Rapid decline of White-Lipped Peccary Populations in Mesoamerica



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Rapid Decline of White-lipped Peccary Populations in Mesoamerica

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1. Abstract

The white-lipped peccary (Tayassu pecari) is a social ungulate that forms groups of 10 to 300 individuals and ranges over extensive areas in well-preserved Neotropical forests. White-lipped peccaries are particularly sensitive to forest fragmentation and hunting pressure, and frequently are the first large mammal species to disappear when humans colonize an area. For these reasons, they have become the most endangered ungulate species in Mesoamerica and are currently listed as Vulnerable on the global IUCN Red List of Threatened Species. In order to draw attention to reported widespread declines across the region, a group of academics and conservationist held a symposium to assess the current population status of white-lipped peccaries and identify the main threats to the species across Mesoamerica. Experts from the 7 countries of Mesoamerica where white-lipped peccaries remain discussed the status, threats and priority conservation actions for each country. Results indicate that the species has been eliminated from 87% of its historical range, and is in critical condition in all 7 countries, with stable and large populations only remaining in the tri-national Maya Forest (Guatemala, México and Belize), and in El Darien in Panama. All other populations are either significantly smaller or highly threatened and becoming isolated at an alarming pace. Based upon this expansive review conducted by experts working across the region, we suspect that white-lipped peccaries should potentially be considered endangered in Mesoamerica and we recommend that urgent action is taken to conserve the species and their forest habitat.

2. Introduction.

The white-lipped peccary (*Tayassu pecari*) is one of three extant species of peccaries. Peccaries are pig-like animals from the *Tayassuidae*, a family of ungulates found in the Neotropics. White-lipped peccaries are distributed in suitable habitat between northern Argentina and southern Mexico. The largest continuous population is in the Amazon forest, but smaller and isolated populations are scattered from Panama to Mexico (Altrichter *et al.* 2012).

White-lipped peccaries mainly inhabit humid well-preserved lowland tropical forests, although there are populations in dry and semi-dry forest zones (e.g. the Gran Chaco ecosystem of Paraguay, Bolivia, and Argentina; the Calakmul forest, México; the semi-deciduous forests in Costa Rica and the llanos of Venezuela; Sowls 1997). They range across habitats from sea level to as high as 1900m in altitude, including the eastern slopes of the Andes. Typically they prefer to be near water bodies such as rivers, lakes, or water holes, especially during the dry season (Sowls 1997, Reyna-Hurtado *et al.* 2016). Because peccaries live in large cohesive groups and have extensive home ranges, they require large continuous areas of undisturbed habitat (Sowls 1997, Fragoso 1998, Reyna-Hurtado *et al.* 2009, Altrichter *et al.* 2012).

Group size can vary from rarely fewer than 10 to occasionally more than 300 individuals (Sowls 1997, Moreira-Ramirez *et al.* 2015, Reyna-Hurtado *et al.* 2016). Historically there were reports of herds of hundreds of white-lipped peccaries (Sowls 1997); however hunting and habitat destruction have dramatically reduced group sizes (Reyna-Hurtado et al. 2016). White-lipped peccaries are highly prized by subsistence and market hunters (Sowls 1997, Reyna-Hurtado et al. 2010; Keuroghlian et al. 2013). The white-lipped peccary's social behaviour is highly developed, with individuals defending each other when they are in danger. This behaviour makes it easy for hunters to locate and kill numerous individuals of the same group at once. The use of modern weapons and the species' proclivity to concentrate near water sources and mud wallows, combined with its fearlessness,

can result in high numbers being killed at a single time (Peres 1996; Altrichter & Almeida 2002; R. Reyna-Hurtado, pers. obs.).

Currently, the species is listed on Appendix II of the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) and classified as Vulnerable on the global IUCN Red List (Keuroghlian *et al.* 2013). In some areas of Brazil and in all of Mexico, it is presently considered by the national environmental authorities as Endangered or Critically Endangered at the local or national level (Brazil: Keuroghlian *et al.* 2012, Mexico: Secretaria de Medio Ambiente y Recursos Naturales-SEMARNAT, NOM-059, 2010). The global IUCN Red List assessment shows an estimated 20.5 percent reduction of the species' global range over the last 100 years

(http://maps.iucnredlist.org/map.html?id=41778), with certain regions suffering more severe reductions, as well as some local extinctions. The species has been extirpated from entire countries such as El Salvador and Uruguay (Altrichter *et al.* 2012) and had been reported to disappear from more than 80% of its historical range in Costa Rica, Guatemala, Mexico and Honduras (Altrichter *et al.* 2012; Portillo and Elvir 2016). In another 48% of its current range the white-lipped peccary persists, but with an assumed reduced abundance and a low to medium probability of long-term survival (Altrichter *et al.* 2012). Prior to this analysis major range declines were recorded in Argentina, Paraguay, southern Brazil, Colombia, Venezuela, northeast Brazil, Guatemala, Mexico, and Costa Rica (Altrichter *et al.* 2012; Keuroghlian *et al.* 2012).

These range reductions have been driven by wide-scale habitat loss and degradation, commercial harvesting, unsustainable levels of subsistence hunting, and zoonotic diseases likely spread from domestic livestock (Keuroghlian *et al.* 2013) with populations in the more xeric systems, such as South America's Caatinga, Cerrado, and Pampas, particularly at risk (Altrichter *et al.* 2012.). Forest fragmentation makes white-lipped peccary populations highly vulnerable to extinction because of the species' requirement of high diversity habitats, (Keuroghlian & Eaton 2008), constantly available sources of water (Keuroghlian & Eaton 2008; Beck *et al.* 2010; Reyna-Hurtado *et al.* 2012), diversity and

abundance of fruiting sources (Beck *et al.* 2005, Beck 2006, Keuroghlian & Eaton 2008; Keuroghlian & Eaton 2009), and relatively large home ranges that sometimes extend outside protected areas (Fragoso 1998; Almeida-Jacomo *et al.* 2013; Reyna-Hurtado *et al.* 2009).

The impact of human disturbance on the species is escalating due to rapidly expanding agricultural frontiers and sprawling road networks that are fragmenting forests and allowing hunters access to previously remote areas (Rivera 2014, WWF 2018). Unsurprisingly, in areas with human pressure, group size is negatively correlated with distance to nearest human settlements, whereas in undisturbed areas group size is dependent upon rainfall, which may be a surrogate variable for resource productivity (Reyna-Hurtado *et al.* 2016).

From Panama through Mexico the situation for the white-lipped peccary is cause of particular concern. The sum of the above-described threats in the increasingly densely populated Mesoamerican isthmus has resulted in exceptionally high threats to the species' survival. White-lipped peccary populations are now fragmented across Mesoamerica, with remnant populations highly jeopardized by hunting and habitat fragmentation. These trends motivated the authors of this report to hold a symposium in 2016, to undertake a regional review of the species based upon expert opinion, experience and data.

3. Objectives and Goals

Long term monitoring projects in strategic sites in Mesoamerica (Maya forest in Guatemala and Mexico; Darién, Panama; Bosawas, Nicaragua) carried out by academic or conservationist organizations (El Colegio de la Frontera Sur; The Wildlife Conservation Society, Yaguara Panama) have suggested that the situation for the white-lipped peccary in this region is quite different than its situation in the Amazon forest. There are concerns that the species' current global status of Vulnerable on the IUCN Red List, which includes vast areas in South America where its survival is more secure, does not accurately represent the status of the species in Mesoamerica, where it is highly jeopardized. Recognizing the need for a regional review, a group of scientists and conservationists convened a symposium

in Belize in August 2016 to discuss the status of the species from Panama to Mexico. Participants contributed information on current range, status of the populations, main threats and conservation actions needed for white-lipped peccaries in each of the seven Mesoamerican countries where the species still exists (Mexico, Guatemala, Belize, Honduras, Nicaragua, Costa Rica and Panama; the species is extinct in El Salvador). This report contains the main results obtained from the symposium and provides information to evaluate the species at the regional level. We also hope that the information provided helps environmental agencies in Mesoamerica to re-evaluate the species' status in each country.

4. Methods

In June 2016, we sent a questionnaire to experts in each of the seven countries; we requested that each expert coordinate with other national researchers to compile information regarding populations of white-lipped peccary in their country. We selected experts based upon extensive in-country field research experience, possession of data on white-lipped peccary abundance and distribution, and their ability to engage with fellow-researchers in their country.

This questionnaire required coordinators and their in-country contacts to gather information on current range of the species in each country, and requested that they review and compile records with spatial information (publications, records of the species) to estimate, to best of their knowledge, the current distribution range of the species, the areas from which the species was known to have disappeared, and areas in need of exploration/additional research. The questionnaire also asked for estimates of population size (within categories of 0-1000, 1000 to 5000, more than 5000), estimates of average group size (0-50, 50-100, 100-300, more than 300), main threats to these populations (hunting, habitat loss, diseases, etc.), and whether the population was perceived to be stable, increasing or decreasing (See Appendix).

All coordinators delivered responses to the questionnaire in advance of the meeting that took place on August 24th, 2016 in Belize City as a part of the wider

XX Congress of the Mesoamerican Society for Biology and Conservation. The objectives of the symposium were described with an opening presentation led by Dr. Rafael Reyna and Dr. Jeremy Radachowsky, followed by seven presentations summarizing existing knowledge regarding the species for each country. The final section of the symposium involved a mapping exercise to plot the current range of the species from Mexico to Panama on a single map. This exercise was led by Dr. Daniel Thornton of Washington State University, who used polygons, shapefiles, and drawings to elaborate maps representing the best up-to-date knowledge on the species' distribution across Mesoamerica.

5. Results

Respondents identified 29 populations of white-lipped peccaries scattered across seven countries of Mesoamerica. Twenty of the 29 populations showed a decreasing trend (69%), four were classified as unknown (14%) and four were stable (14%). Only one population was reported to be increasing (3%). The majority (75%) of national populations were estimated to be less than 1000 animals, and in most cases where data was available, current group sizes were estimated to be fewer than 50 animals (75%) (Table 1), which – compared to remote sites, and historical records – demonstrated a reduction in group size for this species (Altrichter *et al.* 2012; Reyna-Hurtado *et al.* 2016).

Stable populations greater than 1,000 individuals were reported only in the tri-national Maya Forest (Calakmul Biosphere Reserve in Mexico, Maya Biosphere Reserve in Guatemala and Rio Bravo Conservation and Management Area of Belize) and Darien National Park in Panama, with smaller but stable, or increasing, populations in the Maya Mountains complex of Belize and Corcovado National Park, Costa Rica. All other populations are experiencing rapid decreases due to habitat loss, hunting pressure and loss of connectivity (Table 1). Large-scale numerical estimates of white-lipped peccaries are problematic due to their lack of individual identifying markers, unpredictable wide-ranging movements, and often in the larger remnant habitats, difficult access. Changes in ranges and group sizes therefore constitute the most universal and reliable metrics for evaluating white-

lipped peccary population stability (Altrichter et al. 2012; Reyna-Hurtado et al. 2016). Due to the fact that most of the populations are decreasing, few are stable and only one increasing, and with historical connectivity of the species across much of Mesoamerica now completely disrupted and remnant populations nearly or completely isolated, the overall trends were summarized as negative.

Most experts reported hunting pressure and habitat loss as the main threats to all populations, and, in addition, one population was reported to be impacted negatively by seasonally limited surface water availability (Calakmul Biosphere Reserve, Mexico). Diseases are an unknown factor, but have been suggested to reduce white-lipped peccary populations and distributions to some extent (Fragoso *et al.* in preparation). Lack of connectivity among populations is already a grave concern. At least 10 of 29 populations detected in this study may no longer exist, or may only consist of few individuals isolated in one or two small groups (Dzilam and Area de Protección de Laguna de Terminos in Mexico; Sarstoon-Temash National Park in Belize; Donoso, Portobelo and Chagres in Panama; and four populations in Eastern Costa Rica). These populations were determined by a single or very few records in the last ten years (Moreno and Meyer 2014). Some of those records came from severely fragmented areas of these countries, increasing the likelihood that these small populations may already be extinct (Table 1).

Country	Populations	Population size (range)	Group Size (range)	Main Threats	Trend
Mexico	Calakmul Biosphere Reserve	1000-5000	<50	Hunting, Dry up of water sources	Stable
Mexico	Montes Azules Biosphere Reserve	1000-5000	50-100	Hunting, habitat loss	Decreasing

Table 1. Estimated population size, group size, main threats and population trend

 of white-lipped peccary populations from seven countries of Mesoamerica.

Mexico	Dzilam State Reserve	1-1000	<50	Hunting habitat loss	Decreasing
Mexico	Sian Kaan Biosphere Reserve	1-1000	?	Hunting and habitat loss	Decreasing
Mexico	Chimalapas region	1-1000	?	Hunting, habitat loss	Decreasing
Mexico	Area de Protección de Flora y Fauna Laguna de Terminos	1-1000	<50	Hunting, habitat loss	Unknown
Belize	Northeastern Belize	1-1000	Unknown	Hunting	Unknown
Belize	Rio Bravo and Gallon Jug Private Conservation Areas	Unknown	Unknown	Habitat loss, hunting	Unknown
Belize	Maya Mountains Massif	Unknown	50-100	Habitat loss and hunting	Increasing
Belize	Sarstoon-Temash National Park	1-1000	Unknown	Hunting	Unknown
Guatemala	Eastern Maya Biosphere Reserve	1000-5000	50-100	Hunting and habitat loss	Decreasing/Stable
Guatemala	Sierra del Lacandon National Park	1-1000	<50	Hunting and habitat loss	Decreasing
Honduras	Rio Platano Biosphere Reserve, Tawahka, Consejos Territoriales	1000-5000	<50	Hunting and habitat loss	Decreasing

Honduras	Patuca National Park	1-1000	<50	Hunting and habitat loss	Decreasing
Nicaragua	Bosawas Biosphere Reserve	1-1000	<50	Habitat loss	Decreasing
Costa Rica	7 populations (Protected areas of: Santa Rosa, Corcovado, La Amistad and in: 4 in the Eastern Central area of the country)	1-1000	<50 but one of 150	Hunting and habitat loss	Decreasing/Stable
Panama	Darien National Park	1000-5000	50-300	Hunting and habitat loss	Stable
Panama	Santa Fe National Park	1-1000	<50	Hunting and habitat loss	Decreasing
Panama	Donoso Multiple Use Area	1-1000	<50	Hunting and habitat loss	Decreasing
Panama	Portobelo National Park	1-1000	<50	Hunting and habitat loss	Decreasing
Panama	Chagres National Park	1-1000	<30	Hunting and habitat loss	Decreasing
Panama	Parque Internacional de la Amistad	1-1000	50-100	Hunting	Decreasing
Panama	Palo Seco Bosque Protector	1-1000	50-100	Hunting and habitat loss	Decreasing

Our mapping results indicate that the species has been completely eliminated from 87% of what was estimated to be its historical range in Mesoamerica (an area that

was estimated to be inhabited by the species around the year 1492, WCS Bolivia Workshop 2005). This reduction is even more dramatic than the most recent estimate by Altrichter et al. (2012) based on data collected in 2005, upon which the current IUCN categorization for the species was based.



Figure 1. Map of historical (hatched) and estimated current (green) distribution of white-lipped peccary in Mesoamerica.

6. Discussion

The future for the white-lipped peccary in Mesoamerica is not optimistic. Seventy percent of the isolated remnant populations were reported to be decreasing with only 17% showing a stable or increasing trend within large blocks of intact habitat and/or protected areas. Given the large areas (>100 km²) that groups need for their survival (Fragoso 1998; Reyna-Hurtado et al. 2009; Almeida-Jacome *et al.* 2013), it is not surprising that only Mesoamerica's largest areas of forest, such as the trinational Maya Forest (>30,000 km²) and Darien National Park in Panama (>5,790 km²) contain the region's most stable populations. We estimated that less than 2000 white-lipped peccaries may survive in the Calakmul Biosphere Reserve, within the northern section of the tri-national Maya Forest (Reyna-Hurtado *et al.* 2010); however, together with the contiguous forests of the Maya Biosphere Reserve in Guatemala and Rio Bravo in Belize, the entire Maya Forest hosts the largest white-lipped peccary population stronghold in Mesoamerica, with an estimated population of around 5000 individuals.

In addition to the Maya Forest, Mesoamerica's other comparatively large forest blocks currently provide the highest probability of long-term survival (more than 50 years) for white-lipped peccaries, such as the vast block including Darien National Park of Panama and contiguous forests in the Colombian Department of Choco. The remote forests of the bi-national complex of the Rio Platano and Tawahka Asagni Biosphere Reserves in Honduras, and the Bosawas Biosphere Reserves in Nicaragua also harbour populations likely to persist at least 50 years or more. Two stable, and likely increasing, white-lipped peccary populations were reported in Corcovado National Park in Costa Rica and in the Maya Mountains Massif of Belize. We estimated both populations to be smaller than those in the Maya Forest or Darien-Choco forest, but experts considered their probability of long-term survival to be high due to the efficacy of conservation interventions in these areas, and especially if connectivity with other populations are smaller than 1000 and live in highly fragmented landscapes. Some are known only from a few old records and may have been extirpated (for example, Donoso Multiple Use Area in Panama; Dzilam State Reserve in Yucatan Mexico; Sarstoon-Temash National Park in Belize).

The major threats identified across all countries were hunting pressure and habitat loss. Although experts were not able to define the comparative severity of each threat, there is evidence that targeted and sustained hunting pressure may extirpate entire populations even from areas of well-preserved forest (for example, in large *"ejidos"* or communal forests of southern Mexico (Reyna-Hurtado et al. 2010). Experts agreed however, that the combination of targeted hunting and habitat loss is the worst scenario for the conservation of white-lipped peccaries in Mesoamerica.

We believe that the status of white-lipped peccaries in Mesoamerica is far more critical than represented by the species' current global IUCN classification as Vulnerable (Keuroghlian et al 2013). Approximately 500 years ago, this species occurred across virtually all of Mesoamerica's Caribbean slope from Belize through Panama. Populations also extended well into the semi-deciduous forests of Costa Rica. In 2005 it was estimated that more than 73% of the historic range was lost (Altrichter et al. 2005), in our 2016 exercise this was refined to 87%. The current population range is estimated to be 52% smaller than the 2005 estimate. This reduction may be an artefact of a better definition of current polygons inhabited by the species in every country of Mesoamerica in the 2016 assessment vs. the 2005 assessment, which looked at the whole range, including South American countries, but it may also indicate a strong acceleration of population decline in recent decades.

Based upon this information, in Mesoamerica the species is predicted to persist for more than 50 years or more only in the tri-national Maya Forest, Darien National Park in Panama, Corcovado National Park in Costa Rica, and in select sections of the bi-national Mosquitia spanning Honduras and Nicaragua. The species is in jeopardy with the remaining two-thirds of the populations already being small, genetically isolated, highly threatened and some likely already extinct.

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Today's current strongholds are effectively just remnants of a precipitous regional decline in range and group size that justifies a regionally accurate classification and the development of conservation action in each country to help spur action to arrest or at least slow population collapse.

Our results indicate that effective conservation of white-lipped peccaries requires large, connected forest areas free of heavy hunting pressure. The species has the most stringent needs for expansive, undisturbed forest of all the ungulates and large mammals in the region. Given their vulnerability, the simple presence of resident herds of white-lipped peccaries in Mesoamerican protected areas has increasingly become an indicator of conservation success. Based on herd home range estimates of 100 km² (Fragoso 1996, Reyna-Hurtado et al. 2009) and groups of 50 animals or less, a population of at least 500 animals (minimum viable population size from genetic criteria; Soulé 1987), requires areas of forest of at least 1000 km² to hold at least 10 groups, and due to the species' dependence on mature, well-conserved tropical forest, it is reasonable to suggest that adequate conservation of white-lipped peccaries would confer protection for other wide-ranging, large-bodied species such as Central American tapir (*Tapirus bairdii*), jaguar (*Panthera onca*), brocket deer (*Mazama temama* and *M. pandora*), and puma (*Puma concolor*), among others.

7. Conclusion

Our assessment indicates that the white-lipped peccary has been extirpated from 87% of its historical range in Mesoamerica. If not swiftly arrested, this overwhelming and rapid negative trend will continue. Of the remaining 29 scattered populations 20 are decreasing and only 5 are stable or increasing. The results of this rapid analysis indicate that the global IUCN Red List status of the species (Vulnerable, Keuroghlian *et al.* 2013) may not accurately represent the status of Mesoamerican populations. Further analysis is required for an evaluation of whitelipped peccary conservation status at the Mesoamerican level according to IUCN Red List guidelines. However, we hope that this regional expert assessment of the species can boost conservation action in every country to secure remaining populations to avoid a very real possibility of its extinction.

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9. Appendix

Questionnaire

White-lipped peccary in Mesoamerica: Status, Threats and Conservation Actions Dear Symposium participant:

We are glad that you will be participating in the Symposium in Belize and will share data and knowledge on the white-lipped peccary distribution and status from your area of expertise. To achieve the goals of this symposium we are asking you to **respond to the queries below by August 17** and to bring the following data and your presentation structured in the way described below. We are very happy to have you with us and look forward to seeing you in Belize! Rafael, Jeremy and Lee

1. Map of Current Distribution

Please provide a schematic map of your country/ies of expertise with the current distribution of white-lipped peccaries drawn to the best of your ability, according to the following three categories:

(a) Areas of known current distribution (please label each area with a name)

(b) Areas where the species does not currently exist

(c) Unknown areas / areas (within the historical distribution range, for which expert knowledge is not available)

Hand-drawn or digital map images are fine, as well as shapefiles or ArcGIS project files.

2. Short questionnaire on population status and group size per area:

Please respond the following questions for each area where you have knowledge on the status of the species. If you have knowledge of more than one population or area please feel free to copy and paste the table and respond as many times as possible (an <u>example</u> of answer is provided in yellow, please delete and replace with your information).

Name of area	Extension (km²)	West geog. coord. (decimal degrees from a point in the center of the area)	North geog. coord. (decimal degrees from a point in the center of the area)	Legal status of the area (protected or unprotected)
Population size	1-1,000 ind.	1,000-5,000 ind.	5,000-20,000 ind.	More than 20,000 ind.
In which range would you classify the current population size?				
Population trend	Decreasing	Stable	Increasing	Not known
How would you classify the trend of the last 20 years of the population of this area?				

Main threats	Habitat loss or fragmentation	Hunting pressure	Diseases	Other (please describe)
What is the main threat (if any) to the population of this area?				
Group size	1-50	50-100	100-300	More than 300
What is the range of average group size reported for the area?				
What is the maximum group size reported for this area?				

Some open questions for this population:

- 1. Is this population connected with other populations?
- 2. What kind of research has been done in this population?
- 3. Main methods used?

3. Geographic data:

From the extent of your knowledge only, and within the historical distribution range of the species in your country, please send as many points (geographic coordinates in decimal degrees) of the three following categories of area from your country:

Type of area Number	Areas with current confirmed presence of the species (in the last ten years)	Areas where the species has disappeared	Unknown areas
1	West/north	West/north	West/north
2			
3and as many as possible!			

4. Presentation:

Each presentation will be 20 minutes (15 minutes for the presentation and 5 minutes for questions /discussion). So, please feel free to prepare your presentation in your favorite style and format, but be sure to use the following structure:

- 1. An overview status of the species in your country (10 min)
 - 1. Estimated current distribution range and estimated range reduction in the last 20 years
 - 2. Population trend of the species in your country
 - 3. General main threats to the species
- 2. Your main results from your research or experiences with the species in your specific area(s) (5 min)
- **3**. *Questions/ discussion on the country (5 min)*