

## Editorial

# Tropical Conservation Science: a first special issue

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The current issue of *Tropical Conservation Science* is the first special issue published by *TCS* and it focuses on a very important group of mammals, the ungulates, in a megadiverse country in the Neotropics, Mexico [1]. The guest editors for this issue are Dr. Sonia Gallina and Dr. Salvador Mandujano, research scientists at the Instituto de Ecología, A.C. in Mexico. Drs. Gallina and Mandujano took the initiative in proposing, organizing and assembling the special issue. All papers in this special issue went through a peer-review process.

To place the special issue in perspective, the following comments may be relevant.

According to the Smithsonian Institution there are about 257 recognized species of ungulates world-wide [2]. Of these, at least five species have gone extinct in the last 300 years due to anthropogenic pressures, and many other species are of critical conservation concern [2].

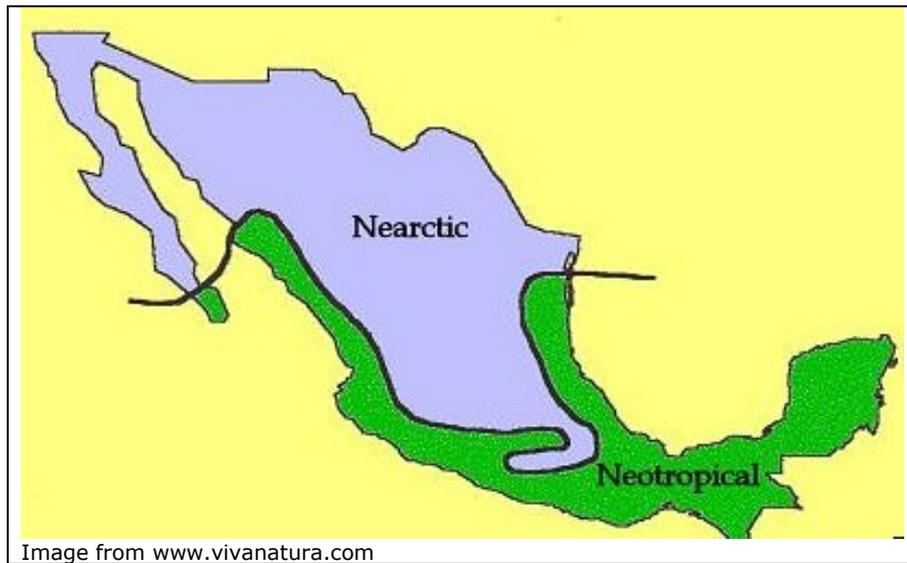
Ungulates account for the vast majority of large herbivores currently on earth and their native range includes all zoogeographic regions except Antarctica [3]. With human help, ungulates have expanded also into many geographical regions in the globe and in others, where they had become extinct, they have been reintroduced, e.g., the horse in the American continent [4,5].

In the American continent there are 34 reported species of ungulates, representing 13% of the ungulate species worldwide [6]. Eleven ungulate species are found in Mexico (one Perissodactyl species and ten Artiodactyl species), which correspond to 32% and 4% of ungulate species in America and worldwide, respectively [6].

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Mexico harbors the transition zone dividing two of the world's major biogeographical zones forming a bridge between the Nearctic (North American) and Neotropical (central and south America) realms (<http://www.conabio.gob.mx/>). This transition zone appeared approximately 6 million years ago, when the central American land bridge joined the land masses of North and South America [7]. Such contact resulted in an amalgamation of components of two rich ancestral biogeographical zones that gave origin to a rich mixture of fauna and flora and to many endemic species. The ungulates of Mexico are a case in point. For example, five species (pronghorn antelope, bison, bighorn sheep, elk, and mule deer) inhabit its Nearctic region, four species (tapir, red brocket, Yucatan brown brocket and white lipped peccary) inhabit the Neotropical region, and the remaining two species (white-tailed deer and collared peccary), with the widest geographical and ecological distribution, are found throughout the country [6]

According to the fossil records, in Mexico ungulates were much more widespread in the geologic past and were represented by many more species. The Quaternary Period, the most recent among the subdivisions of the geologic record, is constituted by two epochs, the Pleistocene, 2.6 million years ago until around 10,000 years ago and the more recent epoch known as the Holocene [8]. The quaternary was characterized by frequent glacial stages alternating with warm episodes. While ice sheets and the coldest conditions predominated in the north of the American continent, in the southern United States, Mexico and Central America the lands were free of ice, except the high mountains. Climatic conditions never were severe in Mexico [9], favoring more diversified plant and animal communities and the persistence of ungulates.

An important aspect that characterized the Quaternary, and especially the end of the Pleistocene, is the extinction of many plant and animals. It is argued that such extinctions were caused by climatic change and ecological imbalance, but proliferation of early Americans and excessive hunting also have been proposed. These theories are still a subject of debate [10]. Fossil remains of Pleistocene ungulates have been unearthed in

Mexico since the Spanish colonization. Mammoths, camelids and bison, were among the most attention-calling fossils.

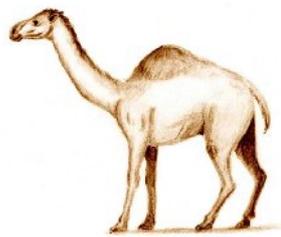
Currently, 770 fossiliferous localities in Mexico have generated about 15,000 mammal records [9]. These records indicate the existence in the Pleistocene in Mexico of 42 ungulates (excluding 5 Probocidae) of which 74% became extinct in the late Pleistocene/early Holocene (see Appendix).

Examples of three extinct ungulates from Mexico and North America. From left to right, horse (one of 5 extinct species), camel (one of eight extinct species) and the largest bison species (one of four extinct species – only one species is currently found in North America, *Bison bison*).



*Equus pacificus*

Source of image:  
<http://www.paleoportal.org/i>



*Camelops hesternus*

Source of image  
<http://en.wikipedia.org/wiki/Camelops>



*Bison latifrons*

Source of image:  
<https://www.dmr.nd.gov/ndfossil/poster/PDF/Bison%20latifrons.pdf>

The role of ungulates in human history is very significant. Ungulates were a source of food for early man for thousands of years [11]. In more recent times, some of the earliest domesticated animals such as goats and sheep were ungulate species, and ungulates such as horses and others were a key-stone resource for development in many ancient cultures in the old World and continue to be used world-wide for transportation and other activities [2]. Humans continue to use ungulates to provide meat, milk, fiber, and transportation, among other benefits, and are very important in the daily livelihoods of rural people in various geographic regions, including the tropics [12].

Ungulates play an important ecological role in tropical forests. For example, as a result of their fruit-eating habits, many influence seed dispersal and seed germination for many fruit trees; their browsing may also control some herbaceous populations which otherwise can grow in high numbers and their seasonal movement may, in general, impact various aspects of the dynamics of the landscapes [13].

In Latin America subsistence hunting is an important activity that provides a substantial proportion of high-quality protein in the diets of rural people and is also an important source of income. For example, in the Brazilian Amazon alone an estimated 14 million animals are consumed annually and wild meat is often sold to obtain cash to buy other subsistence items [14-16].

Ungulates are among the preferred species for subsistence hunting because they provide large amounts of good quality meat and in several parts of Latin America the tapirs, deer, and peccaries are considered among the most preferred species of Neotropical subsistence hunters [15,16]. The impact of unsustainable hunting of ungulate populations is unknown for some species, but it is believed that some species can be more affected than others [15]. However the resulting local extirpation or decline of populations of ungulates as a result of excessive hunting can have important consequences for the dynamics of habitat regeneration via reduction of primary and secondary seed dispersal and the altering of the species composition of seedlings and saplings, among others [13]. Coupled to hunting, habitat loss and fragmentation as well as disease transmission are factors that also contribute to declines in ungulate populations in the tropics including Mexico [16].

The above pressures have placed many ungulates in the tropics at risk. The IUCN Red List database indicates that six of the ungulates that occur in Mexico are in the “least concerned” category, two in the near “threatened” category, one “endangered,” one “vulnerable,” and one for which data are insufficient (see table below). The Mexican environmental agency, SEMARNAT, using its own ranking system lists four of the eleven species as “endangered” and two as threatened (see table below).

The papers in this special issue address a variety of aspects regarding the conservation of the ungulate species that occur in Mexico. These cover aspects of geographic distribution and conservation, assessments of the relative success of government-sponsored management of white-tailed deer, simulating habitat features and management strategies for harvestable ungulates and the monitoring of feral pigs, among others. Five of the papers deal with aspects of white-tailed deer conservation and management, possibly a reflection of the importance of this ungulate in the subsistence economy of local communities and of the ease with which it can be maintained in captive or semi-captive conditions. In short, the special issue sets the stage for further research and conservation assessments of populations of the ungulate species that occur in the transition zone between the Nearctic and Neotropical realms.

| Species                       | Status (IUNC)   | Mexico -SEMARNAT (NOM-059, 2001)         |
|-------------------------------|-----------------|--|
| <i>Odocoileus virginianus</i> | Least Concern   | NDA*                                     |
| <i>Odocoileuias hemionjus</i> | Least Concern   | (A) Amenazada (threatened)               |
| <i>Pecari tajacu</i>          | Least Concern   | NDA                                      |
| <i>Mazama pandora</i>         | Vulnerable      | NDA                                      |
| <i>Mazama temama</i>          | Data deficient  | NDA                                      |
| <i>Ovis canadensis</i>        | Least Concern   | (P) En peligro de Extinción (endangered) |
| <i>Antilocapra americana</i>  | Least Concern   | (P) En peligro de Extinción (endangered) |
| <i>Tapirus bairdii</i>        | Endangered      | (P) En peligro de Extinción (endangered) |
| <i>Tayassu pecari</i>         | Near threatened | (A) Amenazada (threatened)               |
| <i>Bison bison</i>            | Near threatened | (P) En peligro de Extinción (endangered) |
| <i>Cervus elaphus</i>         | Least concern   | NDA                                      |

\*NDA: no data available

Source IUCN: <http://www.iucnredlist.org/> Accessed 18 May 2009

Source SEMARNAT: <http://www.profepa.gob.mx/NR/rdonlyres/84142613-CF26-4223-B7E9-38BE4AEB0C96/1426/NOMECOL0592001.pdf> Accessed 18 May 2009

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**Appendix.** List of extinct and extant ungulates of Mexico based on Arroyo-Cabrales et al. (2007 – ref [8]).  
 \* Modern classification based on molecular techniques do not include this order in the formerly known group Ungulata, but it is still considered a closely related order [2,3]. + Formerly *Mazama Americana*. ++ Species not included by Arroyo-Cabrales et al. (2007 – ref [7]), but known as an endemic species of Mexico [3].

| Order          | Family          | Species                          | Extinct   | Present   |
|----------------|-----------------|----------------------------------|-----------|-----------|
| Artiodactyla   | Antilocapridae  | <i>Antilocapra americana</i>     |           | X         |
|                |                 | <i>Capromeryx mexicana</i>       | X         |           |
|                |                 | <i>Capromeryx minor</i>          | X         |           |
|                |                 | <i>Stockoceros conklingi</i>     | X         |           |
|                |                 | <i>Tetrameryx mooseri</i>        | X         |           |
|                |                 | <i>Tetrameryx shuleri</i>        | X         |           |
|                |                 | <i>Tetrameryx tacubayen</i> Yess | X         |           |
|                | Bovidae         | <i>Bison alaskensis</i>          | X         |           |
|                |                 | <i>Bison antiquus</i>            | X         |           |
|                |                 | <i>Bison bison</i>               |           | X         |
|                |                 | <i>Bison latifrons</i>           | X         |           |
|                |                 | <i>Bison priscus</i>             | X         |           |
|                |                 | <i>Euceratherium collinum</i>    | X         |           |
|                |                 | <i>Oreamnos harringtoni</i>      | X         |           |
|                |                 | <i>Ovis canadensis</i>           |           | X         |
|                | Camelidae       | <i>Camelops hesternus</i>        | X         |           |
|                |                 | <i>Camelops mexicanus</i>        | X         |           |
|                |                 | <i>Camelops minidokae</i>        | X         |           |
|                |                 | <i>Camelops traviswhitei</i>     | X         |           |
|                |                 | <i>Eschatius conidens</i>        | X         |           |
|                |                 | <i>Hemiauchenia blancoensis</i>  | X         |           |
|                |                 | <i>Hemiauchenia macrocephala</i> | X         |           |
|                |                 | <i>Procamelops minimus</i>       | X         |           |
|                | Cervidae        | <i>Cervus elaphus</i>            |           | X         |
|                |                 | <i>Mazama temama</i> +           |           | X         |
|                |                 | <i>Mazama pandora</i> ++         |           | X         |
|                |                 | <i>Navahoceros fricki</i>        | X         |           |
|                |                 | <i>Odocoileus halli</i>          | X         |           |
|                |                 | <i>Odocoileus hemionus</i>       |           | X         |
|                |                 | <i>Odocoileus virginianus</i>    |           | X         |
|                | Tayassuidae     | <i>Pecari tajacu</i>             |           | X         |
|                |                 | <i>Platygonus alemanii</i>       | X         |           |
|                |                 | <i>Platygonus compressus</i>     | X         |           |
|                |                 | <i>Platygonus ticuli</i>         | X         |           |
|                |                 | <i>Tayassu pecari</i>            |           | X         |
| Perissodactyla | Equidae         | <i>Equus conversidens</i>        | X         |           |
|                |                 | <i>Equus mexicanus</i>           | X         |           |
|                |                 | <i>Equus pacificus</i>           | X         |           |
|                |                 | <i>Equus parastylidens</i>       | X         |           |
|                |                 | <i>Equus tau</i>                 | X         |           |
|                | Tapiridae       | <i>Tapirus bairdii</i>           |           | X         |
|                |                 | <i>Tapirus haysii</i>            | X         |           |
| Proboscidea*   | Elephantidae    | <i>Mammuthus columbi</i>         | X         |           |
|                |                 | <i>Mammuthus primigenius</i>     | X         |           |
|                | Gomphotheriidae | <i>Cuvieronius tropicus</i>      | X         |           |
|                |                 | <i>Stegomastodon mirificus</i>   | X         |           |
|                | Mammutidae      | <i>Mammut americanum</i>         | X         |           |
| <b>Total</b>   |                 |                                  | <b>36</b> | <b>11</b> |