Project

AN EDUCATIONAL VIDEO GAME TO FOSTER COEXISTENCE: OPERATION FERDINAND

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1. Introduction

Across many African countries, human-carnivore conflict often takes the forms of livestock depredation and human safety risk, resulting in famers incurring high livelihood and wellbeing costs (Ripple et al., 2014). In the Serengeti, pastoralists have reported that depredation costs have amounted to up to 19% of their annual cash income (Holmern et al., 2007).

Ideally, conflict mitigation tools should aim to benefit both carnivore conservation objectives and the goals and needs of local farmers who live with wildlife (Loveridge et al., 2017; Sibanda et al., 2020). While many examples of carnivore conservation programmes exist, many use in-person delivery models such as workshops and one-on-one training to engage audiences (Lichtenfeld et al., 2015; Morehouse et al., 2020; Sibanda et al., 2020). However, new ways of engaging people to reduce the risks of living with carnivores are unfolding. This includes the use of game-based learning platforms (Dunn and Vermissimo, 2020).

2. Game-based learning

Conservation education is often used to build awareness and encourage change in wildlife-related attitudes and behaviours (Jacobson et al., 2006). A cornerstone of conservation education programmes is contextually-relevant information presented to learners in an engaging way (Hughes et al., 2013; Jacobson et al., 2006). In engaged forms of instruction, learner involvement in the content is central to the approach (de Jong, 2019). This includes learners performing meaningful activities by modifying or elaborating content (e.g. interpreting, exemplifying, classifying, inferring, differentiating or organising) and reflecting upon it individually or in discussion with others (Prince, 2004). This enables learners to build deeper comprehension and also interest beyond the content to which they are exposed (de Jong, 2019). Elements of engaged learning include focused goals, novelty and variety, and immediate affirmation of learning performance (Dickey, 2005).

Educational video games are one way of promoting engaged learning, as they incorporate a series of learning principles that promote interactive problem-solving as well as a medium to disseminate facts and encourage analysis and reflection through game-play (Dickey, 2005; Egenfeldt-Nielsen, 2006; Gee, 2003). Boyle et al. (2015) conducted a literature review that identified the positive impact of educational video games, with knowledge acquisition as the most frequent outcome. This can bode well for using game-based learning to teach human-wildlife conflict mitigation methods, to promote better understanding of the ecosystem effects of removing carnivores and to encourage pro-conservation behaviours (Bachen et al., 2012; Dunn and Verissimo, 2020). With this in mind, we created an interactive, pictorial, educational video game as a means to prevent conflict between farmers and carnivores in the Niassa National Reserve (NNR) in northern Mozambique.

3. Human-carnivore conflict in Niassa National Preserve

The NNR is one of the largest protected areas in Africa, covering 42,000 km^2 (Fig. 1). NNR is one of only ten strongholds of African lions (*Panthera leo*) in the world and also has more than 350 African wild dogs (*Lycaon pictus*) as well as leopard (*Panthera pardus*) and spotted hyena (*Crocuta crocuta*) populations (NCP, 2016). Importantly, NNR supports more than 4,000 people across 42 villages inside the protected area (Riggio et al. 2012).

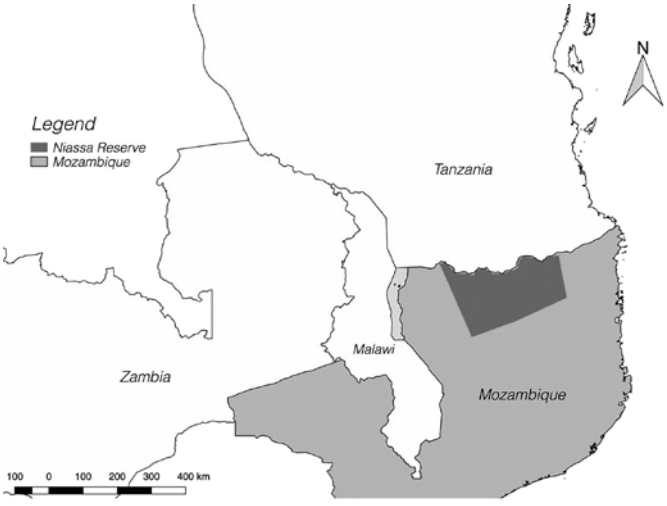

Fig. 1 Niassa National Reserve, Mozambique.

Fig. 2 African lion (*Panthera leo*) in Niassa Reserve killed by carcass poisoning. *(Photo: Niassa Carnivore Project)*

It is widely acknowledged that large carnivores play key roles in regulating ecosystems (Di Minin et al., 2016; Ripple et al., 2014). However, depredation on livestock often brings carnivores into conflict with human interests. This occurs in rural communities worldwide and involves many species (see Bautista et al., 2019; Guerisoli et al., 2020; Miller et al., 2015; Rashid et al., 2020). In Africa, livestock depredation by lions and leopards inflicts high costs on farmers and poses human safety risks (Löe and Röskaft, 2004).

In retaliation for the threat that carnivores pose to their livelihoods, some people resort to illegal measures, such as direct killing or the use of poison (Fig. 2), which is largely indiscriminate and often kills non-target species including scavengers such as the white-backed vulture (*Gyps africanus*) and black-backed jackal (*Canis mesomelas*) (Macdonald et al., 2010). The removal of scavengers can facilitate the spread of disease and negatively affect ecosystem dynamics, species survival and human health (Markandya et al., 2008). Poisoned livestock carcasses also contaminate the surrounding area, including waterholes (Roxburgh and McDougall, 2012). In turn, this may result in debilitating illness or death of livestock, wildlife or even people who drink poisoned water. Addressing farmer perceptions of carnivores and affecting change in livestock husbandry and predator control practices are therefore necessary steps in order to positively affect human well-being, carnivore populations and broader ecosystem health (Lichtenfeld et al., 2015).

Initiatives to address conflict commonly include in–person training on livestock protection measures such as fencing and guarding animals (e.g. Loveridge

et al., 2017; McManus et al., 2015). While these can be effective, they often require in-depth training sessions with farmers where barriers can include language differences and loss of interest or attention. Since 2003, the Niassa Carnivore Project (NCP) has been working collaboratively with government and non-profit organisations to encourage knowledge and behaviour change as a means to address human-carnivore conflict in the area (NCP, 2016). In this article, we summarise a novel approach to addressing human-carnivore conflict using a video-game based platform.

4. Game development and function

Inspired by climate-related games[1], NCP partnered with G. Fleury, a software engineer and graphic designer, to create a free, downloadable Windows and OS X video game suitable for field conditions, utilising simple graphics to communicate key concepts pictorially. The resulting game, *Operation Ferdinand* (*Op Ferdinand*), was intended to be played by children and adults, with more focus on engaging children in interactive learning for existing environmental education programmes, who in turn would pass on learned information to their parents and wider community (NCP, 2016).

Op Ferdinand aims to increase human safety, reduce livestock loss and improve carnivore and environmental conservation. Its use of pictures rather than verbal or written instruction was to mitigate potential challenges for non-English speaking people or those with lower literacy levels, and with foresight for future use elsewhere, given the diversity of languages and literacy levels across African countries. Pictures for game use were created in Photoshop and PowerPoint, and imported into the free Unity game engine, where the game was coded.

The game exposes players to different scenarios whereby they must select appropriate conflict prevention techniques to avoid detrimental or negative consequences (McManus et al., 2015). Key learning outcomes of *Op Ferdinand* include: the principles of building stronger enclosures for small and mixed livestock to prevent losses to carnivores; identification of predator species (from tracks, scat and killing style) in order to improve nonlethal mitigation efforts by facilitating adaptation of livestock protection measures tailored to the carnivore(s) involved; and a short simulation showing the effects of and alternatives to using poison (Fig. 3).

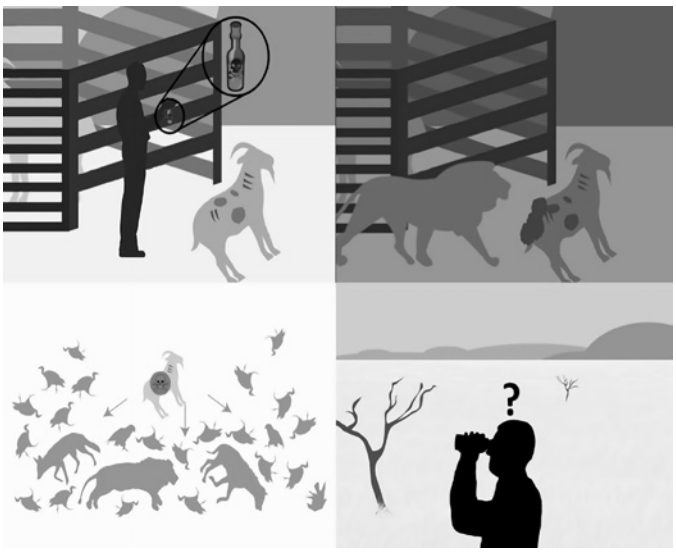

Fig. 3 Graphics illustrating the effects of using poison to address carnivore conflicts.

5. Testing and outcomes

Op Ferdinand was field-tested in June 2017 with 15 local Mozambican children of secondary school age (12–18 years old) from the Mariri village in NCP. The children were allowed to play through the game before providing feedback to facilitators. Responses were positive, with learners describing the game as engaging and easy to understand. Nevertheless, this beta testing phase suggested changes to the game that would improve learner comprehension independent of instructor prompting. This included the addition of a timer to the livestock enclosure section to increase the immediacy of the challenge in selecting prevention techniques; the addition of vulture and lion graphics to show them dying after feeding on a poisoned carcass; and the addition of a human figure collecting water from a poisoned waterhole and subsequently becoming sick. Thanks to these improvements, the game can be played and understood without instructor oversight.

[1] https://www.climateinteractive.org/policy-exercises-and-serious-games/19-climate-games-that-could-change-the-future/

Although *Op Ferdinand* took over a year to complete, it is now a stand-alone program that can be downloaded free of charge[2] and used by multiple groups of learners without additional expenditure. We hope to evaluate its efficacy in three different regions of Africa (Southern, Eastern, Western) with conservation partners that specialise in mitigating human-carnivore conflict.

6. Discussion

Low-complexity video games such as *Op Ferdinand* seem to be well-suited to teaching conservation and conflict mitigation information. Articulating a desired behaviour pictorially can promote better understanding and help learners choose appropriate behavioural outcomes (Cowley et al., 2008). A study focused on environmental education in a primary school classroom demonstrated that perceived ease of use, perceived usefulness, attitudes towards use and intention to use a game reveal a high degree of positive and significant correlations and suggest the possibility for greater learning effectiveness (Cheng et al., 2013). In addition, by working on task-based simulation, educational video games can enable the development of relevant problem-solving skills (Cheng et al., 2013). In our case, this includes prompting players to build effective livestock enclosures to prevent depredation.

Educational video games that use pictures not only make content accessible to non-English language speakers but also mitigate the logistical and financial challenges of tailoring instruction to a host of different language speakers or those with varying abilities (Ke and Abras, 2013; Squire, 2005). The accessibility of *Op Ferdinand* was also enhanced by making it open source. Design costs were minimised largely thanks to the generosity of experts who volunteered long hours of their time to develop the game. The only material costs to NCP were for electricity and use of laptops.

There is considerable potential to implement *Op Ferdinand* with other organisations and communities. The game could be adapted for use outside sub-Saharan Africa and we are currently soliciting such opportunities. For example, typical signs of presence and killing styles of carnivores from other regions could be added to the predator kill identification section. In the meantime, *Op Ferdinand* is available to use as an engaging platform that addresses some of the challenges of coexisting with carnivores within and beyond Africa.

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[2] https://fleurygs3.wixsite.com/brightfrog/projects

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