Institution: University of Oxford

Unit of Assessment: 5 - Biological Sciences

Title of case study: Mitigating human-lion conflict through conservation policy and community-based action

Period when the underpinning research was undertaken: 2000 - 2020

Details of staff conducting the underpinning research from the submitting unit:

Name(s):	Role(s) (e.g. job title):	Period(s) employed by submitting HEI:
Andrew Loveridge	Senior Research Fellow	1999 - Present
David Macdonald	Director of WildCRU	1986 - Present
Amy Dickman	Senior Research Fellow	2009 - Present

Period when the claimed impact occurred: Aug 2013 - Dec 2020

Is this case study continued from a case study submitted in 2014? N

1. Summary of the impact

University of Oxford research on trophy hunting and human-lion conflict in two globally important lion landscapes, in Zimbabwe and Tanzania, has actively informed management policy and conservation approaches at national, regional and global scales. The research has informed government policy on lion conservation in several countries, including Tanzania, Zimbabwe, UK and USA, and contributed to key international conservation (IUCN) guidelines. Strategies from this research have reduced critical conservation threats facing lions, including poorly managed trophy hunting and conflict with humans, in two globally important African lion population strongholds. The livelihoods of local people have been improved through employment, education, healthcare, livestock protection, and food security, as a result of conservation action stemming from the research findings.

2. Underpinning research

African lions (*Panthera leo*) are iconic apex predators vital to ecosystem function. They are also a highly threatened species in need of urgent protection. Lions often share space with vulnerable and impoverished rural people, leading to conflict and serious harm to human lives and livelihoods, and to lions. Research by the University of Oxford Wildlife Conservation Research Unit (WildCRU) centred on two globally significant lion populations in the Hwange (Hwange Lion Research Project, Zimbabwe, started in 1999) and Ruaha (Ruaha Carnivore Project, Tanzania, started in 2009) ecosystems, has aimed to better understand the threats facing both lions and people, and to develop appropriate methods to improve conservation and livelihoods in the following key areas.

Understanding impacts of lion trophy hunting in the Hwange ecosystem
Through the period since 2000, WildCRU studies have monitored the lion populations in this ecosystem, including through tracking animals with GPS and radio collars, which provides extremely detailed information on the movements of this wide-ranging species, along with camera-trapping and spoor (footprint) surveys. Their research has quantified the impact of trophy hunting on lion socio-spatial dynamics, population structure, and age- and sex-specific survival rates [1], revealing that high levels of trophy hunting in Zimbabwe were profoundly damaging to population dynamics, by removing pride males and significantly reducing cub recruitment. Subsequent WildCRU research undertaken from 2005-2012 examined and quantified the effects of altered management regimes recommended by their research [2].

Understanding human-lion conflict in Ruaha and Hwange landscapes
Interactions between lions and human communities frequently lead to conflict and lion killings, which are one of the major threats to the species. Over the past 10 years, WildCRU research has focused on understanding the intensity and drivers of human-wildlife conflict in the Ruaha and Hwange ecosystems. The work in Ruaha revealed the highest documented level of lion killing in East Africa in modern times, with 37 lions killed in 18 months, in less than 500km^2, whilst in Hwange, lion mortalities from conflict situations made up 16% of overall annual adult female

mortality and conflict related snaring contributed 29% of annual mortality, as shown by analysis using data from the GPS radio-collared lions [3]. The University of Oxford research showed that reducing high levels of anthropogenic mortality from these sources would improve conservation outcomes for lions. Investigations into patterns of domestic livestock depredation by lions showed that subsistence agriculture and livestock husbandry practices influence seasonal patterns of livestock loss to large predators, but that herd protection and use of secure traditional night-time livestock enclosures (bomas) significantly reduces livestock loss to predators [4]. In both areas there were very high levels of antagonism towards lions by local people, as lions imposed significant costs and provided few or no benefits, with particular effects on marginalised groups such as traditional pastoralists, women and youth [5]. This research demonstrated that local people wanted lion populations to decline and that cultural factors exacerbated this conflict [5, 6]. These findings highlighted the need for multi-faceted conflict mitigation measures that not only deliver conservation outcomes but also provide conservation education, community benefits and improvements to human welfare and wellbeing [6].

3. References to the research
(University of Oxford employees in bold, Oxford students in italics; citations WoS 03-2021)

1. **Loveridge AJ**, Searle AW, Murindagomo F, **Macdonald DW** (2007). The impact of sport hunting on the population dynamics of an African lion population in a protected area. *Biological Conservation* 134, 548-558. DOI:10.1016/j.biocon.2006.09.010. 198 citations.

2. **Loveridge AJ, Valiex M,** Chapron G**,** *Davidson Z,* Mtare G, **Macdonald DW** (2016)**.** Conservation of large predator populations: demographic and spatial responses of African lions to the intensity of trophy hunting. *Biological Conservation* 204:247-54. DOI:10.1016/j.biocon.2016.10.024. 35 citations.

3. **Loveridge AJ**, **Valeix M**, *Elliot NB,* **Macdonald DW** (2017). The landscape of anthropogenic mortality: how African lions respond to spatial variation in risk. *Journal of Applied Ecology* 54(3):815-25. DOI: 10.1111/1365-2664.12794. 36 citations (WoS 03-2021).

4. **Loveridge AJ**, *Kuiper T,* Parry RH, *Sibanda L,* **Hunt JH, Stapelkamp B,** Sebele L, **Macdonald DW** (2017). Bells, bomas and beefsteak: complex patterns of human-predator conflict at the wildlife-agropastoral interface in Zimbabwe. *PeerJ.* 5:e2898 DOI:10.7717/peerj.2898

5. **Dickman AJ,** Hazzah L, Carbone C, Durant SM (2014). Carnivores, culture and 'contagious conflict': Multiple factors influence perceived problems with carnivores in Tanzania's Ruaha landscape. *Biological Conservation* 178:19-27. DOI:10.1016/j.biocon.2014.07.011. 54 citations.

6. *Western G,* **Macdonald DW, Loveridge AJ, Dickman AJ** (2019). Creating Landscapes of Coexistence. *Conservation & Society.*17:204-17. DOI:10.4103/cs.cs_18_29

Funding included: Robertson Foundation GBP2,000,000 (reference 9907632, 2017-21), DEFRA Darwin Initiative total GBP318,827 (23-18, 2016-19), IUCN SOS (2019-22).

4. Details of the impact
Lions are one of the world's most iconic species, but their population declined by 43% between 1993 and 2014. They remain in less than 10% of their historic range and are classed as vulnerable by the International Union for Conservation of Nature (IUCN). Only 7 countries still have more than 1,000 lions, including Tanzania and Zimbabwe. Where lion populations occur outside protected areas, they live alongside some of the world's most impoverished people (proportion of people in multidimensional poverty is 31% and 55% in Zimbabwe and Tanzania, respectively), and co-existence with wildlife can impose substantial additional costs on these vulnerable communities.

Conservation impacts
International guidance and best practice
The University of Oxford research was instrumental in developing IUCN recommendations on trophy hunting and human-wildlife conflict. The 2018 IUCN Cat Specialist Group publication '*Guidelines for the Conservation of Lions in Africa'* extensively references University of Oxford research, including [1], [2], [3] and [4], and includes a chapter from WildCRU researchers providing guidance to help ensure that where trophy hunting is practiced, it *"minimises the risk of detriment to the population and maximises the chance of effective conservation"* [Ai]. University of Oxford

research contributed to the 2019 IUCN Trophy Hunting Briefing paper (citing [1] and data on lion populations from WildCRU), which provides guidance for responsible international decision-making [Aii]. The researchers also provided recommendations for conflict mitigation developed by the IUCN Human-Wildlife Conflict Task Force; this living toolkit for best practice (developed from 2015) extensively references approaches used by the Ruaha Carnivore Project (RCP) [Aiii].

<u>Strategies for managing lion trophy hunting in the Hwange ecosystem</u>
WildCRU research demonstrating the negative effects of unsustainable trophy hunting [1, 2] has led to greatly improved sustainability of trophy hunting in Zimbabwe. Specifically, from October 2013, WildCRU worked with the Zimbabwe parks authority to establish an age-based quota setting system for lion trophy hunting, implemented from 2014 [Bi]. This quota system has had a major impact on lion population sustainability: for example, in 2013 approximately 60% of hunted lions were aged less than 4 years, whereas in 2015 less than 5% of hunted lions were in this age group [Bii]. The population is now stable, with benefits not only for lion conservation but also industries such as trophy hunting and photo-tourism (confirmed by the Zimbabwe Professional Guides Association (ZPGA) [Biii], which rely on lion presence and contribute to the economy, and local communities benefit from revenues derived from sustainable hunting [Biv].

<u>Mitigating intense human-lion conflict in Ruaha and Hwange ecosystems</u>
The WildCRU projects, RCP and Hwange Lion Research Project, have provided practical conservation outcomes to address human-lion conflict. Their research showed that livestock depredation was a key driver of conflict in both sites [4, 5, 6], so reducing this has been a priority. Food insecurity is a major issue in both locations, affecting 38% and 15% of rural Zimbabweans and Tanzanians, respectively. Protecting livestock improves both economic and food security. Since Aug 2013, RCP has predator-proofed 207 livestock enclosures, protecting at least 17,300 livestock animals worth over USD1,000,000 from carnivore attack [Ci, ii]. Households with wire enclosures lose 56% less livestock to carnivore attack [Ci]. Additionally, as of 2019, 15 conflict officers were employed and 9 livestock guarding dogs were placed to protect over 500 households from lion attacks [Cii, iii]. RCP has trained and employed warriors from traditionally marginalised groups as 'Lion Defenders' (17 employed in 2019 [Ciii]) to chase away lions from households and find lost livestock, which are particularly vulnerable to attack (per year, approximately 4,000 livestock recovered, worth approximately USD750,000 annually) [Ciii]. Depredation has been reduced by over 60% in target households, improving economic security and protecting culturally valuable assets [Ci, ii, iv]. During 2019, the Lion Defenders prevented or stopped 26 lion hunts, bringing the total stopped since 2013 to 111 [Ciii]. Retaliatory killing of carnivores has been reduced by over 80% compared to the baseline in 2011: for example, only 4 lions were killed in 2018 compared to approximately 60 per year prior to the Lion Defenders programme [Cv]. Strategies and a case study from the University of Oxford research were included in the Tanzanian National Human-Wildlife Conflict Strategy, endorsed by the government in 2020, which recommends approaches used by RCP including livestock guarding and education [D].

In Hwange, since 2013 the WildCRU project has employed local men and women as 'lion guardians' (the Long Shields programme; 9 employed in 2013; 12 in 2020 [Biv]) to establish and improve livestock husbandry practices, including predator-proofing livestock enclosures, implementing successful non-lethal methods of deterring predators from community land, and alerting villagers of nearby lions [Ei, ii]. The programme covers an area of approximately 2,500km^2 and benefits over 6,800 rural households engaged in subsistence agro-pastoralism. This has led to substantial (up to 50%) reductions in losses of livestock to lions and other predators since the initiation of the programme in October 2013 [Ei, ii]. WildCRU found there to have been a 41% reduction in retaliatory killing of lions by local people since the research-based conflict mitigation programme around Hwange (2013-2017) [Fi]. Attitudes to the presence of lions in the area has also measurably improved: evaluation of farmers' attitudes before and after introduction of the Long Shields programme showed that 91% felt the programme had helped them avoid impact from lions, and the proportion of farmers wanting lion populations to decrease fell from 93% to 65% [Fii]. Village leaders have welcomed the mitigation measures and report improved attitudes towards lions and protection for livestock [Eiii,iv,v]. Between 2014 and 2019, the project team trialled 10 mobile canvas livestock enclosures ('bomas') to protect livestock and simultaneously fertilise crop fields, benefiting 89 households and protecting 854 cattle from carnivore attack and improving crop yields on fertilised fields by approximately 30%, substantially improving local food

security [Bi], with the local council stating that bomas bring "*soil structure regeneration…a huge positive impact being realized through increased yields of cereal crops*" [Ei].

WildCRU's Hwange programme served as a blueprint for community-based conservation programmes elsewhere, including in Namibia, Botswana, and other sites in Zimbabwe [Bi]. For example, WildCRU provided training for community programmes to reduce human-predator conflict in Chizarira and Gonarezhou National Parks (Zimbabwe) that have successfully protected livestock [Gi, ii]; informed other practitioners, e.g. through a Human-Wildlife Conflict training workshop in Gabon in 2017 organised by the World Bank [Giii]; and shaped national human-wildlife conflict strategies (e.g. Human Wildlife Conflict Strategy for Zimbabwe, 2018 [Bi]).

Impacts on local populations

In both Hwange and Ruaha ecosystems, wildlife often imposes a substantial burden on vulnerable rural communities, so wildlife-related benefits need to outweigh those costs [e.g. 4, 5, 6]. The research teams employ over 100 local people (Hwange: 30 Zimbabweans employed, supporting approximately 150 family members; Ruaha: more than 80 Tanzanians employed, supporting at least 800 family members). A local village leader in Hwange confirmed that the employment is valuable to the community [Eiii]. The RCP ensures 800 primary school children are fed each day, reducing food insecurity and increasing school attendance [Ciii]. 42 secondary-school and 4 higher-education scholarships have been funded and a programme that twins 16 local schools with international schools provides the local schools with essential materials and equipment for teaching [Ciii]. In a village in Ruaha, the school pass rate increased dramatically since 2014, which the village leader attributes at least in part to "*the impact of school feeding, as well as…support materials and infrastructure*" received through RCP [Civ]. A 'community camera-trap' programme, in which villagers monitor the wildlife and gain rewards for wildlife presence, covers 16 villages (approximately 30,000 people) and delivered USD70,000 of education, healthcare and veterinary care in 2020 [Ci]. A village leader stated "*before there was no benefit, only bad things, but now people easily see the benefits of having carnivores and we want to continue to protect them*" [Civ]. Trials of this approach in northern Tanzania, Zambia and Botswana were ongoing in 2020.

The research projects have improved local awareness of conservation. In Ruaha, the researchers produced a local-language book to foster changes in attitudes towards lions, distributed free to all local primary schools [Ciii]. In Ruaha, over 40,000 local people were engaged through educational film nights and visits to the Park since 2013; in 2019, 99% of respondents from the local people who had visited the Park reported more positive feelings towards wildlife after the visit [Ciii]. The conservation and local development impacts of this work have been recognised by international awards, including Cincinnati Zoo Wildlife Conservation Award 2018 [Hi], and 2016 Saint Louis Zoo Conservation Award [Hii] to Amy Dickman. The CEO of Saint Louis Zoo is quoted in the award press release as stating: "*Amy and her team have converted lion killers into lion conservationists and in doing so, saved countless animals*" [Hii].

Impacts on trophy hunting debates and policy development

Public debate and awareness of trophy hunting and conservation

The illegal killing on 1 July 2015 by a trophy hunter of one of long-term study-animals from the Hwange project, 'Cecil', sparked an international media furore, including at least 95,000 print media articles and 700,000 social media mentions in 3 months [Ii]. This reaction was based in part on University of Oxford GPS collar-tracking [1], providing data showing Cecil was wounded 10-12 hours before his death [e.g. Iii]. This changed international public perceptions of trophy hunting: for example, more than 40 airlines introduced or reaffirmed bans on transporting trophies from the 'Big 5' African animals [Iiii]; and a survey of 1,000 adults in the USA by National Geographic one month after the killing showed 10% had signed a petition or pledge in response [Iiv]. A WildCRU proposal in 2017 on funding conservation was reported by *The Economist* [Ji] and in 2018 the UN Development Programme established *The Lion's Share* fund, to which companies are asked to donate 0.5% of media budgets for advertising that uses animals, raising USD2,917,873 by 31 Dec 2019 [Jii]. At the fund's anniversary in 2019, Dickman addressed the UN General Assembly.

Informing national political debate and policy development in the US and UK

WildCRU research [e.g. 1, 2] has contributed to the evolution of UK government policy on trophy hunting. In a debate in the UK House of Commons in 2015 [Ki], the Minister for the Environment stated that the government department had worked with WildCRU and that "*…Andrew Loveridge and David Macdonald from Oxford University have contributed a great deal on the subject. For*

DEFRA, trophy hunting is a serious issue…the Government will ban the importation of trophies into Britain unless we see very significant improvements in what is happening in Africa". In 2016, WildCRU provided a commissioned report to the Minister for the Environment on trophy hunting, particularly with respect to lions [Kii], and in Oct 2019 the UK government's legislative programme (Queen's Speech) included proposed legislation to ban imports from trophy hunting. This started with a formal consultation [Kiii], to which WildCRU researchers contributed evidence from their research and also presented to a UK parliamentary group in June 2020. Similarly, in the US, WildCRU research informed legislative debate in 2019 on the Conserving Ecosystems by Ceasing the Importation of Large Animal Trophies Act ('CECIL Act'), including their work (including [2]) being cited in testimony to a Sub-committee of the House of Representatives [Kiv].

5. Sources to corroborate the impact

A. IUCN guidelines, including recommendations based on University of Oxford research:
   i) Guidelines for the Conservation of Lions in Africa (2018), e.g. chapter 6.5; ii) Trophy Hunting Briefing Paper (2019); iii) Human-Lion conflict toolkit (living document, since 2015).

B. Statements on sustainable quota setting in Zimbabwe: i) Two Letters from Zimbabwe Parks and Wildlife Management Authority, National Coordinator for Transfrontier Conservation Areas, confirming importance of WildCRU research in quota setting and conflict strategies;
   ii) Presentation by Chief Ecologist of ZPWMA on sustainable wildlife management; iii) Letter from Chairman, ZPGA, stating benefits from WildCRU contribution to sustainable quota setting; iv) Letter from Director, CAMPFIRE Association (community-based natural resource management initiative) describing impacts of WildCRU on quotas and conflicts.

C. Ruaha Carnivore Project outcomes: i) Letter from District Wildlife Officer, Iringa, Tanzania, describing achievements in Ruaha (Jan 2021); ii) RCP website, list of project achievements to end of 2019 (accessed Dec 2020); iii) RCP Annual Report 2019; iv) Letter from Chairman of Kitisi Village, Tanzania, desciding benefits from RCP; v) Article in the Independent (UK), Feb 2018, quoting RCP Lion Defenders manager.

D. National Human-Wildlife Conflict Strategy, Tanzania (Oct 2020).

E. Letters from local leaders in Hwange describing benefits of WildCRU work: i) Chief Executive, Hwange Rural District Council; ii) Chief Executive, Tsholotsho Rural District Council;
   iii) Headman from Dete; iv) Village Head from Lupote; v) Headman from Tsholotsho.

F. Oxford journal articles: i) Sibanda, L *et al*. 'Effectiveness of community-based livestock protection strategies: a case study of human-lion conflict mitigation'. *Oryx* (in press, 03-2021); ii) Sibanda, L *et al*. 'Evaluating changes in attitudes towards lions (Panthera leo) after the introduction of a non-lethal human-lion conflict intervention in northwestern Zimbabwe'. *Human Dimensions of Wildlife*, Nov 2020. DOI: 10.1080/10871209.2020.1850933

G. Uptake of WildCRU conservation tools: i) Letter from African Lion and Environmental Research Trust, about lion-livestock conflict mitigation in Chizarira National Park;
   ii) Letter from Director, Gonarezhou Conservation Trust, regarding training from WildCRU;
   iii) Agenda for World Bank training workshop, 2017, including A. Dickman.

H. International conservation awards press releases: i) Cincinnati Zoo Wildlife Conservation Award 2018; ii) Saint Louis Zoo Conservation Award 2020.

I. Responses to the killing of Cecil the lion: i) Journal article: Macdonald, D.W., *et al*. (2016). 'Cecil: A moment or a movement? Analysis of Media Coverage of the Death of a Lion, Panthera leo.' *Animals 6:26*. DOI:10.3390/ani6050026; ii) National Geographic report with extracts from book 'Lion Hearted' by A Loveridge, describing the killing of Cecil (March 2018); iii) Humane Society International report on airlines banning hunting trophies;
   iv) National Geographic and Ipsos survey of respondents in the USA (August 2015).

J. Publicity of The Lion's Share: i) Commentary in The Economist, 'A wild idea about paying for conservation', Aug 2017, citing a WildCRU article; ii) The Lion's Share annual report 2019.

K. UK and US government consultation: i) UK House of Commons Hansard, 24 Nov 2015, v.602. Debate on African Lion numbers and trophy hunting; ii) Report submitted by WildCRU to UK Minister for the Environment, 2016; iii) UK government announcement of consultation on trophy hunting imports; iv) Testimony of Senior Specialist, Humane Society International to House Subcommittee on Water, Oceans and Wildlife, 18-07-2019.