Biodiversity knowledge loss in children's books and textbooks

Culture is a complex dimension of global environmental change (Proctor 1998; MA 2005). Loss of local knowledge about the environment is both a cause and consequence of cultural homogenization worldwide and threatens present and future conservation efforts (Miller 2005; Rozzi 2013). Children are especially susceptible to cultural homogenization because of their decreasing interaction with nature and their growing connection with visual electronic media (Pergams and Zaradic 2006; Soga and Gaston 2016). Here we examine a comprehensive sample of children's books (school textbooks as well as fictional and natural history storybooks) to assess their role in providing school-aged children with information about their local environment and native biodiversity (Cutter-Mackenzie *et al.* 2010).

A key driver of biodiversity knowledge loss, one that is also associated with cultural homogenization, is the biased perception children have of their home environments and local biota, received from the media, including literature, television programs, computer games, and the internet (Pergams and Zaradic 2006; Wason-Ellam 2010). Loss of knowledge about local biodiversity and wild nature has become widespread (Ballouard *et al.* 2011), especially in Latin America, since the mid-20th century (Zent 2009; Rozzi 2013). This process can be exacerbated by deficient information about local nature provided to schoolchildren through the literature available in formal and non-formal educational settings. To assess the relevance of books in enhancing or detracting from children's knowledge about nature in their area, we reviewed 1242 children's books (both fiction and non-fiction) that were marketed in Chile and that contained stories based on natural history or presented drawings or photographs of plants and animals in wild landscapes. Our sample was obtained from the 2012 International Children's Book Fair that took place in Santiago, Chile, and included only books in Spanish, some of them with a broader distribution in Latin America and Spain (WebTable 1). We asked how frequently and in what form local biodiversity and their environments were portrayed in the sampled literature. We sought to quantify biases toward native or exotic examples of flora, fauna, and landscapes, thus providing a baseline for future analysis. With this letter, we hope to stimulate additional research about the potential drivers of biodiversity knowledge loss and cultural homogenization.

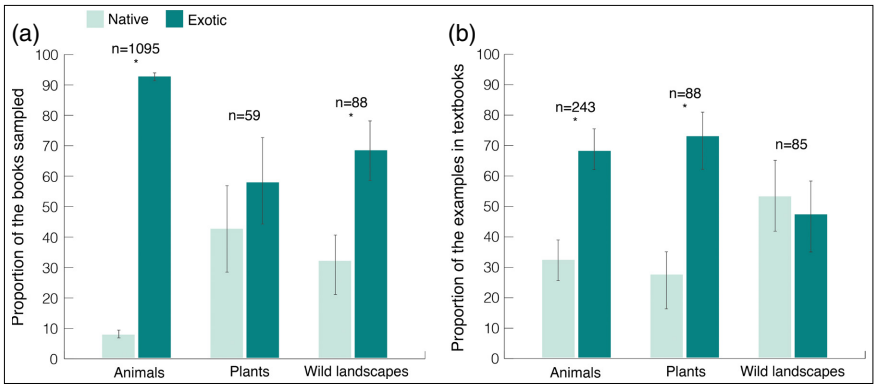

Figure 1. *Classification of (a) recreational storybooks and (b) natural science school textbooks – read by children in Chile – according to the types of plants, animals, or wild landscapes that they illustrate. The sample includes 1242 recreational books displayed at the International Children's Book Fair, Santiago, Chile, in August 2012 (http://camaradellibro.cl/ferias/feria-del-libro-infantil-juvenil) and 12 required-reading school textbooks. In (a), bars are proportions (±95% confidence intervals [CIs]) of the children's storybooks classified in the different groups. In (b), bars are proportions (± 95% CIs) of the number of plant, animal, and landscape examples shown in natural science school textbooks. Numbers above the bars indicate sample sizes (n), and asterisks denote statistically significant differences (P << 0.01) in the representation of native versus exotic species and environments. Statistical differences are based on the sign test (Sheskin 2004).*

We grouped the sample of books into three non-exclusive categories, depending on whether the storyline included plants, animals, or wild landscapes. Books were further divided into two groups, based on whether the plants, animals, or landscapes pictured were native or foreign to Chile. We report the proportions of the total number of books classified in each category. We also inspected required-reading textbooks on natural science, which are recommended by the Chilean Ministry of Education for children from preschool (kindergarten) to high school. In each of these textbooks (n = 12), we tallied and analyzed the specific examples of plants, animals, or wild landscapes shown. Overall, these 12 textbooks included 88 examples of flora, 243 examples of fauna, and 85 examples of wild landscapes. We report the percentages of examples of native or exotic wildlife and environments.

Regarding the subjects of the storybooks, exotic species or landscapes appeared more frequently (89%; 1106 out of 1242) than native biodiversity or environments. Only 7.6% (83 out of 1095) of the children's books depicted native fauna. Also, these books mostly depicted exotic plants and foreign wild landscapes or natural scenarios (Figure 1a). Among the 12 textbooks (Figure 1b), 67.9% (165 out of 243) of the represented animals and 72.7% (64 out of 88) of the represented plants were exotic. Although 52.9% (45 out of 85) of the landscapes shown in textbooks were native, this value was not statistically

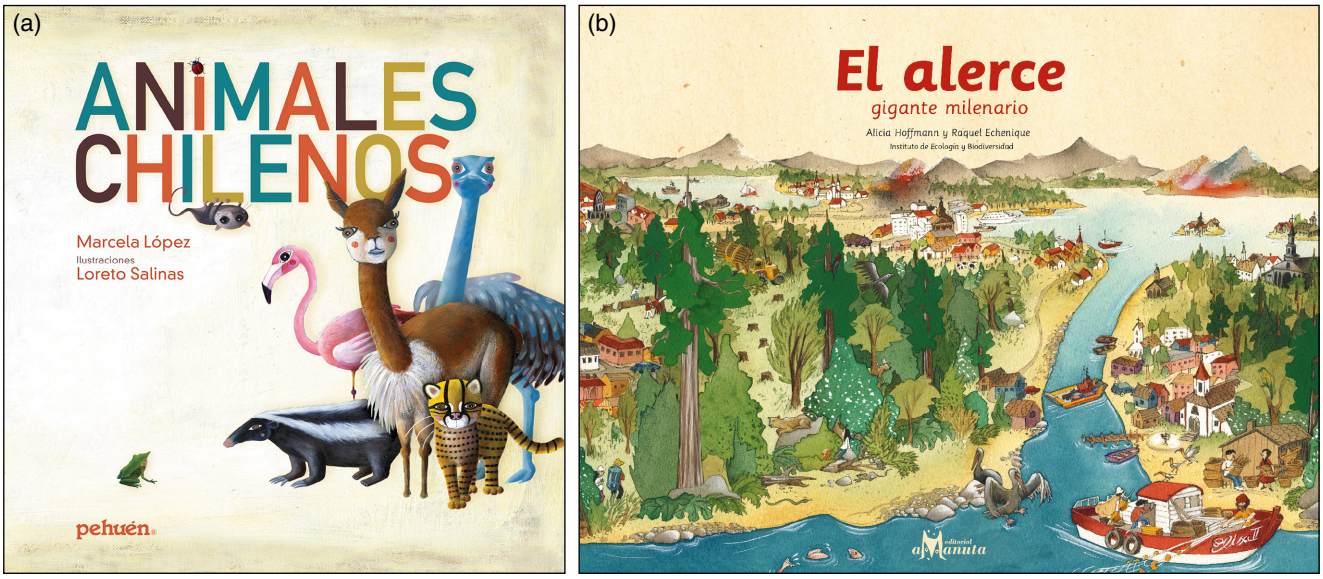

Figure 2. *Two selected examples of children's books that illustrate native Chilean fauna and flora: (a) "Animales Chilenos" (Chilean animals) by Pehuen Publishers (2010) and (b) "El Alerce" (Patagonian cypress) by Amanuta Publishers (2011). Both publishers have a strong focus on native biodiversity. Reproduced with permission.*

different from the proportion of exotic environments (Figure 1b).

We have shown that native biodiversity and wild landscapes are poorly represented in the available literature from which parents must choose their children's readings. Textbooks and books for recreational reading were similar in this regard. Children's stories were most often about exotic animals (both domestic and wild) whose native ranges occur in the Northern Hemisphere or in Africa (WebTable 2). This finding is especially problematic in the case of textbooks because children in schools learn more about exotic natural systems than about local biodiversity.

Despite the existence of publicly funded outreach programs in Chile since 1985 (WebPanel 1) and the recent growth of scientific outreach activities both from inside and outside of academia, coordination regarding the ecological content of children's books is still poor. Twenty years ago, less than 20% of the examples described in textbooks were of native plants or animals (Rozzi *et al.* 2000). Today, this figure has increased only slightly (up to 30%). The strong bias toward exotic flora, fauna, and environments in children's books constitutes an additional threat to the persistence of local culture and knowledge of wild native ecosystems, with far-reaching implications for conservation efforts and children's appreciation of local biodiversity (Ballouard *et al.* 2011; Zhang *et al.* 2014). In recent decades, children are becoming less likely to have direct contact with nature (Louv 2005; Soga and Gaston 2016), while at the same time being exposed to a biased sample of biodiversity in books, usually dominated by exotic species, which may curb children's knowledge and concerns about local biodiversity (Ballouard *et al.* 2011). Consequently, the challenge for the media, including publishers, is finding new ways to foster children's emotional affinity with nature to complement but not replace the healthy benefits of outdoor experience (Louv 2005). Greater collaboration among local scientists, publishers, educators, and illustrators should be strongly encouraged to expand the few existing examples of good practices (Figure 2). The creation and publication of new and more region-specific natural science books based on knowledge of local biodiversity is urgently needed if we are to revert this process (Primack 2013).

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Supporting Information

Additional, web-only material may be found in the online version of this article at http://onlinelibrary.wiley.com/doi/10.1002/fee.1324/suppinfo

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