Appendix A – Copy of the paper: "Conserving desert biodiversity through ecotourism"

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Opinion piece

Conserving desert biodiversity through ecotourism

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abstract

Deserts are often neglected in what concerns conservation funding. Ecotourism, an alternative land-use with ability to preserve threatened biodiversity, is also less developed in these arid lands. Since ecotourism can constitute a complementary approach to natural and cultural resources and to local economy development, more investment should be allocated to desert ecotourism research. Particularly in sites where few alternatives remain to sustain the livelihoods of poor communities. Some key issues on desert ecotourism are discussed here. More research on this particular topic is needed.

It has been shown that ecotourism preserves threatened biodiversity and enhances local economies in remote regions (Buckley, 2009). Ecotourism is the fastest growing segment of tourism, generating annual revenues of more than US $28 billion for developing countries (Kirkby et al., 2011). These estimations are much higher than previously predicted by Goodwin (1996) for the 2000s.

Some of the most remote regions are located in deserts, often perceived as bared lands with no life. This misconception is so generalized worldwide that little conservation funding has been allocated for deserts in the last years (Durant et al., 2012). Ecotourism is underdeveloped in deserts, whereas forests and savannahs are preferred (Krüger, 2005). Though several desert attractions and incentives have been proposed by Weaver (2001), the reality is that few tour enterprises have invested in these areas to date. However, desert ecosystems need alternative land-uses to decrease poverty (6% of the world's population live in deserts in poor conditions; United Nations Development Programme, 2014) and to preserve their natural and cultural heritage. This short communication constitutes a call for ecotourism research in deserts.

Deserts show several advantages for ecotourism development (Brito et al., 2014; Vale, Pimm, & Brito, 2015). They are often unaltered by human activities and intervention (an exception goes for Las Vegas). They also offer tourists a broad viewing range, which enhances visual encounters with desert animals, especially in sparsely vegetated and tree uncovered areas (Weaver, 2001). Some of these desert species are among the most endangered worldwide (Durant et al., 2012), which attract very specialized tourists. Several unique attractions justify the development of ecotourism activities within deserts: exceptional geological features (e.g. sand dunes, mesa, alluvial fans, and playas); unique desert flora that blooms quickly in rainfall periods and ancient or unusual vegetation (e.g. the 2000-year-old Welwitschia mirabilis plants endemic to Namib desert and the giant saguaro cacti native to south-western USA); and sparsely dispersed oases. Also, unique forms of trekking (e.g. Tuareg camel trek in Sahara) and the link of indigenous inhabitants to the surrounding environment (e.g. the Aborigines of Australia's arid land or the Bushmen of the Kalahari Desert) might be of high interest for international tourists (Weaver, 2001).

Ecotourism can help regenerate desert ecosystems, helping to mitigate the potential negative impacts of desert activities. Of particular interest is one case study provided by Ryan and Stewart (2009) on Al Maha, a luxury resort in Dubai. There, ecotourism is so successful that the plant cover is now greater than ever before and previously extinct animal species are now occupying the region. The resort is a major contributor to the local finances, which helps conservation efforts. Al Maha shows that the best opportunities for desert environmental regeneration lay on commercial nature-based tourism. Al Maha is one of those examples able to disrupt the misconception of deserts being bare lands with no life or interest to visit. This is also supported by Reichel, Uriely, and Shani (2008), who found that nature, landscape and desert ancient cultures are highly desired attractions, though poorly developed and publicised. However, few desert ecotourism studies are available in the literature (Table 1), which constitutes a major barrier to the prediction of economic revenues provided by this alternative land-use to deserts.

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Table 1
Number of publications found in scientific databases by searching for desert and tourism-related keywords. Note that there are many publications related to tourism and desert subjects, but very few concerning both topics.

Database	Keywords				
	Tourism	Ecotourism	Desert	Tourism + desert	Ecotourism + desert
Google Scholar	1,980,000	145,000	1,510,000	78,200	8840
ISI Web of Knowledge	55,617	2123	93,501	134	14
ScienceDirect	55,831	4812	99,729	152,559	104,071
Scopus	48,739	4004	47,602	201	304

Desert ecotourism is best represented in the USA and Australia, where protected areas (such as the Grand Canyon and Simpson Desert, respectively) have been long established in deserts. However, the Sahara and Arabic deserts receive less annual visitors compared to the former. One of the main reasons for this happening is their little protected area network combined with the lack of ecotourism facilities to accommodate people and the rudimentary transportation network found in these deserts (Brito et al., 2014; Reichel et al., 2008; Weaver, 2001). Terrorism, wars, kidnappings, leakage of incomes and poor economic situations can also compromise the establishment of ecotourism or any other land-use in deserts (Brito et al., 2014).

As the world's protected areas receive about eight billion visits each year, with an associated expenditure of US $600 billion (Balmford et al., 2015), networks of desert protected areas should be increased in the following years in order to attract more international tourists able to expend large amounts of money. This money can ultimately be allocated to desert biodiversity preservation (Brito et al., 2014). Environmental, social and cultural impacts may be accessed in the specific context of deserts, but in regions where so few opportunities are available to the poorest communities, ecotourism can be an incentive to create local employment opportunities and to decrease poverty (Kiss, 2004). Ecotourism can lead to the abandonment of activities that may threat habitats, species and even locals (Krüger, 2005). This assumes a special relevance in the specific context of deserts, where poaching, logging, unmanaged agriculture, and other forms of habitat and species disturbance have been compromising natural and cultural resources (Brito et al., 2014).

Local governments should be aware of unstable geopolitical issues. Cooperation between stakeholders is crucial to avoid third parties (e.g. rebels and terrorists) from corrupting ecotourism and conservation goals in deserts, especially in the Saharan and Arabian deserts. Climate change may also challenge the success of desert ecotourism and biodiversity conservation in the future, with recent estimations pointing out desert ecosystems facing the highest velocity in temperature changing (Loarie et al., 2009). It is crucial to address this issue in future desert ecotourism research. One important change worth mentioning is the shift of the desert fauna commonly publicised, with images of dangerous reptiles and arachnids being usually used (Weaver, 2001), which can drive people away from deserts. There are plenty of other group animals suitable for ecotourism campaigns, such as large carnivores and antelopes endemic to these arid regions that can attract more interest than the former (Belbachir, Pettorelli, Wacher, Belbachir-Bazi, & Durant, 2015). The selection of suitable flagship should be further researched.

Whether ecotourism is able to reduce poverty and preserve biological resources across deserts is of urgent concern. For now, it cannot be viewed as a panacea. But, if it is developed sustainably, it will change the current paradigm in deserts. The lack of ecotourism studies with rigorous quantitative data (Kiss, 2004), especially in desert ecosystems, affects our knowledge upon what to do in the field. A key issue within this context is to address the goals of different policy makers, which goes from protecting fragile ecosystems to engaging people in a balanced economic development and promoting a long-term ecotourism stability.

If well managed desert ecotourism will benefit threatened biodiversity as well as the economy of rural communities, constituting a complementary approach to conservation planning policies. It may also be responsible for proclaiming desert wildlife and its evolution, cultures and histories, and desert unique life forms to the world. If desert ecotourism thrives, it is likely that the image of a sterile desert, with no life and no cultural interest, may be counteracted. Future ecotourism development in deserts should be contextual and take into account the specificities of the region.

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