Quantifying the Long-Term Impact of Zoo and Aquarium Visits on Biodiversity-Related Learning Outcomes

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ABSTRACT

Zoos and aquariums aim to achieve lasting impact on their public audiences' awareness of biodiversity, its value and the steps they can take to conserve it. Here, we evaluate the long-term educational impact of visits to zoos and aquariums on biodiversity understanding and knowledge of actions to help protect biodiversity. A minimum of two years after completing a repeated-measures survey before and after visiting a zoo or aquarium, the same participants were invited to take part in a follow-up online survey. Despite the small number of respondents (n = 161), the study may still represent the best available quantitative evidence pertaining to zoo and aquarium visits' long-term educational impact. We found that improvements in respondents' biodiversity understanding from pre- to post-visit levelled off, staying unchanged at the follow-up survey point. In contrast, the improved knowledge of actions to help protect biodiversity from pre- to post-visit showed further improvement from post-visit to delayed post-visit follow-up survey. These results suggest that the immediate positive effects of a zoo or aquarium visit may be long-lasting and even lay the groundwork for further improvements over an extended period of time following the visit.

Keywords: aquarium; biodiversity; education; impact; visit; zoo

INTRODUCTION

Target 1 of the Aichi Biodiversity Targets within the United Nations Strategic Plan for Biodiversity 2011–2020 (https://www.cbd.int/sp/targets) calls for action to ensure that "by 2020, at the latest, people are aware of the values of biodiversity and the steps they can take to conserve and use it sustainably". Committed to providing environmental education [Barongi et al., 2015], the world's zoos and aquariums are well positioned to marshal the more than 700 million annual visits [Gusset and Dick, 2011] they receive to support achieving this target. The World Association of Zoos and Aquariums (WAZA) is an official partner of the Convention on Biological Diversity (CBD) during the Decade on Biodiversity to support its aims.

While recent studies have shown the learning impacts zoos and aquariums can foster globally (e.g., Wagoner and Jensen, 2010, 2015; Jensen, 2014; Moss et al., 2015), there are no published longitudinal studies that track zoos' and aquariums' learning impacts at the individual level over an extended period of time. Given the long-term nature of change that is required to establish a more environmentally sustainable world, such long-term impact is a key interest. The present study builds on a previous repeated-measures impact evaluation that assessed differences between zoo and aquarium visitors' pre- and post-visit biodiversity understanding and knowledge of actions to help protect biodiversity. The study found that aggregate knowledge of biodiversity and pro-conservation actions both significantly increased during zoo and aquarium visits [Moss et al., 2015]. In other words, zoos and aquariums were shown to be making a contribution to achieving Aichi Biodiversity Target 1.

Following on from this on-site survey, we invited participation in a delayed post-visit follow-up survey via e-mail. The aim of this online follow-up survey was to evaluate to what extent participants retained their understanding of biodiversity and actions to protect it that they evidently acquired over the course of their zoo or aquarium visit.

METHODS

Pre- and post-visit surveys were designed to measure two dependent variables (biodiversity understanding and knowledge of actions to help protect biodiversity) and to evaluate any change in individual participants over the course of their zoo or aquarium visit. The survey was designed as a repeated-measures instrument (i.e., the same participants were measured twice, with the same pre- and post-visit outcome measures). To measure biodiversity understanding, we asked respondents to list anything that came to mind when they thought of biodiversity (space for up to five responses provided). To measure knowledge of actions to help protect biodiversity, we asked respondents to think of an action they could take to help save animal species (space for up to two responses provided) (for detailed methods, see Moss et al., 2015).

In short, the pre- and post-visit survey was designed to be distributed on paper by staff members and self-administered by respondents. It included a pre-visit component (administered at the zoo or aquarium entrance) and a post-visit component (administered at the zoo or aquarium exit) for the same participants. Potential survey respondents – visitors ≥10-year-old – were selected using systematic sampling (every *n*th visitor) or on a continual-ask basis (once one survey response was completed, the next visitor to cross an imaginary line was selected as the potential next respondent). Surveys were administered from 1 November 2012 to 31 July 2013. Twenty-six WAZA member organizations from 19 countries around the globe participated. The total number of valid surveys received across participating institutions was 5,661.

Following on from the pre-and post-visit surveys conducted at the zoo or aquarium, those participants who had indicated their e-mail address (n = 1,640) were contacted during August 2015 to complete a follow-up survey. The time elapsed since completing the on-site survey was a minimum of two years. This online survey (made available in eight languages) was again designed to measure our two dependent variables (see above) and to evaluate any change in individual participants over the time following their zoo or aquarium visit. Overall, 161 participants took part in the survey at all three data collection points, and we restricted our analysis to these data. The follow-up survey sample included 67% women and 33% men, with a mean age of 37 years (range 12 to 71).

The qualitative data gathered to measure the two dependent variables on the three occasions were subjected to content analyses to provide quantitative data suitable for statistical analyses (for detailed methods, see Moss *et al.* 2015). In short, scales for both dependent variables were developed based on the range, type and content of responses. The maximum score per survey response was 10 for both dependent variables. Once quantified, we used repeated-measures linear mixed models with participating institutions as a (categorical) random effect factor. The restricted maximum likelihood method was used to estimate variance

components. All statistical tests were two-tailed, had a significance level of $P \leq 0.5$, and were conducted with IBM SPPS Statistics 22.

RESULTS AND DISCUSSION

A comparison of pre-visit, post-visit and delayed post-visit follow-up survey results for the two dependent variables shows significant increases from pre- to post-visit in the 161 participants who took part in the survey at all three data collection points (Fig. 1): biodiversity understanding ($F = 3.026$, $P = 0.050$) and knowledge of actions to help protect biodiversity ($F = 11.271$, $P < 0.001$). The restricted sample in the present study thus mirrors the educational impact findings for the overall study population [Moss et al., 2015].

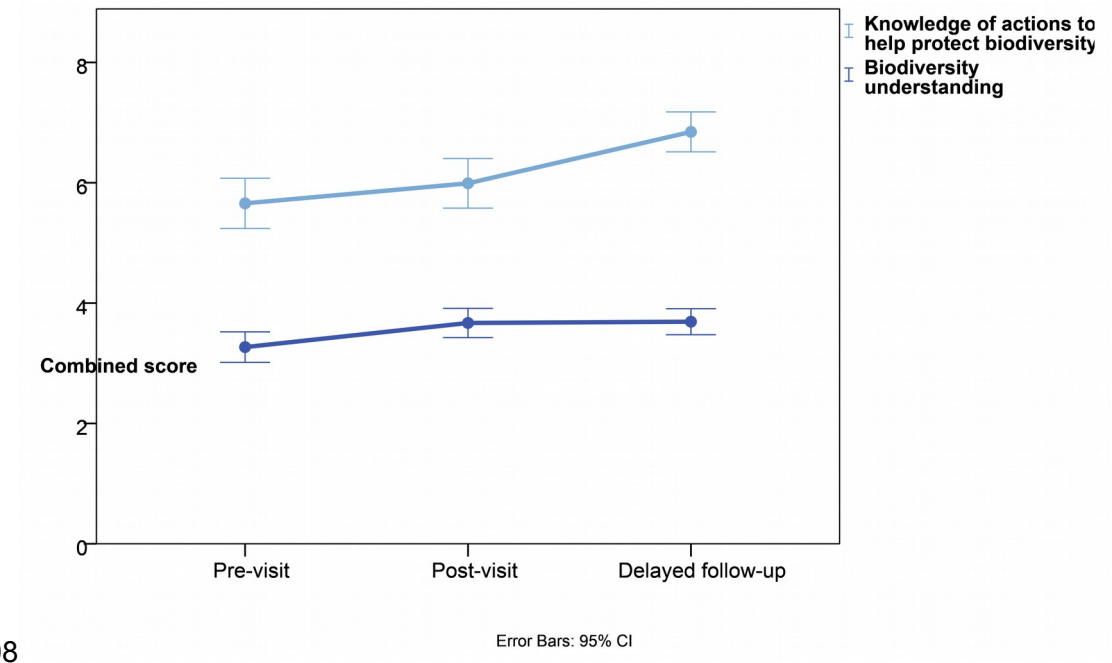

Fig. 1. Comparison of pre-visit, post-visit and delayed post-visit follow-up survey results for the two dependent variables – biodiversity understanding and knowledge of actions to help protect biodiversity (combined scores on 10-point scales; values in boxes indicate mean scores).

While the level of biodiversity understanding remained steady, the level of knowledge of actions to help protect biodiversity increased significantly from post-visit to delayed post-visit

follow-up survey (Fig. 1). This pattern is indicative of a possible "sleeper effect" (e.g., Kumkale and Albarracín, 2004). One way this might have worked is that the experience during the zoo or aquarium visit primed respondents to pay greater attention to information about pro-conservation actions available through other communication channels when they returned to their normal lives. That is, the zoo or aquarium visit may have laid the foundation for future growth in practical knowledge of pro-conservation actions.

We now turn to our study's primary limitations. As is common with longitudinal research, attrition in participation was substantial. However, the fact that our analysis focuses on tracking learning outcomes for the same individuals over the entire study period mitigates concerns about sampling bias due to attrition in study participation (e.g., Jensen and Lister, 2016). This is because all data in the present study are drawn from individuals who participated in the survey at all three data collection points: pre-visit, post-visit and delayed post-visit follow-up survey.

Another concern in longitudinal research is the possibility that confounding variables might explain the patterns that are uncovered in a follow-up survey (e.g., Dawson and Jensen, 2011). This means that the present study is only able to demonstrate that the data from the delayed post-visit follow-up survey are consistent with a pattern of long-term impact; the attribution of the outcome patterns we have identified is not definitive. For example, respondents may have visited more zoos and aquariums since completing the on-site survey; we previously showed that in the overall study population, repeat visitors have better biodiversity-related knowledge [Moss et al., 2016].

Nevertheless, the persistence, and even improvement, of the aggregate learning outcomes 2+ years after the zoo or aquarium visit is a surprising and promising finding. These results suggest that the immediate positive effects of a zoo or aquarium visit may be long-lasting and even lay the groundwork for further improvements over an extended period of time following the visit. In addition to the educational impact realized over the course of a zoo or aquarium

visit [Moss et al., 2015], such a long-term impact may further support achieving Aichi Biodiversity Target 1.

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177**Figure Legend**

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