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IS TRANSLOCATION OF PROBLEMATIC JAGUARS (PANTHERA ONCA) AN EFFECTIVE STRATEGY TO RESOLVE HUMAN-PREDATOR CONFLICTS?

Systematic Review Protocol

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1. BACKGROUND

The jaguar (*Panthera onca*) is the largest terrestrial predator in the Neotropics and is the only representative of the genus *Panthera* in America (Seymour 1989). It is strongly associated with areas that have considerable vegetation cover, water availability and prey abundance, although it is able to survive in a number of different environmental conditions (Rabinowitz & Nottingham 1986, Mondolfi & Hoogesteijn 1986, Seymour 1989, Crawshaw & Quigley 1991, Rabinowitz 1992, Jackson 1992, Novell & Jackson).

Like most other felines, the conservation status of jaguar populations is defined principally by habitat conditions and by its interaction level with humans (hunting activities, trade, competition for prey; Nowell & Jackson 1996, Mondolfi & Hoogesteijn 1992, Jackson 1992, Swank & Teer 1992). Up to the 1970s, the species´ main threat consisted in poaching activities for its skin. It was for this reason that the jaguar was included in 1973 in Appendix I of the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) (Seymour 1989, Swank & Teer 1989). Today, the jaguar is principally threatened by habitat loss and destruction, indiscriminate hunting of its natural prey and the conflicts that exist between it and humans which are caused by predation of domestic animals (Nowell & Jackson 1996, Swank & Teer 1992, Hoogesteijn et al. 1992). Consequently the species is catalogued as Nearly Threatened (NT) by the International Union for the Conservation of Nature (IUCN).

The sources of threat that affect the species are not independent. Habitat loss and destruction directly affect the jaguar by reducing its shelter availability, and has a negative effect on the populations of its prey which alongside hunting activities notably reduces the jaguar's food availability (Rabinowitz 1992, Hoogesteijn et al. 1992, Saénz & Carillo 2002, Hoogesteijn et al. 2002). It is believed that this situation encourages the substitution of the jaguar's natural prey by domestic animals, which leads to financial losses and general animosity towards this predator. This conflict between anthropogenic activities and the jaguar has promoted its active persecution and hunting. Therefore in the present day, hunting activities are one of the main causes of mortality (Saénz & Carillo 2002, Hoogesteijn et al. 2002).

In order to reduce human-predator conflicts, different strategies have been proposed to manage both predator and domestic animal populations (Swank & Teer 1992, Taber et al. 2002). However, the management of domestic animals aimed at reducing predation events have so far not been accepted by farmers as they are costly in terms of effort, time and money. These management strategies stabilize the coexistence between predators and domestic animal coexistence but do not guarantee that no animal will be predated upon. Some of the methods that have been most widely used to control indiscriminate jaguar hunting activities, have been the selective hunting of problematic animals, and the translocation of animals to areas of reduced human activity. Of these two alternatives, the capture and translocation of problematic animals might be an effective option for jaguar conservation. This method involves the transfer and liberation of problematic jaguars in an area within the jaguar´s original distribution where there is low human activity and consequently a lower hunting pressure. The translocation of problematic animals tends to

take place in both public and private protected areas. In this way, habitat and prey availability is guaranteed to encourage the maintenance and conservation of jaguar populations.

The translocation of problematic animals is a management strategy that has been widely used for jaguars and other big carnivores. However, there are serious limitations such as the difficulty of identifying individuals that predate on domestic animals, costs of capture and transfer of animals, choice of translocation areas, absence of monitoring and continuity of translocation programs, lack of institutional support, (Hoogesteijn et al. 1992, Swank & Teer 1992). On the other hand, hunting of jaguars may still be taking place in areas where a translocation programmes are running due to lack of the programme´s credibility (leading people to eliminate any animal that may be present in the area without reporting the event)), and to local cultural values that promote the hunting practice of this predator (Hoogesteijn et al. 2002).

Translocation of problematic animals is a potentially effective technique for the conservation of the jaguar. However, the results of different jaguar translocation programmes within the species´ distribution range, require evaluation to determine whether they have been effective in improving the conservation status of jaguar populations and in limiting hunting events due to predator-human conflicts. The objective of this review is to compile, organise and evaluate the results of different jaguar translocation programmes using an evidence-based conservation approach (Sutherland et al. 2004).

By using systematic review methodology we hope to determine whether the different strategies used in protected area management provide evidence to find out which specific strategy is effective in conserving jaguars and the habitat of the latter. It will therefore be of vital importance to review not only the available scientific literature, but also grey literature as well as interviewing specialists to be able to get all available data.

2. OBJECTIVE OF THE REVIEW

2.1. Primary question

Is the translocation of problematic jaguars an effective strategy to resolve the human-predator conflicts?

Table 1. Definitions of components of the primary systematic review question

Subject	Intervention	Outcome	Comparators	Designs
Human-predator conflict involving Jaguars (*Panthera onca*).	Jaguar traslocation.	Change in the number of records of domestic animals hunted by jaguars. Change in number of jaguars hunted as a result of human-predator conflicts	Studies which report the number of domestic animals that have been predated upon by jaguars, and/or the number of domestic animals hunted before and after start of the jaguar translocation program	Quantitative studies that present data could facilitate the assessment of the intervention using the predefined comparators and variables. Other variables and comparators could also be used once initiated the systematic review.
		Survival of translocated jaguars	Studies which evaluate the survival of translocated animals.	
		Improvement in humans´ perception towards the jaguar.	Studies where possible changes in people's perception of the jaguar before and after the start of the translocation program have been assessed	Qualitative studies that contain facts and reports that permit the evaluation of the intervention

2.2. Secondary questions

What are the determinants of jaguar translocation success?

What are the more frequently used techniques for the capturing and transferring of problematic jaguars?

What are the selection criteria that define which areas are adequate for the translocation of animals?

3. METHODS

3.1. Search strategy

3.1.1. General sources
A search will be carried out using the following databases:

1. ISI Web of Knowledge: ISI Web of Science: Science Citation Index Expanded. (http://apps.isiknowledge.com)
2. Science Direct (http://www.sciencedirect.com)
3. Ebsco (http://web.ebscohost.com)
4. Scientific Electronic Library Online (http://www.scielo.org)
5. JSTOR (http://www.jstor.org)

A search will be carried out using the following search engines.
1. Google Scholar (www.scholar.google.com)
2. www.alltheweb.com
3. www.dogpile.com

The search using databases, catalogues and search engines will be carried by only one reviewer.

The search will be performed using the following keywords in English and in Spanish:
1. *Panthera onca*
2. *Panthera onca* AND Conflict*
3. *Panthera onca* AND "Predation of domestic animals"
4. Panthera onca AND "Cattle depredation"
5. Panthera onca AND Livestock*
6. *Panthera onca* AND "Human activity"
7. Panthera onca AND Relocation*
8. Panthera onca AND Transfer*
9. Panthera onca AND Translocation*
10. *Panthera onca* AND Management
11. *Panthera onca* AND "Problematic animals"
12. *Panthera onca* AND "hunting"

Considering that locally and regionally, a considerable number of common names are used to describe the jaguar, the above search will stretched out to include the most representative common names of the species. The list of key words will be extended in the following way: Jaguar* OR Yaguar OR Onça* OR Tiger* OR "Tig Marqué".

The search using the above keywords will be performed in English, Spanish, Portuguese and French.

For the internet searches the first 100 references of each search will be reviewed. These references will have to be available in Word, Pdf and other document formats.

3.1.2. Specialist sources

IUCN / SSC Cat Specialist Group - Digital Cat Library (http://www.catsg.org/catsglib)

The search of grey literature will be carried out and will consider reports, theses, unpublished research manuscripts, reports of management activities that have been carried out within the protected areas, legal reports (hunting, deforestation), notifications of problematic animals and others. To do this, the following institutions or the libraries of the following institutions will be visited: Ministerio del Poder Popular para el Ambiente, INPARQUES, Museo de la Estación Biológica de Rancho Grande, UNELLEZ, Fundación La Salle, and others. Experts will also be interviewed to get more information on the topic. The latter will be carried out to improve the gathering of grey literature.

3.2 Study inclusion criteria

3.2.1. Relevant subject(s):
The subject of this review will be the human-predator conflicts involving jaguar (*Panthera onca*) in his entire range of distribution.

3.2.2. Type of intervention:
The intervention to be studied is the translocation of jaguars. This strategy will have to consider the capture, transfer and liberation of individuals within its distribution range.

3.2.3. Types of comparator:
Comparators will encompass data from before and after the start of the jaguar translocation program. However, those studies that permit the potential comparison at a spatial level between areas where jaguar translocation programs have been carried out and those areas that have not experienced any type of management, will also be included in the review.
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3.2.4. Types of outcome:
a) Those studies that provide data about the effectiveness of the jaguar translocation programs which are based on reports of domestic animals that have been killed by jaguars, hunting data of jaguars that have been killed due to human-predator conflicts and the survival of translocated jaguars. b) Studies that evaluate man's view of the jaguar as a competitor and as a potential conflict source. These studies will have to provide evidence of how humans´ attitudes towards the jaguar have changed as a result of the proposed intervention. Other variables will also be considered once the review has begun.

3.2.5. Types of study:
All studies that report information on the subject, intervention and variables of this review will be considered to evaluate the effectiveness of this intervention. The studies will need to have quantitative measures of the proposed variables. However, studies that have descriptions or qualitative data will be reviewed to assess the quality of the information. Theoretical studies may be considered if applicable to this review.

3.2.6. *Potential reasons for heterogeneity:*

A few factors that may alter the comparison of results of the different studies in this review are the following.

1. Ecological factors and species characteristics:
   - Characteristics of the ecosystem
   - Presence of other predators
   - Local threats for the Jaguar
   - Age, gender and health of translocated individuals
2. Identification, capture, transfer and liberation methods of problematic animals:
   - Monitoring and identification techniques of problematic animals
   - Different levels of conflict between jaguars and humans
   - Capture, transfer and liberation techniques
   - Selection of liberation areas
   - Protection, management and monitoring of translocated jaguars
   - Duration and continuity of translocation programs
3. Social and institutional factors:
   - Cultural value of the jaguar
   - Density of human populations
   - Socioeconomic status of the people involved in the conflic.
   - Land use
   - Environmental education and promotion of the importance of protected areas
   - Availability of funds and institutional support
   - Ethical values

Other general variables that may affect the analyses are: social development and local economic policies, human population structure, and others. All these variables will be extracted and organized into tables for comparison of biological data that will be evaluated

With the objective of filtering the most relevant studies, we will use the following inclusion criteria in three phases

1. Title and keywords: only those studies whose title and keywords are associated to the objective of this review will be included.
2. Abstract: All the abstracts from the selected studies will be revised and only those satisfying the review criteria will be considered.
3. Entire manuscript: All the studies selected above will be read in full to determine which are suitable for data extraction

In each of the selection phases, a second reviewer will assess a sample of 25% of the studies to verify whether the previously mentioned criteria are clearly defined and whether they have been correctly used to include or exclude studies from the review. The results will be contrasted using a Kappa analysis, in which the criteria will be considered

adequate and replicable if the result of the analysis is equal or greater than 0.6. If the values of the Kappa Analysis are lower than 0.6, the criteria will be readjusted and the studies will be assessed once again.

3.3. Study quality assessment

The quality of the studies will be determined from the revision/analysis of the entire text of the selected documents, by a single reviewer. The studies will be classified according to readjusted hierarchically criteria proposed by Pullin and Knight (2001). These criteria will have to be adjusted and detailed, although the following criteria will be initially presented:

Table 2. Criteria for the classification of study quality (Based on Pullin & Knight 2001)

Category	*Criteria*
I	Strong evidence from well designed experiments (controlled and random experiments) with an appropriate sample size.
II-1	Evidence from well designed controlled experiment but without randomness.
II-1	Evidence derived from a comparison of differences between different locations or situations that are or aren´t influenced by the independent variable ("treatment" vs. "control").
II-3	Evidence derived from several time series or blunt results of uncontrolled experiment.
III	Opinions of experts which are based on qualitative field results, descriptive studies and reports from expert committees.
IV	Inadequate evidence due to methodological problems (simple size, duration, etc.) or unexplained evidence.

After having carried out the above categorisation, a second reviewer will assess a sample of 25% of the studies to ensure that the criteria are clearly defined and have been correctly used to classify the studies. The results will be contrasted using a Kappa analysis in which criteria will be considered to be adequate and replicable if they have a value equal or greater than 0.6. If the calculated Kappa values are lower than 0.6, the criteria will again be revised, and the studies re-evaluated.

3.4. Data extraction strategy

The data extraction for this review will be performed by a single reviewer, who will summarise and organise the data in previously designed tables. These tables will be evaluated and adjusted according to the results of pilot studies. Tables will be created to firstly compile qualitative data, as well as quantitative data of the previously defined variables for the evaluation of the intervention.

A sample of 25% of the studies will be evaluated by a second reviewer to verify whether the data extraction criteria and the effectiveness of the tables are adequate.

During the data extraction, the following study characteristics will be recorded: study type (experimental, theoretical), location, date, potential reasons for heterogeneity, study quality category as well as other characteristics. To evaluate the quality of the studies, data will be extracted to be able to categorise the studies according to the criteria in Table 2. It will be necessary to compile information on the possible sources of bias and on the measures taken by researchers to try and mitigate the latter. The following sources of experimental bias will be considered:

- Differences in the scale of the analysis and of the studied process
- Selection of the study unit (spatial and temporal autocorrelation)
- Pseudoreplication
- Detection bias (detection probability)
- Omission bias (open population)
- Sample size
- Sample methodology
- Comparator use
- Selection of statistics analysis used
- Probability of making Type II error (statistical strength)

These potential bias sources will be independently assessed in a predefined scale that will vary from 0 to 1. Once each of these sources has been evaluated, the results will be summed up to determine the percentage of bias of the study. A study will be considered to be acceptable if the bias percentage does not exceed 40% of the total marks.

3.5. Data synthesis

The methods used to analyse and synthesise the data will vary according to the type of data found in the studies that are included in the review. Summary tables will be created to compile the information on the authors, organisation, study year, study area, bibliographical sources, and others.

For each of the analysed studies, summary sheets and tables will be created in which the most important extraction information will be noted: characteristics and quality of the study, potential reasons of heterogeneity, most important results (qualitative and quantitative), and others. In these summary tables a summary narrative describing the study will be included.

If sufficient quantitative data are extracted, quantitative analyses will be carried out as it could be: semi-quantitative synthesis, secondary analyses and meta-analyses. The statistical treatments that will be used to analyse the data will vary according to the type and quantity of data. All of the quantitative data will be summed up in tables so that they may be contrasted and analysed in an orderly fashion.

4. POTENTIAL CONFLICTS OF INTEREST AND SOURCES OF SUPPORT

5. REFERENCES

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