causing climate change, and introducing invasive species to ecosystems through global trade. The resulting decline in biodiversity directly impacts our ecosystem services and can lead to significant social conflict. Methods for reducing the risk of biodiversity loss call for social and behavioral change. However, changing human behavior at scale is a daunting task. This paper provides a review of the phenomenon of biodiversity loss and synthesizes the research on theories of behavioral change models and messaging strategies to provide recommendations for practice.

Introduction

Biodiversity is a multifaceted concept that lacks a common definition across varying disciplines and stakeholders. For example, biodiversity can pertain to genetic, species, or ecosystem biodiversity, and it can be defined through a morphological or a biological lens depending on the stakeholder (Primack, 2010). In addition to a lack of a common definition, research on biodiversity lacks standardization around the scale of time and space, and the research methods used to understand and predict biodiversity loss. As a result, there are several challenges that we face when responding to biodiversity issues.

While there is a lack of standardization around the definition and study of biodiversity, there is general consensus that it is rapidly declining (Barnosky et al., 2011; Mannion et al., 2014) and human activities are a leading cause (Haddad, 2015; O'Bryan et al., 2017). These declines have significant impacts on human quality of life, particularly as it relates to ecosystem services (Chitraker, 2018; Haddad, 2015) and social conflict (Brashares et al., 2014). While scientists are driving efforts to study and respond to these declining trends (Carvajal et al., 2018; Gholizadeh et al., 2019; Kucsicsa et al., 2018), we will not be able to move the needle fast enough without changing human behavior.

In this paper, a synthesis of the literature on biodiversity loss is provided with a particular focus on the nature of the problem and methods for changing behaviors through social campaigns. The first section includes a discussion of the phenomenon of biodiversity loss focusing on human causes. The second section provides a synthesis of the literature leading to identified strategies for invoking behavioral change to reverse these declining trends. The third and final section provides an overall summary of the key themes discussed in this paper.

The Era of Significant Biodiversity Loss

Biodiversity loss is a significant and growing problem that has tremendous implications for our environment and quality of life (Barnosky et al., 2011; Mannion et al., 2014). Anthropogenic causes of biodiversity loss include habitat destruction, resource exploitation, introduction of invasive species through global trade, and climate change (Allen et al., 2009; Brook et al., 2008; Green et al., 2019; O'Bryan et al., 2017; Richter et al., 2020). The resulting decline in biodiversity directly impacts our ecosystem resources (Richter et al., 2020) and can

lead to significant social conflict (Brashares, 2014). Furthermore, the relationship between ecosystem services and biodiversity is reciprocal, further complicating the problem (Figure 1).

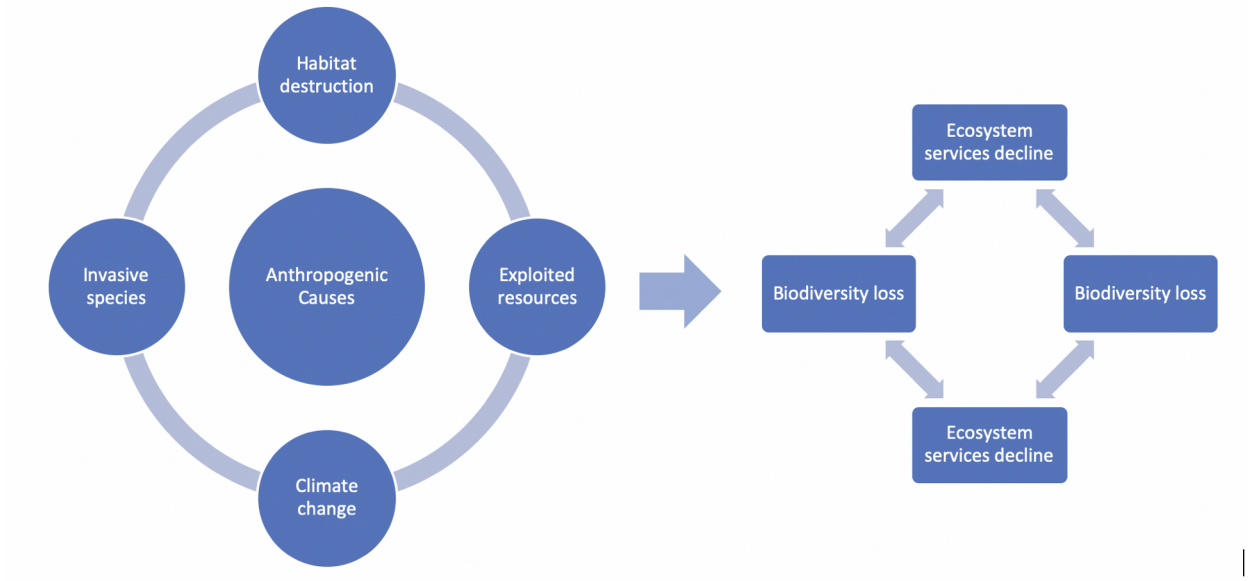

Figure 1. Interrelationships between human behavior, ecosystem services, and biodiversity loss.

Agricultural farming is a leading driver of habitat destruction and resource exploitation (Brook et al., 2008; O'Bryan et al., 2017). For example, Richter et al. (2020) found that human consumption of freshwater for irrigation of cattle-feed crops is reaching a threshold by which replenishment is not sufficient to sustain demand, which will negatively impact humans and many other species. To complicate matters further, agricultural farming contributes to greenhouse gases, which is a leading cause of climate change (Allen et al., 2009; Roberts et al., 2020). Other examples of human causes of habitat destruction include logging and infrastructure development (Freeman, 2012; O'Bryan et al., 2017).

Climate change is another significant driver of biodiversity decline. In fact, climate change is one of the biggest global conservation challenges today (Haight & Hammill, 2020). While climate change is not new, faster and more extreme changes in climate are human induced. Carbon emissions and greenhouse gases cause global warming (Allen et al., 2009; Roberts et al., 2020), and deforestation further impacts climate by removing trees, which serve as carbon sinks (Carrington, 2019). Climate change directly impacts species' survival rates by changing their natural behaviors and making them more vulnerable to extinction. One specific

example is the impact that climate change has had on the hibernation timing of cave-dwelling bats, which has made them more susceptible to starvation (Muthersbaugh et al., 2019). Also, climate change may make habitats intolerable resulting in the extinction of those species who are unable to disperse to suitable locations fast enough (Román-Palacios & Wiens, 2020).

In addition to habitat destruction, resource exploitation, and climate change, invasive species also contribute to biodiversity loss. Global trade is the primary cause of species invasions (Meyerson & Mooney, 2007) indicating again, that anthropogenic factors are a leading cause. Invasive species present significant global threats to their non-native ecosystems. The threat of invasive species is even more substantial in areas with high rates of endemic species (Meyerson & Mooney, 2007). For example, in Hawaii, the endemic dominant tree on the island is being overtaken by an invasive species known as M. faya (Simberloff, 2011).

Despite a slowing human population growth rate, the total population is projected to continue to increase (Roser et al., 2019), which will increase tension and conflict between humans, other species, and ecosystems. Demand for land and food will continue to grow, while at the same time, supply will continue to decrease. Even if the human population was decreasing, it would not happen fast enough to reverse these trends. Therefore, other solutions that have a more immediate impact are needed. Specifically, we need behavioral change.

Modifying Behavior to Mitigate Biodiversity Loss: Hope for Tomorrow

There are various methods that have been used to facilitate behavioral change as it relates to conservation. One such method is the use of external payments, which is the practice of providing payment to landowners as a reward for protecting and improving natural resources (Alix-Garcia et al., 2018). While external payments can be an effective approach, intrinsic drivers of behavioral change will likely result in more permanent behavioral changes. Furthermore, we need a solution that pertains to a much larger population base.

Other methods, which are more intrinsically based, pertain to social campaigns designed to change behavior. However, invoking behavioral change requires a multi-dimensional view of the problem. Specifically, the message being delivered and the context in which the delivery occurs both need to be considered when designing a strategic approach. As such, both behavioral change theory and social marketing practices should be considered when designing a behavioral

change initiative (Green et al., 2019). Furthermore, since the primary goal is to invoke behavioral change, it is critical that behavioral change (versus simply measuring attitudes or intent) is measured as part of the approach (Challender et al., 2014; Nilsson et al., 2019).

Conceptual Models and Theories on Behavioral Change

There have been several theories proposed relating to the concept of behavioral change in the psychology and marketing literature. In general, newer theories build on prior theories to construct more robust conceptual models that can be tested via empirical methods using survey research and statistical models (e.g., confirmatory factor analysis, path analysis). When considering a particular theoretical model in which to ground one's study, it is important to understand the underpinnings and limitations of the various models. Some of the more common theoretical models include Roger's diffusion of innovation theory (1962), Fishbein & Ajzen's theory of reasoned action (1975), Prochaska's transtheoretical model of behavioral change (1979), and Ajzen's theory of planned behavior (1991). These are seminal works that built the foundation for more recent frameworks and models to be created and tested.

The evolution of behavioral change theory. One of the oldest theories of behavioral change is the diffusion of innovation theory, which was originated by Rogers in 1962. This particular theory focuses on explaining how ideas spread throughout a population to cause adoption of new ideas and behaviors. According to this particular theory, behavioral change is more likely to occur when people engage in discourse pertaining to those ideas, and when they observe those behaviors (Green et al., 2019). The transtheoretical model of behavioral change, originated by Prochaska in 1979, assumes that behavioral change occurs through a series of cognitive stages known as contemplation and preparation (Green et al., 2019). Therefore, the role of communication and cognitive processing impact human behavior.

In addition to the role of communication and cognition, Fishbein & Ajzen proposed a behavioral change theory known as the theory of reasoned action in 1975. This particular theory focused on the relationship between attitudes, behavioral intentions, and actual behavior. As such, this theory considers the specific role of intentions in human behavior, and posits that behavioral intention is a function of one's attitude and his or her subjective norms (Madden et al.,

1992). In 1991, Ajzen added perceived behavioral control to this model, creating an updated model known as the theory of planned behavior (Madden et al., 1992).

Each of the theories outlined above have contributed to the landscape of behavioral change theory. In combination, these theories highlight the importance of considering communication, cognitive processing, social norms, attitudes, behavioral intentions, and perceived behavioral control when attempting to explain or cause behavioral change. Therefore, it is plausible that combining many of these dimensions into one model may prove to be more effective at explaining behavioral change.

Theory of change for biodiversity conservation. In an effort to build upon prior behavioral change theories, Green et al. (2019) conducted a meta-analysis on the pre-existing literature where various models were tested empirically using path analysis. The researchers analyzed questionnaire data from 84 targeted social marketing campaigns that spanned across 18 countries. In their analysis, they tested models with varying levels of theory integration with the final model containing seven indicators of behavioral change, which included knowledge-systems, knowledge-solutions, attitudes-barrier removal, attitudes-benefits, attitudes-norms, interpersonal communication, and intention.

The results indicated that the full model, which incorporates aspects of multiple theories, yielded the best fit to the data (CFI = 0.95) and explained the most amount of the variability (R2 = .71). These results suggest that future marketing campaigns should focus on the comprehensive set of behavioral variables to be most effective. As such, outreach efforts need to consider a combination of intervention strategies that can include educational programs to build awareness in addition to more strategic initiatives aimed at community norms, values, communication, perceived benefits, and openness to behavior modification. Another insight from the study indicates that changes in knowledge have a reciprocal and reinforcing relationship with interpersonal communication suggesting that campaigns with opportunities for interpersonal communication may be particularly effective.

Importance of Messaging and Context

Messaging is one of the primary considerations when designing a social campaign aimed towards eliciting behavioral change, and conservation-related campaigns must leverage validated

behavioral change theories and marketing strategies to maximize their effectiveness (Kidd et al., 2019). For example, Taufique et al. (2016) conducted a survey research study and found that environmentally-related marketing strategies should focus on specific environmental issues along with more general environmental concerns to increase their effectiveness. Therefore, the message being sent should focus on a specific issue, such as habitat destruction due to factory farming, to help elucidate the problem. In this way, the target population can connect a specific cause to a specific effect. Unfortunately, research indicates that when it comes to conservation messaging, adoption of behavioral change theories and marketing strategies is lacking, and therefore efforts to change behavior to be more eco-friendly are not meeting their full potential.

In addition to messaging, context is an important component of the strategy as well. Specifically, understanding your target population's characteristics and prior experiences will be critically important when developing your message and your delivery approach. Richter & Klöckner (2017) indicate the need to consider prior behaviors and habits, situational conditions, and socio-economic conditions in combination with the behavioral variables featured in the model proposed and evaluated by Green et al. (2019). Similarly, Alcock et al. (2020) found a significant positive effect of recreational nature visits on pro-environmental behavior. These results were consistent across all segments. Therefore, prior experiences and exposure are critical factors to consider as part of the context and campaign strategy.

Another example of the importance of context is provided by a secondary analysis (Shutay, 2019) conducted with data from a study pertaining to local residents' attitudes toward elephant conservation (van de Water & Matteson, 2018). Specifically, it was found that having no experience with elephants (positive or negative) is associated with a lower tolerance level of elephants than having negative experiences. This finding could suggest that those without exposure to elephants are less likely to feel a sense of care for such animals. Perhaps education might be most beneficial for this population. Those with only negative experiences were most likely to have conditional tolerance, which makes sense since they require mitigation strategies to minimize the conflict. Those with some positive exposure were most tolerant, particularly those with higher incomes. Perhaps ecotourism, participation in conservation efforts, and/or providing resources to protective areas such as water could be most effective for this group.

Developing a Comprehensive Strategy

Based on the review of the literature, it is clear that future models for designing and implementing behavioral change must consider multiple behavioral and social variables associated with behavioral change models in addition to marketing strategies. Campaign designers must understand the characteristics and prior experiences of their target population, and their approach for reaching that target population will likely be moderated by those characteristics and experiences. Characteristics such as culture, social norms, and socio-economic status are important factors to consider.

As a result of the synthesis of the literature, and as an attempt to help guide future campaigns, I propose a methodological framework for designing and implementing social change campaigns. This proposed approach contains four phases and is based on the assumption that those designing and implementing a campaign have the collective expertise pertaining to the conservation issue at hand, marketing strategies, and research methodology.

The first phase of the process is to specify the campaign goals and objectives, which includes creating a logic model (Corporation for National & Community Service, n.d.) where you connect the problem statement to the inputs, outputs, and outcomes of the campaign. You will need to identify your key performance indicators (KPI) and operationally define them so that they are measurable. For example, if a KPI is to get people to commit to buying only from sustainable sources, you will need to include that as a metric to measure and monitor. The short-term outcome could be a percentage of people switching to sustainable sources. Defining the KPIs means that you will need a way to verify these outcomes, which could be as simple as asking people to provide their level of confidence that they will change their behavior to only purchase from sustainable sources, or it could be as complex as asking people to provide specific details about their purchasing behavior over time. The trade-off here is that the more information and involvement you require from participants, the more rigorous your campaign will be, but the less likely people will be to participate in your campaign. The long-term outcome could be a reduction in factory farming demands. While it may seem attractive to include decreased deforestation and carbon emissions entering the atmosphere as a long-term KPI, it might not be practical to measure this, particularly in the time frame specified within your campaign.

The second phase pertains to designing your campaign strategy. In this phase, your messaging strategy and the context in which your campaign is grounded are considered. To determine your strategy and context, you will need to collect information on your potential target audience, which should include demographic information, prior experience and knowledge, and attitudes and behaviors relating to your topic of interest. This might require leveraging archival information as well as collecting survey data. Once this information is collected, you will segment your target population so that your message is tailored based on the characteristics of each segment. If a particular segment has no prior experience with the species of interest, perhaps providing a short video in the beginning of the campaign would be helpful. For those people who have likely already bought into your cause based on their profile, you may want to focus more on teaching them how to influence those within their network. Therefore, you may have different KPIs for different segments. Also, as part of phase two, you will want to make sure that you connect the issue to the target population in a personal way. The target population should understand how the topic of interest will impact them personally. Be sure that you provide a specific example in addition to providing a more general framework for your campaign. For example, if your cause pertains to deforestation, you could highlight the impact of factory farming on deforestation and then connect factory farming to meat and dairy consumption, which is within the participants' direct behavioral control; it is important that you target behaviors in which participants have a perception of behavioral control. Finally, you will need to create opportunities for participant discourse.

The third phase is the design of your campaign evaluation. The validity of your campaign should be of utmost concern. Best practices include providing a baseline or benchmark metric in which to compare. In an ideal world, you would want to have both an experimental and a control group with baselines for each. The control group would get a standard campaign message and your experimental group would receive the tailored campaign message based on segment assignments. You would compare the two groups based on your specified KPIs.

The fourth and final phase is to launch your campaign and monitor its performance. This phase will require you to collect data for your KPIs and assess the extent to which your campaign results in the expected changes. Since some of the goals of the campaign may be

associated with long-term effects, you will likely need to monitor some of your metrics over time. In this final phase, it is of utmost importance that you are able to present the results in a way that is consumable to your key stakeholders including your funding organizations and individual donors. It is recommended that you provide visualizations via dashboards that tell a comprehensive and powerful story. You need to do more than simply state the number of people who responded to your campaign by sitting on a call or webinar; you need to show that action was taken as a direct result of your campaign.

Conclusions

Biodiversity loss is a significant and growing problem that has tremendous implications for our environment and quality of life (Barnosky et al., 2011; Mannion et al., 2014). Humans play a significant contributing role in biodiversity loss through their behaviors and outputs (O'Bryan et al., 2017; Roberts et al., 2020). The primary mechanisms by which humans degrade the environment and therefore cause biodiversity loss include destroying habitats exploiting resources, causing climate change, and introducing invasive species to new ecosystems (Allen et al., 2009; Brook et al., 2008; Green et al., 2019; O'Bryan et al., 2017; Richter et al., 2020). The resulting decline in biodiversity directly impacts our ecosystem resources (Richter et al., 2020) and can lead to significant social conflict (Brashares, 2014). Methods for reducing these trends call for social and behavioral change.

One common method for invoking social and behavioral change is to launch a social campaign, and conservation-related campaigns must leverage validated behavioral change theories and marketing strategies to maximize their effectiveness (Kidd et al., 2019). For example, the campaign should focus on the comprehensive set of behavioral variables that are represented in behavioral change theories to be most effective. As such, outreach efforts need to consider a combination of intervention strategies that can include educational programs to build awareness in addition to more strategic initiatives aimed at community norms, values, communication, perceived benefit, and openness to behavior modification. In addition to messaging, context is an important component of the strategy as well. Specifically, understanding your target population's characteristics and prior experiences will be critically important when developing your message and your delivery approach.

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