

Carnivore Conservation Evidence: Framework and Connections

by

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1. Abstract

The order Carnivora is extraordinarily diverse, with over 240 terrestrial species ranging from 30g to 700kg, the Far East to the Western US, and from invasive to critically endangered. The methods employed to conserve these carnivores are equally diverse. Without an evidence base to gauge and support conservation decisions, these methods may also be subject to personal opinion, bias, and conventional wisdom in place of the best available science. By collating all of the available evidence on the effectiveness of interventions, the Conservation Evidence project aims to provide a methodological standard for decisions made. This work details the Conservation Evidence application to carnivores, and then identifies ways in which access and evidence exchange may be increased within the Conservation Evidence context.

2. Introduction

A revolutionary change is underway in the field of conservation. Over the last decade, conservation leaders have begun calling for the application of evidence-based practice to the decisions being made in environmental management and conservation (Sutherland, Pullin et al. 2004). They have also taken on the challenge of developing facilitative frameworks, modeled after those used in evidence-based medicine, to bolster decision-making and bridge the divide between science and practice (Pullin and Knight 2003).

The Conservation Evidence Project, based out of the University of Cambridge, is one of the key components in this new evidence-based framework. This project begins by summarizing all available evidence on the effectiveness of conservation interventions, from peer-reviewed journals articles and books to grey literature and conference proceedings. All summaries are written as objective, independent assessments, providing scientific information in a useable format. The summaries are then compiled into synopses, which are made widely accessible through an online, open-access database, a freely downloadable PDF, and a printed handbook. These

synopses aim to provide a point of reference to inform decision-making (www.conservationevidence.com).

The Conservation Evidence Project's goal to make conservation more evidence-based is a very real and current need in environmental practice (Sutherland, Pullin et al. 2004). As management planning and policy are key elements in conservation, it is vital for individuals involved in these processes to be able to evaluate all of the relevant evidence. However, even when the science exists, there are many obstacles that may hamper individuals from applying it, including: time constraints, lack of training, or inaccessibility due to subscription requirements and library access (Dicks 2010). Without access to information on the results of conservation approaches, decisions in management and policy are left to rely on anecdotes, common sense, or conventional 'wisdom' in the place of science (Sutherland 2003).

The two main objectives of my Master's Project are directly tied to this growing movement in evidence-based conservation. My first objective is to build a coherent and approachable framework for the Carnivore Conservation Evidence Synopsis, following the established Conservation Evidence guidelines. Faced with the difficulties of accessing grey literature and unpublished reports, as well as the desire to make this synopsis as inclusive as possible, my second objective is to identify and execute ways to increase access and evidence exchange within the Conservation Evidence context.

3. Carnivore Conservation Evidence Synopsis

The first objective of my Master's Project was to develop a framework for the Carnivore Conservation Evidence Synopsis. My work with this project initiated through my involvement with Duke University's Big Cats Initiative intern team. During the 2011-2012 academic year, our team compiled a list of interventions aimed at reducing big cat mortality. This list was first organized by the causes of big cat mortality and then re-ordered into possible interventions that could reduce the occurrence of such causes. Once the list was created, search terms were placed into online databases, including the ISI Web on Knowledge and Google Scholar, and relevant publications were

collected. The interventions and articles identified during this time have since been contributed to the formation of a larger Carnivore Synopsis for the Conservation Evidence Project.

The Carnivore Synopsis will be part of a growing series of Conservation Evidence synopses, which are gradually being built into a comprehensive collection. Once completed, this collection will offer evidence on the effects of conservation interventions for all biodiversity throughout the world (www.conservationevidence.com). The methods used to create the framework of this synopsis follow the established guidelines put forth by the Conservation Evidence Project (2012). The subsequent sections detail the application of these methods.

Synopsis Objectives:

The Carnivore Synopsis aims to provide an open-access, user-friendly resource that offers evidence-based support for decision-making in carnivore conservation. It brings together and summarizes all of the available scientific evidence on the effects of carnivore conservation interventions worldwide.

Intended Audience:

The primary audience for this synopsis consists of individuals working to conserve carnivores, from land managers and farmers, to conservationists, researchers and policymakers. It may also serve as an educational information source for teachers, students, and individuals with a general interest in carnivore conservation.

Synopsis Scope:

The Carnivore Synopsis will include all available evidence on the effects of conservation interventions for terrestrial carnivores (order Carnivora, class Mammalia). Marine carnivores belonging to the superfamily Pinnipedia (walruses, seals, and sea lions) have been excluded from this synopsis for pragmatic reasons. As many of the threats and conservation actions taken to conserve marine carnivores are distinct from

those for terrestrial species, this group would be better suited in a marine mammal synopsis. This exclusion also allows for a more focused approach to selecting Advisory Board members, as well as for identifying and trawling specialist journals.

The Carnivore Synopsis also excludes evidence on the effects of carnivore pest control interventions. Interventions that aid in the conservation of native carnivore species (e.g. removal of invasive carnivores to conserve a native population) are an exception. A future synopsis on pest control will include the interventions aimed at removal of carnivores for other conservation objectives.

Interventions List:

After defining the synopsis scope, a draft list of carnivore ‘conservation interventions’ was created. Conservation Evidence defines these interventions as ‘anything you might do to manage, protect, enhance or restore biodiversity’ (www.conservationevidence.com). The only set limitations are that outcomes of interventions are quantitatively measured, and a conservationist could realistically carry out these actions. To create this list, I first restructured the previously identified big cats conservation approaches under the IUCN Threat and Action Classification Schemes. I then read a number of carnivore specialist books and spoke with conservationists to identify additional interventions and pull references. Carnivore-specific journal articles collected by the Conservation Evidence Cambridge team provided additional intervention categories. Please refer to Appendix 1 for the Carnivore Conservation Interventions List.

Advisory Board:

An international panel of conservationists and academics with relevant specialist knowledge was then formed to advise on the scope and content of the synopsis. The board members selected come from several continents and have diverse areas of expertise within carnivore conservation. Please refer to Appendix 2 for a list of board members, as well as their geographic locations and positions.

Members of the Advisory Board have two main duties. They were first sent a draft list of conservation interventions and asked to comment on the initial scope of the synopsis. Once agreement had been reached, the Carnivore Synopsis was updated and explicitly planned under the structure of the IUCN Threat and Action Classification Schemes. Second, when the draft synopsis is completed, the board members will be asked to review all sections pertaining to their area of expertise and send their comments.

In addition to their active roles as advisors, they will be listed in the final publication, both online and in print, as members of the Advisory Board. Having their input on both the quality and inclusiveness of the synopsis bring increased validity to the final product and may also increase readership.

Literature Review:

The literature review process involved searching for all available evidence of the effectiveness of carnivore conservation interventions. This includes trawling specialist journals, as well as searching for all relevant grey literature, systematic reviews, books sections, reports and conference proceedings. As previously mentioned, Conservation Evidence requires that two criteria be met for a study to be included as evidence in the synopsis. First, the intervention must be something that a conservationist would do. Second, the effects of the intervention must be quantitatively documented (www.conservationevidence.com).

Journal Trawling:

Journal trawling provides a clear methodology for literature review that is both replicable and thorough in identifying evidence-based articles. Journal trawling is time consuming and many journals are not taxon-specific. Therefore, all relevant papers are pulled from each journal trawled and sent to the Conservation Evidence Cambridge team to avoid multiple searches of the same journals.

The challenge with selecting specialist journals for the carnivore synopsis comes from the enormous diversity of both the species in this order and the threats they face. To aid in the identification of relevant specialist journals, I created a spreadsheet of all of the journals in which I had found articles during my initial planning of the synopsis. A total of 228 scientific journals were identified in this process. From this list, I then selected journals containing 10 or more relevant articles that had not been previously trawled. The resulting journals are: Mammal Review, Journal of Mammalogy, Wildlife Society Bulletin, Cat News, and Applied Animal Behavior.

After the journal trawling is completed, the ISI Web of Knowledge and Google Scholar will be searched for additional papers. Special attention will be given to interventions noted by the Advisory Board that contain little or no collected evidence. The Conservation Evidence online database will also be searched for articles that have already been summarized as part of different synopses. Throughout this process, an EndNote library will be continuously updated, checked for duplicates, and organized under intervention categories. Once the literature review is complete, all references will then be linked to interventions in the synopsis skeleton.

4. Moving Forward

The following steps are not part of the synopsis framework development, but outline the remaining steps for synopsis completion.

Summarize Studies:

Each paper is summarized into an individual synopsis paragraph, which outlines the strongest findings, basic background information, and the methods employed in the study. Each new summary is then edited by a Conservation Evidence advisor and uploaded to the Conservation Evidence online database.

Compile Evidence:

Summary sections are then written to include all of the individual synopsis paragraphs compiled around each intervention. Simple, overarching conclusions called 'key messages' are then pulled from the summary sections. The 'key messages' are found at the beginning of each chapter, with chapters taking the form of IUCN-CMP Threats and Actions. The chapters are then compiled into the final synopsis. Once the synopsis compilation is complete, it will be sent to the Advisory Board for review.

Publish, Publicize and Update:

The synopsis will be published online as a download PDF, searchable in the Conservation Evidence database of interventions (both free), and available as a book for purchase in print. The synopsis will be annually updated online, while the print version will be updated less often, depending on demand.

Nicholas School Student Involvement:

During the fall of 2012, a number of Nicholas School students assisted with the Carnivore Synopsis development. They worked on journal trawling and summarizing evidence. All summaries fitting the inclusion criteria will be contributed to Conservation Evidence. Over the next several months, I will be working to summarize all remaining sections of the Carnivore Synopsis.

5. Increasing Awareness and Participation in Conservation Evidence Exchange

The second objective of my Master's Project aimed to identify and execute novel approaches to increase awareness and participation in the exchange of conservation evidence for the Carnivore Synopsis.

I have taken the following approaches in an effort to better connect with conservationists in the field, ensure broader literature coverage within the various carnivore families, and to increase awareness of the Conservation Evidence Project. It is my hope that other teams working on the creation of Conservation Evidence synopses will adopt similar practices in the future.

First, to present a professional point of contact for work related to Carnivore Synopsis, I created the email address. carnivores@conservationevidence.com. I then arranged a meeting with the Senior Scientific Officer to the Species Survival Commission (SSC). He kindly agreed to place the following request on the IUCN's SSC e-bulletin:

The Conservation Evidence project (www.conservationevidence.com), based out of the University of Cambridge, is currently creating a Carnivore Synopsis. This synopsis aims to synthesize all available evidence on interventions that a conservationist could use to make management or policy decisions with respect to carnivores. These include any actions to restore or preserve carnivores and/or their habitats, ranging from human-carnivore conflict mitigation or disease management, to the success or failure of reintroduction projects. The only restriction is that the interventions must be quantitatively documented. The submission of any relevant work (peer reviewed articles, reports, conference proceedings, or other grey literature) from across the SSC network will be warmly welcomed. Please send any work fitting this description, or address any questions to carnivores@conservationevidence.com.

Finally, I developed an extensive list of carnivore conservation organizations from around the world. These ranged from large, international organizations to much smaller, species-specific conservation groups and included all terrestrial carnivore families. Organizations working with carnivores listed as threatened or endangered by the IUCN Red Listing were explicitly identified. Please refer to Appendix ___ for the list of organizations.

Each organization was sent a personalized letter introducing the Conservation Evidence Project and requesting the submission of available evidence for use in the Carnivore Synopsis. I also created a Prezi that introduced the Conservation Evidence Project and goals of the Carnivore Synopsis. The link was attached to the emails, along with a request that they pass it along to colleagues in order to help spread the word. I tried to make the Prezi as approachable and interesting as possible, with the hope that this would more likely be shared and remember. I plan to send a PDF of the completed Carnivore Synopsis to all organizations that have responded as soon as it is published.

These approaches aim to increase access to unpublished evidence, which will ideally aid in expanding the synopsis' evidence base, fill literature gaps or produce journal articles that were overlooked during trawling. They may also allow for increased representation of conservation action and, in turn, decrease the effects of publication biases.

6. Conclusion

Evidence-based frameworks such as the Conservation Evidence Project, I believe have the ability to revolutionize the way we do conservation. As conservationists we need to be able to put our work, and our science, back into the larger context as well as share and learn from our collective successes and failures. Scientific literacy is by no means increasing, nor is easy access to reliable information. Therefore, science needs to make itself accessible, and that is in part what projects like Conservation Evidence are aiming to achieve. As published on both the website and print version of Conservation Evidence synopses, the evidence is for everyone, from practitioners and policymakers, to everyday people who care about their local environment.

Viewing this revolution as a way to make the conservation field more objective and accessible to the multitude of individuals that participate in conserving the world's biodiversity, it seems imperative that we empower those interested to contribute their knowledge. Frameworks being developed by the Conservation Evidence project, as well as others in the evidence-based movement are being to facilitate this exchange.

7. Acknowledgements

I would like to thank my advisor, Professor Stuart Pimm for his support and encouragement throughout this entire process. I would also like to thank Professor William Sutherland, Dr. Lynn Dicks, and the rest of the Conservation Evidence Cambridge team for their guidance and warmth during my time in Cambridge. I also want to acknowledge all of the Duke University Big Cats Initiative interns for their

hard work and contributions to this project. And finally, I would like to give a special thanks to Andrew Jacobson and Elspeth Wilman for their patience and assistance.

8. Appendices

Appendix 1. CARNIVORE CONSERVATION: A SYNOPSIS OF THE EVIDENCE

- Draft list of interventions
- Threats used in list correspond to the IUCN Threat Classification Scheme (3.1) and the IUCN Conservation Actions Classification Scheme (2.0) as appropriate.
- Interventions relate to terrestrial carnivores (order Carnivora, class Mammalia)
- Numbers are to facilitate comments

THREAT: AGRICULTURE

LIVESTOCK FARMING AND RANCHING

1. Maximize land use/zoning

- Increase agricultural productivity
- Consolidate people and livestock
- Relocate activities
- Secure separate water points for wildlife

2. Increase economic options to farmers

- Incentivize smaller herds
- Facilitate alternative livelihoods
- Encourage alternative food sources
- Domesticate indigenous livestock 'alternatives'

THREAT: TRANSPORTATION & SERVICE CORRIDORS

ROADS and RAILROADS

3. Reduce collisions

- Install infrastructure (e.g. underpasses, speed bumps, exclusion fences)
- Change traffic laws (e.g. speed limits, access points)
- Increase driver awareness (e.g. highway lighting, signs)

THREAT: BIOLOGICAL RESOURCE USE

INTENTIONAL MORTALITY (HUMAN USE)

4. Change legal hunting laws and practices

- Stop trophy hunting
- Upgrade species protection under CITES (i.e. Appendix 1)
- Increase hunting restrictions (e.g. limitations on age, season, locations)
- Reduce hunting quotas and permits
- Ban imports and exports of trophies
- Encourage hunting alternatives (e.g. "Green hunts")

5. Decrease illegal taking (i.e. poaching, trade of live animals)

- Improve enforcement (e.g. anti-poaching teams, ranger patrols)

- Strengthen anti-poaching laws
- Increase effectiveness of anti-poaching (e.g. support/finance of patrol teams)
- Increase enforcement presence
- Increase tourism
- 6. Reduce incentives to poach**
 - “Pay not to poach”
 - Decrease economic attractiveness of poaching
 - Facilitate alternative employment (e.g. ‘poacher turned gamekeeper’)
 - Introduce alternative food sources (e.g. reduce bushmeat consumption)
- 7. Reduce demand for carnivores and their products**
 - Criminalize trade in wildlife (e.g. restaurants, sale)
 - Use educational and public awareness campaigns
 - Decrease medicinal trade and demand

INCIDENTAL OR ACCIDENTAL MORTALITY

- 8. Conserve prey bases**
 - Reintroduce prey species
 - Manage habitats for prey species
 - Limit takes of prey base (e.g. legal and illegal hunting)
 - Restore vegetation-prey-predator balance
- 9. Food and water shortage**
 - Provide supplemental food and watering holes
- 10. Use medical interventions for injured/snared animals**
- 11. Mitigate potential infrastructure risks (e.g. wells, electrocution)**

PERSECUTION & CONTROL

- 12. Punish retaliatory killings**
 - Enforce existing laws (at all levels)
 - Strengthen existing laws (e.g. larger fines, increased prison lengths)
- 13. Control specific problem animals**
 - Kill (e.g. selective removal, trophy hunting)
 - Relocate
 - Identify problem animals (e.g. salivary DNA testing)
- 14. Prevent livestock killings**
 - Install or improve fencing (e.g. electric fences, bomas)
 - Install technology (e.g. movement-activated alerts, radio collars, GSM/GPS)
 - Increase vigilance (e.g. watchmen, geo-fencing, horseback guardsmen)
 - Increase guarding (e.g. guard dogs, donkeys)
- 15. Improve livestock husbandry/management**
 - Reduce uncertainty surrounding livestock loss (e.g. document and identify causes, predators involved, and extent of depredation)
 - Reduce other threats to livestock (e.g. starvation, disease, lost animals)
 - Educate on proper husbandry
 - Select secure pastures (e.g. avoid areas with stalking cover)
 - Change livestock breeds (e.g. flocking behavior, anti-predator instincts, size)
 - Change breeding patterns (e.g. controlled breeding times, seasonal patterns)
- 16. Improve waste management**
 - Dispose of animal carcasses

17. Use deterrents and adverse conditioning

- Install light and sound devices (e.g. firecrackers, alarms, ultrasonic devices)
- Use biological deterrents (e.g. lion dung, pepper products)
- Induce pain (e.g. electric shock collars, rubber bullets)
- Use conditioned taste aversion methods

18. Prevent human death

- Prevent crop raiders (to reduce humans sleeping in fields)
- Change behavior to avoid attacks (e.g. Sundarbans masks)
- Change herder habits (e.g. increase age, restrict nighttime activity)

19. Educate with respect to cultural killing (e.g. rites of passage)

20. Educate with respect to problems of persecution (carnivore's ecological role)

21. Design species-specific education initiatives (when appropriate)

22. Target key groups in education (e.g. tourists, community leaders)

23. Use market-based incentives to reduce retaliation

- Use compensation programs (e.g. monetary, access to resources)
- Use insurance programs (e.g. insure property or livestock)
- Use assistance incentives (e.g. co-fund adoption of good husbandry practices)
- Provide payments or subsidies for carnivore presence on private land
- Transfer user fees from recreation to land owners

25. Offer employment opportunities

- Employ local conflict managers and officers
- Hire local teachers and community members for outreach
- Support alternative employment (e.g. handicraft markets)

26. Increase value of carnivores to local people (e.g. ecotourism)

27. Decrease access to poisons (e.g. Furadan)

28. Decrease desire to retaliate (e.g. complaint forums, increased acceptance)

29. Enhance local pride and participation

- Use cooperative wildlife management processes
- Incorporate local knowledge (e.g. tracking, trapping)
- Build community-relevant monitoring processes (e.g. Lion Guardians)

THREAT: HUMAN INTRUSIONS & DISTURBANCE

30. Limit motorized access

31. War?

32. Oil development?

THREAT: INVASIVES & OTHER PROBLEMATIC SPECIES CONTROL

INVASIVE NON-NATIVE SPECIES

33. Eradicate invasive species

- Reduce competition (e.g. American mink outcompeting European mink)
- Reduce predation (e.g. stoats in New Zealand)
- Reduce hybridization (e.g. coyotes and red wolves)
- Perform blanket reductions

PROBLEMATIC NATIVE SPECIES

34. Pest control

- Kill (e.g. poison, kill traps, recreational harvest, host specific disease)
- Control fertility (e.g. control reproductive rate, reversible contraception)

Perform permanent sterilizations (i.e. surgical and chemical)
Establish sterile barriers (e.g. fencing)
Trap and remove individuals (e.g. translocations)

Disease

35. Control disease vectors

Cull or vaccinate putative domestic reservoirs (e.g. feral dogs)
Offer livestock disease control methods
Increase human self-interest in disease control (e.g. rabies contraction)
Increase pet owner responsibility (e.g. change owner behavior, encourage vaccination for critical pathogens, enforce mandatory immunizations)

36. Remove causal factors (e.g. toxic agents, heavy metals)

37. Control disease within populations

Deworm (e.g. mass distribution of medicines via food baits)
Vaccinate (e.g. trap-vaccinate-release, baits)
Cull (e.g. individuals, to reduce density, or to create pathogen barriers)
Treat individual or focal animals (direct intervention when susceptible)

38. Address disease by specific species

Identify and mitigate potential for disease spread and severity
Identify and mitigate epizootic threats and potential diseases
Perform disease detection with scat analysis

39. Perform veterinary conservation checks

Quarantine translocated animals before release

THREAT: POLLUTION

40?

THREAT: CLIMATE CHANGE

41? (Polar bears, tigers- e.g. rising sea level in the Sundarbans, changes in vegetation and resultant changes in herbivore numbers)?

OTHER THREAT TYPES:

HABITAT PROTECTION/MANAGEMENT

42. Protect core populations and habitats

Create new protected areas
Increase effectiveness of existing PAs (e.g. buffers, reduced edge effects)
Increase support and protection of PAs (e.g. funding, guards, fencing)

43. Improve or restore habitat

Introduce fire management
Increase water access and availability
Convert ranchlands to conservation or tourism areas

44. Reduce fragmentation with corridors

Incorporate corridors between PAs
Incorporate private and public reserves
Maintain or recreate corridors of natural migration

45. Use graded management zones or metapopulation management

SMALL/DECLINING POPULATIONS

46. Increase species number

- Enhance reproductive success or output
- Provide breeding sites and refuges
- Artificially augment groups (e.g. release captive bred animals)

47. Maintain genetic viability

- Identify and control heritable diseases
- Cross-foster captive born individuals to wild parents
- Increase connectivity (e.g. corridors)
- Decrease hybridization (e.g. polecats and ferrets)
- Translocate individuals (e.g. into isolated subpopulations)
- Preserve “back-up” populations

48. Perform ex-situ conservation

- Breed captive animals
- Create genome resource banks

49. Assist reproduction (e.g. in-vitro fertilization, embryo transfer)

50. Perform reintroductions

51. Increase effectiveness of reintroductions (e.g. health risks, habituation)

Appendix 2: Advisory Board Members

David Garshelis (Chair, IUCN Bear Specialist Group, USA)

Kay Holekamp (Chair, IUCN Hyaena Specialist Group)

L. David Mech (Chair, IUCN Wolf Specialist Group)

Luigi Boitani (Chair, IUCN Wolf Specialist Group)

Jerrold Belant (Chair, IUCN Small Carnivore Specialist Group)

Mark Stanley Price (Chair, Species Conservation Planning Sub-Committee)

Claudio Sillero-Zubiri (Chair, IUCN Canid Specialist Group)

David MacDonald (Director, WildCRU)

Luke Hunter (President, Panthera)

Scott Robertson (Small carnivores & trade, WCS)

R. Ullas Karanth (Tigers, WCS)

Harriet Davies Mostert (Head of Science and Research, Endangered Wildlife Trust)

J.W. ‘Tico’ McNutt (Founder and Director, Botswana Predatory Conservation Trust)

Rosie Woodroffe (Senior Research Fellow, Institute of Zoology, ZSL, London)

Luke Dollar (Director, National Geographic’s Big Cats Initiative)

David S. Jachowski (University of Missouri)

Craig Packer (Co-founder, Savannahs Forever Tanzania)

Leandro Silveira (President, Jaguar Conservation Fund)

9. Literary Citations

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