COLLABORATION FOR ENVIRONMENTAL EVIDENCE

SYSTEMATIC REVIEW NO. 56

ARE PROTECTED AREAS AN EFFECTIVE STRATEGY FOR THE CONSERVATION OF JAGUAR (*PANTHERA ONCA*) POPULATIONS?

CONSULTATION DRAFT REVIEW PROTOCOL

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COVER SHEET

Title	**Working title:** Are protected areas an effective strategy for the conservation of jaguar (*Panthera onca*) populations?
Systematic review	**No. 56**
Reviewer(s)	***Emiliana Isasi-Catalá***
Date draft protocol published on website	**12th August 2008**
Date final protocol published on website	**22nd July 2009**
Date of most recent amendment	
Date of most recent SUBSTANTIVE amendment	
Details of most recent changes	
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Sources of support	**PROVITA**
Conflicts of interest	**None expected**

1. BACKGROUND

The jaguar (*Panthera onca*) is the largest terrestrial predator of 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 also 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 the habitat conditions and the interaction level with humans (hunting activities, trade, competition for prey; Nowell & Jackson 1996, Mondolfi & Hoogesteijn 1992, Jackson 1992, Swank & Teer 1992). Up to the 1970's, the species´ main threat came from poaching activities for its skin. It was for this reason that the jaguar was included in 1973 in Appendix I of the The Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) (Seymour 1989, Swank & Teer 1989). Today the jaguar is mainly threatened by habitat loss and destruction, indiscriminate hunting of its natural prey and by the conflicts that exist between it and humans due to the 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 of one another. Habitat loss and destruction directly affect the jaguar, reducing its shelter availability. Habitat loss also has a negative effect on prey populations which alongside hunting activities notably reduce the jaguar's food availability (Rabinowitz 1992, Hoogesteijn et al. 1992, Saénz & Carillo 2002, Hoogesteijn et al. 2002). It is believed that this situation promotes jaguars to shift their natural prey for domestic animals, which leads to considerable financial losses and discontentment towards the jaguar. This conflict between the anthropogenic activities and jaguars has promoted their active persecution and hunting. Therefore in the present day hunting activities are some of the principal causes of mortality of the species (Saénz & Carillo 2002, Hoogesteijn et al. 2002).

One of the measures that have been carried out for the conservation of the jaguar is the maintenance and management of large areas of habitat where the species may find shelter and abundant prey to maintain viable populations (Vaughan & Temple 2002). Protected areas, especially national parks and natural monuments, are fundamental for the conservation of a great number of species, especially those that are generalists in terms of habitat as is the jaguar. Public protected areas are structured according to a legal framework that limits the type and intensity of human activity that may be developed, thereby reducing the impacts mainly caused by habitat loss and hunting (Miller 1980). Private protected areas, on the other hand, though not considered legal figures, are areas destined for some type of economic activity involving the management of natural resources in such a way that the coexistence of jaguars and anthropogenic activities are permitted thereby promoting the conservation of the former.

Although few protected areas have been specifically established for the conservation of jaguars, most have been created for other reason like protection of watersheds, landscapes and vegetation types. It is therefore difficult to ensure that these areas will serve as real refuges for the species (Vaughan & Temple 2002). On the other hand, there is evidence that even those legally protected areas are considerably affected by anthropogenic activities, mainly by logging, burning, hunting and mining. Therefore even those jaguar populations that are theoretically protected are being seriously affected by human impact (Vaughan & Temple 2002, Blanco & Yerena).

Considering that protected areas are a potentially effective tool for the conservation of jaguars, it is necessary to assess all of the available evidence. In this sense it will be possible to determine whether the creation of protected areas has been effective in improving the conservation status of jaguar population, reducing habitat loss and hunting activities of both jaguars and their prey. Therefore the objective of this review is to compile, to organise and assess the results of maintenance and management programs of protected areas for jaguar conservation, using an evidence-based approach (Sutherland et al. 2004). By means of a systematic review, we expect to determine whether the different strategies used in protecting areas have provided at the same time an effective protection of jaguars and their habitat. 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 of the subject´s available data.

2. OBJECTIVE OF THE REVIEW

2.1 Primary question

Are protected areas an effective tool for the conservation of jaguar populations?

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

Subject	***Intervention***	***Outcome***	***Comparators***	***Designs***
Jaguar (*Panthera onca*)	Planning, creation and management of public and private protected areas that allow the conservation of jaguar populations.	Change in number of jaguars or jaguar trails in the area	Studies with records of density or abundance of jaguars within/outside and before/after the creation of the protected area	Quantitative studies containing data that will permit the evaluation of the intervention using the previously defined comparators and

Subject	*Intervention*	*Outcome*	*Comparators*	*Designs*
			Studies that report landscape lost or changes (from natural to developed, e.g. agriculture, urban etc) outside/inside and before/after the creation of the protected area.	variables. Other variables and comparators could be included once the review has begun
		Change in habitat availability		
		Change in prey availability	Studies that report prey density or abundance within/outside of the protected area, and before/after the creation of the latter	Qualitative studies containing data and reports that permit the evaluation of the interventions
		Change in the number of records of hunting activities of jaguars and their prey	Studies that report hunting events of jaguar or of their natural preys within/outside of the protected area and before/after the creation of the latter	

2.2 Secondary questions

Which of the jaguar´s sources of threat are managed and controlled within the protected areas: hunting or habitat loss?

Are there any differences in the effectiveness of conservation measures for the jaguar in public and private protected areas?

Are the different types of protected areas (defined by the protection level, size and management policies) equally effective for the conservation of the jaguar?

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)
6. Other databases and catalogues that may be relevant to the experts

A internet 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.

Terms in English
1. *Panthera onca*
2. *Panthera onca* AND "Protected area"
3. *Panthera onca* AND Reserve*
4. *Panthera onca* AND "National Park"
5. *Panthera onca* AND "Protected area" AND Hunting
6. *Panthera onca* AND Reserve* AND Hunting
7. *Panthera onca* AND "Protected area" AND "Habitat loss"
8. *Panthera onca* AND Reserve* AND "Habitat loss"
9. *Panthera onca* AND "Protected area" AND "Habitat fragmentation"
10. *Panthera onca* AND Reserve* AND "Habitat fragmentation"
11. *Panthera onca* AND "Protected area" AND Management
12. OR *Panthera onca* AND Reserve* AND Management
13. *Panthera onca* AND "Protected area" AND Law enforcement
14. *Panthera onca* AND Reserve* AND Law enforcement

Terms in Spanish
1. *Panthera onca*
2. *Panthera onca* AND "Área protegida"
3. *Panthera onca* AND Reserva*
4. *Panthera onca* AND "Parque Nacional"
5. *Panthera onca* AND "Área protegida" AND Cacería
6. *Panthera onca* AND Reserva* AND Cacería
7. *Panthera onca* AND "Área protegida" AND "Pérdida de hábitat"
8. *Panthera onca* AND Reserva* AND "Pérdida de hábitat"
9. *Panthera onca*AND "Área protegida" AND "Fragmentación de hábitat"
10. *Panthera onca* AND Reserva* AND "Fragmentación de hábitat"

11. *Panthera onca* AND "Área protegida" AND Manejo
12. *Panthera onca* AND Reserva* AND Manejo
13. *Panthera onca* AND "Área protegida" AND Guardería
14. *Panthera onca* AND Reserva* AND Guardería

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 analyses the first 100 references of each search will be reviewed. These references will have to be available in Word, Pdf o other similar 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 is the jaguar (*Panthera onca*) in his entire range of distribution.

3.2.2 Types of intervention:

The intervention of this review will be the design, creation and management of both public and private protected areas in the range of distribution of the jaguar populations.

3.2.3 Types of comparator:

Ideally, studies considered in this review will mention spatial comparators associated with jaguar numbers or trails, habitat and prey availability, as well as numbers of hunting report of jaguars and prey of the latter. The spatial comparison which considers the above variables will be carried out using data from protected areas (national and private) as well as data from

areas that lack any type of protection measures for the jaguar and its habitat. Temporal comparators will also be considered for the above studies using data from before and after the creation and management of the protected areas.

3.2.4 Types of outcome:

All studies that have information on the effectiveness of the protected areas for the conservation of the jaguar (studies that describe population trends, food availability, habitat fragmentation and loss, hunting events/activities of jaguars and prey of the latter) will be included in this review. All population variables mentioned in the available literature will also be considered, as well as that describing the number of jaguar individuals and trails. Other variables will also be considered once the review has started.

3.2.5 Types of study

All studies that report information on the subject, intervention and indicators/variables of this review will be considered to evaluate the effectiveness of this intervention. This review will consider scientific articles, reports, institutional and non-institutional reports, theses and others. The studies will have to encompass/contain quantitative measures of the proposed variables. However, studies that have descriptions or qualitative data will be verified 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
    - Isolation of jaguar populations
    - Local threats for the Jaguar
2. Monitoring methods for the jaguar and its natural prey
3. Evaluation methods of the threats present within the protected areas
4. Design, creation and management of protected areas:
    - Type of protected area
    - Size of protected area
    - Management policies of the protected area
    - Conservation status of the protected area
5. Social and institutional factors:
    - Cultural value of the jaguar
    - People involved in the management of the protected area
    - Land use
    - Environmental education and public awareness of the importance of protected areas
    - Support from experts and researchers
        - Availability of funds and institutional support

Other general variables that may affect the analyses are: climatic patterns, social development and local economic policies, human population density and structure, and others.

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.

3.2. 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 categorization/classification, a second reviewer will evaluate/assess a sample of 25% of the studies to verify/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/reviewed, and the studies reassessed/re-evaluated.

3.3. Data extraction strategy

The data extraction for this review will be performed by a single reviewer, who will summarise and organize 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 error and experimental bias will be considered:

- Differences in the scale of the analysis and scale 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.

3.4. 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, organization, 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

None expected.

We would like to thank PROVITA, for initiating the first project of Evidence-based Conservation in Venezuela, and for including us in the work team. Thanks to Professor Jafet Nassar for all the support and guidance that he has given us from the beginning of the exercise.

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