Robert Wallace, WCS

Andean Bear Priority Conservation Units in Bolivia & Peru

Robert Wallace, Ariel Reinaga, Teddy Siles, Jan Baiker, Isaac Goldstein, Boris Ríos-Uzeda, Russ Van Horn, Renzo Vargas, Ximena Vélez-Liendo, Luis Acosta, Viviana Albarracín, Jessica Amanzo, Paula De La Torre, Enrique Domic, Marco Enciso, Cecilia Flores, Alicia Kuroiwa, Renata Leite-Pitman, Karen Noyce, Susanna Paisley, Bader Peña, Heinz Plenge, Roxana Rojas, Vera Pinto, Trinidad Tapia, Héctor Vela

Results of the Binational Workshop for the Conservation of the Andean Bear in Bolivia and Peru, November 8th & 9th 2008, held as part of the II International Symposium on the Andean Bear in Lima, Peru.

Andean Bear Priority Conservation Units in Bolivia & Peru

Robert Wallace, Ariel Reinaga, Teddy Siles, Jan Baiker, Isaac Goldstein, Boris Ríos-Uzeda, Russ Van Horn, Renzo Vargas, Ximena Vélez-Liendo, Luis Acosta, Viviana Albarracín, Jessica Amanzo, Paula De La Torre, Enrique Domic, Marco Enciso, Cecilia Flores, Alicia Kuroiwa, Renata Leite-Pitman, Karen Noyce, Susanna Paisley, Bader Peña, Heinz Plenge, Roxana Rojas, Vera Pinto, Trinidad Tapia, Héctor Vela

November 2014

Results of the Binational Workshop for the Conservation of the Andean Bear in Bolivia and Peru, November 8th & 9th 2008, held as part of the II International Symposium on the Andean Bear in Lima, Peru.

Title:

Andean Bear Priority Conservation Units in Bolivia & Peru

First edition:

November 2014

Editor:

Robert B. Wallace

Collaborators:

Robert B. Wallace, Ariel Reinaga, Teddy Siles, Jan Baiker, Isaac Goldstein, Boris Ríos-Uzeda, Russ Van Horn, Renzo Vargas, Ximena Vélez-Liendo, Luis Acosta, Viviana Albarracín, Jessica Amanzo, Paula De La Torre, Enrique Domic, Marco Enciso, Cecilia Flores, Alicia Kuroiwa, Renata Leite-Pitman, Karen Noyce, Susanna Paisley, Bader Peña, Heinz Plenge, Roxana Rojas, Vera Pinto, Trinidad Tapia, Hector Vela

Participating institutions:

Wildlife Conservation Society, Centro de Biodiversidad y Genética de la Universidad Mayor de San Simón de Bolivia, Universidad Cayetano Heredia de Perú and Antwerp University.

Photographs:

Robert Wallace,
WCS, Mileniusz Spanowicz,
WCS, Julie Larsen

Design:

Salinasanchez Comunicación

Suggested citation:

Wallace, R.B., A. Reinaga, T. Siles, J. Baiker, I. Goldstein, B. Ríos-Uzeda, R. Van Horn, R. Vargas, X. Vélez-Liendo, L. Acosta, V. Albarracín, J. Amanzo, P. De La Torre, E. Domic, M. Enciso, C. Flores, A. Kuroiwa, R. Leite-Pitman, K. Noyce, S. Paisley, B. Peña, H. Plenge, R. Rojas Vera Pinto, T. Tapia & H. Vela. 2014. Andean Bear Priority Conservation Units in Bolivia & Peru. Wildlife Conservation Society, Centro de Biodiversidad y Genética de la Universidad Mayor de San Simón de Bolivia, Universidad Cayetano Heredia de Perú & Antwerp University. La Paz, Bolivia. 80 pp.

Legal deposit: 4-1-2806-14
ISBN: 978-99974-812-2-1

Printed in Bolivia

Author order is based on the following criteria. The first three authors were involved in the design, execution and analysis of questionnaires and/or the design and execution of the workshop and/or the analysis of the results and production of the final report. The next six authors participated in the workshop and made major suggestions on the manuscript. The next sixteen authors either attended the workshop and made minor comments, or made major comments following the workshop.

ACKNOWLEDGEMENTS

A special thanks to the organizers of the II Andean Bear International Symposium, Lima, Peru, November 2008, which facilitated the realization of the Binational Workshop on the Distribution y and Conservation Status of Andean Bear in Bolivia and Peru, which formed the basis for the elaboration of this document.

We also thanks Robyn Appleton, Javier Vallejos and José Vallejos, who participated in the binational workshop.

We especially thank Elvira Salinas and Lilian Painter who translated the document into Spanish.

TABLE OF CONTENTS

LIST OF FIGURES AND TABLES 8

LIST OF CONTRIBUTORS 10

INTRODUCTION 12

METHODOLOGY 13

General Range-Wide Priority Setting Methodology 13

Pre-Workshop Methodology 14

Workshop Objectives 14

Workshop Methodology 14

Post-Workshop Methodology 15

PRELIMINARY RESULTS 15

ANDEAN BEAR DISTRIBUTION IN BOLIVIA AND PERU 16

Summary of Systematized Data 16

Summary of Data Received from 16

Questionnaires 16

HISTORICAL RANGE OF THE ANDEAN BEAR IN BOLIVIA AND PERU 16

AREAS WITH AND WITHOUT ANDEAN BEAR EXPERT KNOWLEDGE IN BOLIVIA AND PERU 18

ANDEAN BEAR EXTIRPATED AREAS FOR BOLIVIA AND PERU 18

PRIORITY ANDEAN BEAR CONSERVATION UNITS (ABCU) IN BOLIVIA AND PERU 18

Workshop Preliminary Results 18

REVIEWED POST-WORKSHOP RESULTS 28

DESCRIPTION OF MODIFIED PRIORITY ANDEAN BEAR CONSERVATION UNITS (ABCU) IN BOLIVIA AND PERU 34

ABCU Central Andes 1: Northwestern Peru 34

ABCU Central Andes 2: Northeastern Peru 38

ABCU Central Andes 3: Central Peru 41

ABCU Central Andes 4: Southern Peru-Northern Bolivia 44

ABCU Central Andes 5: Cotapata-Lambate-Altamachi 47

ABCU Central Andes 6: Carrasco-Amboro 50

ABCU Central Andes 7: Iñao-Tariquia 53

DISCUSSION 56

Andean Bear Historical Range 56

Expert Knowledge Coverage within the Andean Bear Historical Range 56

Andean Bear Actual Range 56

Priority Andean Bear Conservation Units (ABCU) 58

Next Steps and Recommendations 62

LITERATURE CITED 64

APPENDICES 66

Appendix I. Workshop Announcement 66

Appendix II. Letter of Invitation, Range Wide Priority Setting Questionnaire Forms and Instructions 67

Appendix III. Instructions for the Questionnaires concerning the Distribution of the Andean Bear *(Tremarctos ornatus)* 69

Apéndice IV: Geographical regions for the Andean Bear *(Tremarctos ornatus)* 77

LIST OF FIGURES AND TABLES

TABLE 1.	Total number of potential contacts and respondents for the Andean Bear Distribution and Conservation Status Questionnaires in Bolivia and Peru	15
FIGURE 1.	Distribution of Confirmed Andean Bear Localities in Bolivia and Peru	17
FIGURE 2.	Baseline Historical Range for Bolivia and Peru (Peyton 1990)	19
FIGURE 3.	Revised Historical Distribution of Andean Bear in Peru	20
FIGURE 4.	Revised Historical Distribution of Andean Bear in Bolivia	21
FIGURE 5.	Areas With and Without Expert Knowledge for Andean Bear Distribution in Peru	22
FIGURE 6.	Areas With and Without Expert Knowledge for Andean Bear Distribution in Bolivia	23
FIGURE 7.	Areas in Peru where Andean Bears no longer occur	24
FIGURE 8.	Areas in Bolivia where Andean Bears no longer occur	25
FIGURE 9.	Priority Andean Bear Conservation Units in Peru identified by workshop participants	26
FIGURE 10.	Priority Andean Bear Conservation Units in Bolivia identified by workshop participants	27
TABLE 2.	Size and Percentage of Historical Distribution Range of Andean Bear Conservation Units (ABCU) identified by workshop participants in Bolivia and Peru	28
TABLE 3.	Adjusted Post-workshop Summary for Andean Bear Knowledge across the Historical Range in Bolivia and Peru	28
FIGURE 11.	General Map of the Andean Bear Conservation Units	30
FIGURE 12.	General Map of the Human Influence Index	31
FIGURE 13.	General Map of the Human Footprint	32
TABLE 4.	Human footprint summaries for polygons identified by experts as areas where a) Andean bears are present, b) without knowledge about Andean bears, and c) Andean bears no longer occur	33
TABLE 5.	Fragmentation analyses for polygons identified by experts as areas where a) Andean bears are present, b) without knowledge about Andean bears, and c) Andean bears no longer occur	34
TABLE 6.	Size and name of Andean Bear Conservation Units (ABCU) identified in Central Andes during the workshop and final post-workshop modified ABCU	35
FIGURE 14.	ABCU Central Andes 1: Northwestern Peru considering Human Footprint analysis (Post-Workshop Modified)	36
FIGURE 15.	Final Post-workshop Modified ABCU Central Andes 1: Northwestern Peru	37
FIGURE 16.	ABCU Central Andes 2: Northeastern Peru considering Human Footprint analysis (Post-Workshop Modified)	39
FIGURE 17.	Final Post-workshop Modified ABCU Central Andes 2: Northeastern Peru	40
FIGURE 18.	ABCU Central Andes 3: Central Peru considering Human Footprint analysis (Post-Workshop Modified)	42
FIGURE 19.	Final Post-workshop Modified ABCU Central Andes 3: Central Peru	43
FIGURE 20.	ABCU Central Andes 4 – Southern Peru-Northern Bolivia considering Human Footprint analysis (Post-Workshop Modified)	45
FIGURE 21.	Final Post-workshop Modified ABCU Central Andes 4: Southern Peru-Northern Bolivia	46
FIGURE 22.	ABCU Central Andes 5: Cotapata-Lambate-Altamachi considering Human Footprint analysis (Post-Workshop Modified)	48
FIGURE 23.	Final Post-workshop Modified ABCU Central Andes 5: Cotapata-Lambate-Altamachi	49
FIGURE 24.	ABCU Central Andes 6: Carrasco-Amboro considering Human Footprint analysis (Post-Workshop Modified)	51
FIGURE 25.	Final Post-workshop Modified ABCU Central Andes 6: Carrasco-Amboro	52

FIGURE 26. ABCU Central Andes 7: Iñao-Tariquia considering Human Footprint analysis (Post-Workshop Modified) 54

FIGURE 27. Final Post-workshop Modified ABCU Central Andes 7: Iñao-Tariquia 55

TABLE 7. Historical range areas, range perimeters and perimeter to range ratios for four Latin American large mammal species 58

TABLE 8. Fragmentation analyses Human Footprint analysis categories within each Andean Bear Conservation Units 59

TABLE 9. Theoretical Andean bear population sizes in seven Andean Bear Conservation Units using most recent estimates of population density 60

LIST OF CONTRIBUTORS

Luís Acosta, Museo de Historia Natural Noel Kempff Mercado, Universidad Autónoma Gabriel René Moreno, Avenida Irala 565, Casilla 2489, Santa Cruz de la Sierra, Bolivia: l.jubatus096@gmail.com

Viviana Albarracín Dávalos, Investigadora Asociada Centro de Estudios en Biología Teórica y Aplicada (BIOTA), La Paz, Bolivia: vivianaalba@yahoo.es

Jessica Amanzo, Laboratorio de Estudios en Biodiversidad, Facultad de Ciencias y Filosofía, Universidad Peruana Cayetano Heredia. Av. Honorio Delgado 340, SMP, Lima. jessica.amanzo@upch.pe

Jan R. Baiker, Department of Geography, University of Zurich, Winterthurerstrasse 190, CH-8057 Zurich, Switzerland: apurimacperu@gmail.com

Paula De La Torre: pdelatuc@gmail.com

Enrique Domic, Wildlife Conservation Society, Casilla 3-35181 SM., La Paz, Bolivia: edomic@wcs.org

Marco A. Enciso, Faculdade de Medicina Veterinária e Zootecnia, Universidade de São Paulo, Av. Prof. Dr. Orlando Marques de Paiva nº87, Cidade Universitária, São Paulo, Brasil: marco.enciso@gmail.com

Cecilia Flores Universidad Mayor de San Simón, Centro de Biodiversidad y Genética, Cochabamba, Bolivia: ceciflorturde@gmail.com

Isaac Goldstein, Wildlife Conservation Society, Resd. Los Frailejones, Apto 102, Av. Carnevalli, Mérida, Venezuela: igoldstein@wcs.org

Alicia Kuroiwa, Wildlife Conservation Society, Av. 15 de Enero 591, Miraflores. Lima, Perú: akuroiwa@wcs.org

Renata Leite-Pitman, 1129A Elmwood Ave. Evanston, IL 60202, USA: mrpl@duke.edu

Karen Noyce, 15542 County Road 72, Warba, MN, 55793, USA. HYPERLINK Karen.noyce @state.mn.us

Susanna Paisley, Durrell Institute of Conservation and Ecology, University of Kent, Giles Lane, Canterbury, Kent, CT2, UK: S.Paisley@kent.ac.uk

Bader Peña, Gobierno Autonomo Municipal de La Paz, Casilla 10654, La Paz, Bolivia: bader.pena@gmail.com

Heinz Plenge, Calle Manuel Seoane 721, Pimentel, Chiclayo, Perú. chaparri@plenge.com

Ariel Reinaga, Wildlife Conservation Society, Casilla 3-35181 SM., La Paz, Bolivia: areinaga@wcs.org

Boris Ríos-Uzeda, Doutorando em Ecologia, Laboratório de Vertebrados, Programa de Pós-Graduação em Ecologia Instituto de Biologia Universidade Federal do Rio de Janeiro, Brazil: borisriosu@hotmail.com

Roxana Rojas Roxana Rojas-Vera Pinto, Frankfurt Zoological Society Peru/Proyecto Isnachi, Calle Los Cipreses H-21, Residencial Huancaro, Santiago, Cusco, Perú: roxyrvp@gmail.com

Teddy Siles, Wildlife Conservation Society, Casilla 3-35181 SM., La Paz, Bolivia: tsiles@wcs.org

Trinidad Tapia, ttrinidad@hotmail.com

Russ Van Horn, San Diego Zoo Institute for Conservation Research, 15600 San Pasqual Valley Road, Escondido, California 92027-7000, USA: rvanhorn@sandiegozoo.org

Renzo Vargas-Rodríguez, Departamento de Biología, Universidad de La Serena. Campus Andrés Belloc/ Raúl Bitran 1305, Casilla 554, La Serena, Chile. Departamento de Ecología y Medio Ambiente, Instituto de Filosofía y Ciencias de la Complejidad. c/ Los Alerces 3024, Ñuñoa. Código postal: 7780192, Santiago, Chile: rvargas@userena.cl

Hector Vela Quispe, Calle Marañon N°137, Urbanización Santa Luisa, La Perla Alta, Callao, Peru: hector_vq@hotmail.com

Ximena Vélez-Liendo, Bear Specialist Group – IUCN, Centro de Biodiversidad y Genetica, Universidad Mayor de San Simon, Casilla 538, Cochabamba, Bolivia: x.velezliendo@gmail.com

Robert Wallace, Wildlife Conservation Society, Casilla 3-35181 SM., La Paz, Bolivia: rwallace@wcs.org

Mileniusz Spanowicz, WCS

INTRODUCTION

Shrouded in mystery the Andean or spectacled bear (*Tremarctos ornatus*) is characterized by a white or light brown marking that covers part of its face around the eyes often appearing as spectacles, although the form and amount of white or brown is variable. It is a solitary animal, which nests in trees or caves and is South America's only bear species (Peyton, 1990). The Andean bear is primarily herbivorous and frugivorous, though will opportunistically take some animal prey, and is the enigmatic flagship for the atmospheric fairy tale cloud forests and adjacent Andean meadows of the Tropical Andes. However, habitat loss and human-animal conflict issues threaten the Andean bear across much of its continental range.

Given the importance of the Andean bear for conservation efforts across the Tropical Andes and the lack of systematized information regarding distribution and ecology, an effort was made at the beginning of the millennium to gather and collectively analyze existing Andean bear data for the Northern Andes. Lead by the World Wildlife Fund (WWF), with institutional support from a number of other conservation NGO's, particularly the Wildlife Conservation Society (WCS) and Ecociencia, this exercise encompassed the entire known northern range for the species in Colombia, Ecuador and Venezuela, as well as the extreme northern portions of Peru (Rodríguez *et al*., 2003). A parallel analysis of these results were also published in an internationally recognized journal (Kattan *et al*., 2004), and the findings and recommendations have been widely cited (Garcia-Rangel, 2012) and incorporated into conservation planning efforts across the range covered by the analysis (Peralvo *et al*., 2005).

Nevertheless, the majority of the known Andean bear range (almost 70%) is in Peru and Bolivia, countries which have also been the setting for much of the groundbreaking research on Andean bear ever since the pioneering work of Peyton in the mid-seventies (Peyton, 1980; 1990). As such despite the vital importance of the Northern Andes analysis, a pressing demand for the Andean bear research and conservation community was to try and replicate a systematization of existing Andean bear data for the Central Andes of Bolivia and Peru.

In 2007 the Andean bear expert team (Bear Specialist Group – IUCN) announced their intention to hold the II International Symposium on the Andean Bear in Lima, Peru in November 2008. In

Mileniusz Spanowicz, WCS

2008, WCS, Center of Biodiversity and Genetics, San Simon University (Bolivia), Cayetano Heredia University (Peru) and Antwerp University (Belgium) enquired as to whether we could incorporate a specific workshop into the Symposium agenda in order to systematize existing distributional knowledge on the Andean bear using the Range-Wide Priority Setting Exercise developed by WCS for landscape and globally threatened species (Sanderson *et al*., 2002). This proposal was approved and the workshop was scheduled for the two days prior to the beginning of the II International Symposium on the Andean Bear.

METHODOLOGY

GENERAL RANGE-WIDE PRIORITY SETTING METHODOLOGY

The Range-Wide Priority Setting Methodology was developed by the Wildlife Conservation Society in response to the need to systematize scarce and usually disparate data regarding the global distribution of threatened wildlife species in order to make informed management decisions regarding their conservation (Sanderson *et al*., 2002). Conceptually the methodology is essentially an expert driven opinion on where the most important conservation sites are for a given species, but based on a current spatially explicit analysis of systematized distributional data for the species. To date the methodology has been successfully used to systematize data for the following species: jaguar (Sanderson *et al*., 2002; Marieb, 2007), American crocodile (Thorbjarnarson *et al*. 2006), white-lipped peccary and lowland tapir (Taber *et al*., 2009) in Latin America, and bison in North America (Sanderson *et al*., 2008), as well as ongoing processes for tiger, four Asiatic Bears, chimpanzees, Mongolian gazelle, lion and snow leopard (WCS, unpublished data).

The basic conceptual steps to this methodology are as follows:

1. Systematize existing public information on the distribution of the species,
2. Request a community of experts to provide updated and/or unpublished information on the distribution of the species in a spatially explicit manner,
3. Consult a community of experts on the threats facing the species across its range,
4. Request experts to identify the most important Conservation Units or conservation strongholds for the species across its range as a function of population sizes,
5. Gather information and provide first spatially explicit drafts of distribution (historical range & current range), threats and conservation units for the species,
6. Bring together contributing experts to review and improve drafts of distribution (historical range & current range), threats and conservation units for the species, and make decisions regarding priority conservation actions,
7. Complete write-up and analysis of results for publication and decision-making use in the future.

The following are some of the key definitions of the Range-Wide Priority Setting Methodology:

Area of Knowledge: Areas where experts are able to express opinion about the presence or absence Andean bear.

Locality Records: Localities where Andean bears surveys have been conducted in the last 20 years including dates, results, type of land use, and type of records.

Potential Range or Historical Range: Areas where Andean bears may have existed in the last 100 years.

Proposed Actual Distribution: Areas (polygons) where experts believe the Andean bear has occurred in the last 20 years.

Andean Bear Conservation Units (ABCU): Areas important for the long-term conservation of the Andean bear divided into two types with details on current threats:
Type I – population resident and stable,
Type II – population resident but under threat.

PRE-WORKSHOP METHODOLOGY

Using models previously designed for jaguars (*Panthera onca*; Sanderson *et al*., 2002), white-lipped peccaries (*Tayassu pecari*; Taber *et al*., 2009) and lowland tapirs (*Tapirus terrestris*; Taber *et al*., 2009) we developed three specific questionnaires for the Andean bear (see Appendices I-IV):

Questionnaire A: Andean bear localities in the last 10 years,

Questionnaire B: Threats to the conservation of the Andean bear across its distribution,

Questionnaire C: Andean Bear Conservation Units (ABCU).

Once these questionnaire forms along with an explanation document had been revised by a small committee of Andean bear experts we sent the forms to people the committee had identified as either a) recognized Andean bear experts in Bolivia and Peru or b) people, such as park guards, with potentially important information on the distribution of Andean bears in Bolivia and Peru. Identified people also received the explanation document, as well as maps of Bolivia and/or Peru in GoogleEarth™ format as an additional tool with which to draw polygons and/or place distribution points (see Appendices I-IV).

Over a period of three months we awaited reception of responses to the questionnaires and as data came in from different respondents we then processed this information into one overall GIS and associated databases for Andean bear in Bolivia and Peru.

Once the reception period closed in September 2008, we then assessed which of the respondents we could invite to the workshop to be held in November 2008 in Lima, Peru immediately preceding the II International Symposium on the Andean Bear. The selection of workshop participants was based on a) budget constrictions, b) geographic coverage of Andean bear knowledge for Bolivia and Peru, c) participant availability, and d) the amount of data provided by each respondent.

WORKSHOP OBJECTIVES

The 2-day workshop in Lima had the following objectives:

- Update distributional knowledge of the Andean bear in Bolivia and Peru and analyze the connectivity of identified populations,
- Evaluate the conservation status of the Andean bear in Bolivia and Peru through identifying ABCU (Andean Bear Conservation Units) and analysis of habitat integrity,
- Determine priority conservation areas for the Andean bear in Bolivia and Peru,
- Develop a binational working group for the Andean bear in Bolivia and Peru,
- Identify and prioritize concrete and local investigation and conservation actions that will also contribute to the binational conservation of the Andean bear.

WORKSHOP METHODOLOGY

On the morning of the first day of the workshop recipients first presented themselves to the group before receiving three brief presentations:

- Binational Workshop on the Distribution and Conservation Status of the Andean Bear in Bolivia and Peru - Rob Wallace,
- Questionnaire Results and Systematization of Data on the Distribution of the Andean Bear in Bolivia and Peru - Rob Wallace, Teddy Siles, Boris Rios-Uzeda & Paola De La Torre,
- Spatial Results on the Distribution of the Andean Bear in Bolivia and Peru - Rob Wallace & Teddy Siles.

Following the presentations providing instructions for the workshop tasks, the participants were divided into two national working groups: one for Bolivia and one for Peru. Using printed map material, digital versions in portable computers and the definitions detailed above, each group was asked to review the historical range draft maps, then the current distribution and knowledge maps, and finally the proposed Andean Bear Conservation Units. Groups were asked to work in the order requested and clearly mark changes on the printed satellite image maps with populations and thoroughfares included, and/or digital versions in kmz format (Google Earth™). The groups were also asked to revise and fill in the corresponding digital questionnaire forms (Forms A, B, C) so that detailed

data for each record and/or polygon could be included in the Table of Attributes of the GIS. Finally each group elected a secretary to record the decisions and progress of the working groups.

Upon conclusion the two national working groups reported back to each other, which was particularly important from the perspective of the transboundary area between Bolivia and Peru. This plenary session was also a key moment of reflection on the difference in interpretation of the Andean Bear Conservation Unit definitions used by each group (see post-workshop methodology below).

POST-WORKSHOP METHODOLOGY

After the workshop the maps were digitized and modified according to the corrections and proposals of the workshop participants and decisions. Subsequently we sent the modified historical range map to the workshop participants, as well as additional recognized experts for final approval.

Finally, following the modifications detailed in subsequent sections, we sent the draft version of this document to all authors for comment and analysis and revised this document according to responses from 24 of 28 contributing authors, before sending a final draft for comments.

PRELIMINARY RESULTS

In this section we present the preliminary results as presented on the final day of the II International Symposium on the Andean Bear in Lima. Based on the information provided by the expert community prior to the workshop we produced a series of maps to summarize Andean bear distribution, historical range, knowledge areas of the participating expert community, areas where knowledge was not available during the workshop, and finally the priority Andean Bear Conservation Units identified in Peru and Bolivia. These maps provided the basis for the workshop review activities.

In total we sent the questionnaires to 60 contacts in Bolivia and 70 contacts in Peru and received a total of 28 responses that included distributional data, although only 14 respondents answered the more detailed questionnaires (Table 1). In order to obtain those responses we sent the questionnaires out on four different occasions.

Based on the criteria described above we invited 11 experts from Bolivia to the workshop and 17 experts from Peru, of whom 10 Bolivia experts attended the workshop along with 13 Peru experts (see List of Participants prior to Introduction). These experts spent two days reviewing the draft maps and produced modified versions (Figures 1 – 10, Tables 2 & 3: see below) as final products of the workshop including the definition of Andean Bear Conservation Units (ABCU).

TABLE 1. Total number of potential contacts and respondents for the Andean Bear Distribution and Conservation Status Questionnaires in Bolivia and Peru

	# Invitations Sent		# Addresses Blocked		# Responses*		# Responses Including Completed Questionnaires		# Email Responses Including Kmz Files	
	Bolivia	Peru	Bolivia	Peru	Bolivia	Peru	Bolivia	Peru	Bolivia	Peru
Total	60	70	15	12	20	8	7	7	6	3

***Of 45 valid email addresses in Bolivia we received 20 responses. Of 58 valid email addresses in Peru we received 8 responses.**

ANDEAN BEAR DISTRIBUTION IN BOLIVIA AND PERU

SUMMARY OF SYSTEMATIZED DATA

In Bolivia we used the working version of the National Medium and Large Sized Mammal Distribution Database (Wallace *et al*., 2013) developed by the Wildlife Conservation Society in collaboration with a number of participating institutions as a tool with which to complete a recently published book (Wallace *et al*., 2010). This database contains distribution points for the Andean bear with details of type of register and locality for each point. After eliminating distribution points with insufficient geographic information such as geographic coordinates, for the purposes of the binational Andean bear workshop 532 distribution points were retained.

In Peru we used the National Database for Landscape Species developed by Fundación Cayeteno Heredia and Wildlife Conservation Society between 2006 and 2008. This database contains distribution points for the Andean bear, and once again having removed the distribution points with insufficient geographic information such as geographic coordinates for the purposes of the binational Andean bear workshop 172 distribution points were retained.

In total systematized data from historical records provided a 704 distribution points with which to examine Andean bear distribution in Bolivia and Peru.

SUMMARY OF DATA RECEIVED FROM QUESTIONNAIRES

Once data from questionnaires had been processed we added 362 distribution points (219 in Bolivia and 143 in Peru) to those that had been systematized from the two national databases thereby reaching a total of 1066 distribution points for use in the workshop (Figure 1).

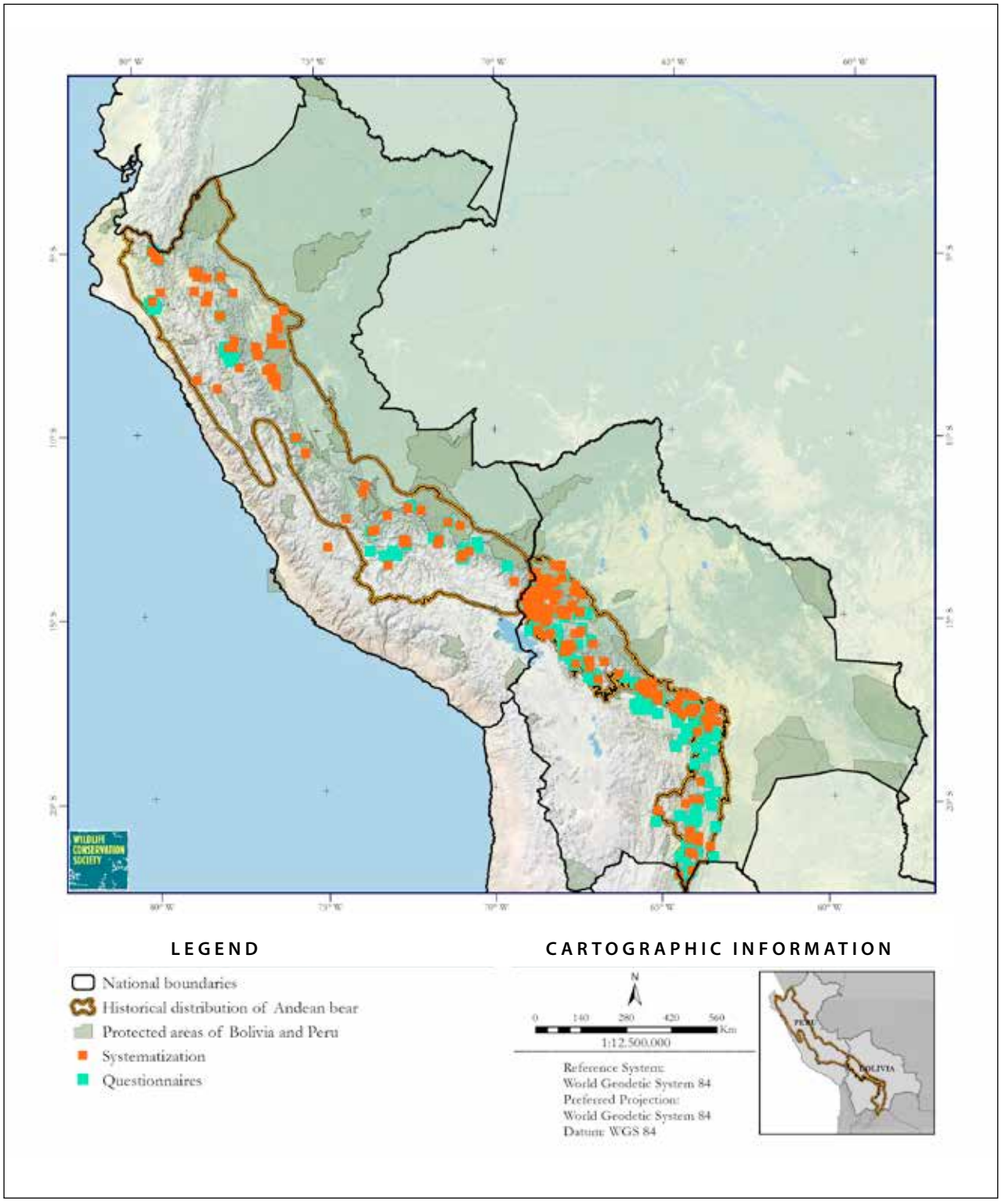
The data coverage of distribution points across the revised historical range was rather impressive for Bolivia (751 distribution points), although a little less so for Peru (315 distribution points) with significant gaps between known distribution points in central Peru.

HISTORICAL RANGE OF THE ANDEAN BEAR IN BOLIVIA AND PERU

Participants at the workshop redefined the historical range of the Andean bear in Bolivia and Peru using a base map for the historical range

Mileniusz Spanowicz, WCS

FIGURE 1. Distribution of Confirmed Andean Bear Localities in Bolivia and Peru



detailed in Peyton (1990), as well more up to date information regarding altitude, vegetation cover and habitat types in both countries. Both national groups worked independently to resolve the map for each country and then met to discuss the results which was especially important for the border area of southern Peru and northern Bolivia. Some errors were corrected in northwestern Peru, as well as excessive range on the original historical range map on the altiplano of southern Peru and northern Bolivia. The original historical range map from Peyton (1990) and the modified versions for each country from the workshop are provided in Figures 2, 3 and 4.

AREAS WITH AND WITHOUT ANDEAN BEAR EXPERT KNOWLEDGE IN BOLIVIA AND PERU

An important aspect of the Range-Wide Priority Setting methodology is identifying the areas where knowledge exists for a species across its distribution and correspondingly recognizing the areas where knowledge is lacking or absent. This ensures that the dataset distinguishes between a lack of knowledge and at least some knowledge for a given area. Whilst available knowledge will be variable between those areas in the second group, the methodology ensures that the expert community recognizes that there are some places where we simply know nothing about a given species. This has proved especially important for subsequently targeting large and potentially important conservation areas for basic surveys for the species in question.

In the case of the Andean bear in Bolivia and Peru experts detailed areas with or without knowledge in the Figures 5-6. To a certain extent the polygons areas with and without knowledge for both countries reflect the distribution of known localities detailed in Figure 1. Larger portions of the distribution in Peru are without knowledge than Bolivia, although there are important areas in both countries that will require further survey work in the near future.

ANDEAN BEAR EXTIRPATED AREAS FOR BOLIVIA AND PERU

Workshop participants were also asked to identify areas where Andean bears no longer occur within their historical range in Bolivia and Peru (Figures 7 & 8). In Peru these areas were restricted to three small polygons in the northern part of the country. In Bolivia three small polygons were also identified: one in the Apolo dry montane grasslands of northern La Paz, and two in the vicinity of the Department limits of Cochabamba and Santa Cruz.

PRIORITY ANDEAN BEAR CONSERVATION UNITS (ABCU) IN BOLIVIA AND PERU

WORKSHOP PRELIMINARY RESULTS

Once the preceding analyses were reviewed and completed by the working groups the participants analyzed the proposed priority Andean Bear Conservation Units. The conclusions of the working groups regarding the Andean Bear Conservation Units are detailed in Table 2 and Figures 9 & 10 below. Our revised historical distribution analysis for the two countries revealed that Bolivia has 23.88% of the historical range, and Peru 76.12%. Participating experts identified similar proportions of the historical range in each country as Andean Bear Conservation Units: 42.28% for Bolivia and 45.12% for Peru (Table 2). In Peru the working group at the workshop identified three Andean Bear Conservation Units (Table 2, Figure 9), two very large ABCUs covering the majority of the Andean bear range in Peru on the eastern side of the Andes, and the third in the northern dry forests of the Pacific coast.

In Bolivia the working group proposed six Andean Bear Conservation Units (ABCU), two large ABCUs in the extreme north and extreme south of the country respectively, two medium sized ABCUs in the middle of the country, and two rather small ABCUs in the central northern part of the Andean bear range in Bolivia (Table 2, Figure 10).

FIGURE 2. Baseline Historical Range for Bolivia and Peru (Peyton 1990)

FIGURE 3. Revised Historical Distribution of Andean Bear in Peru

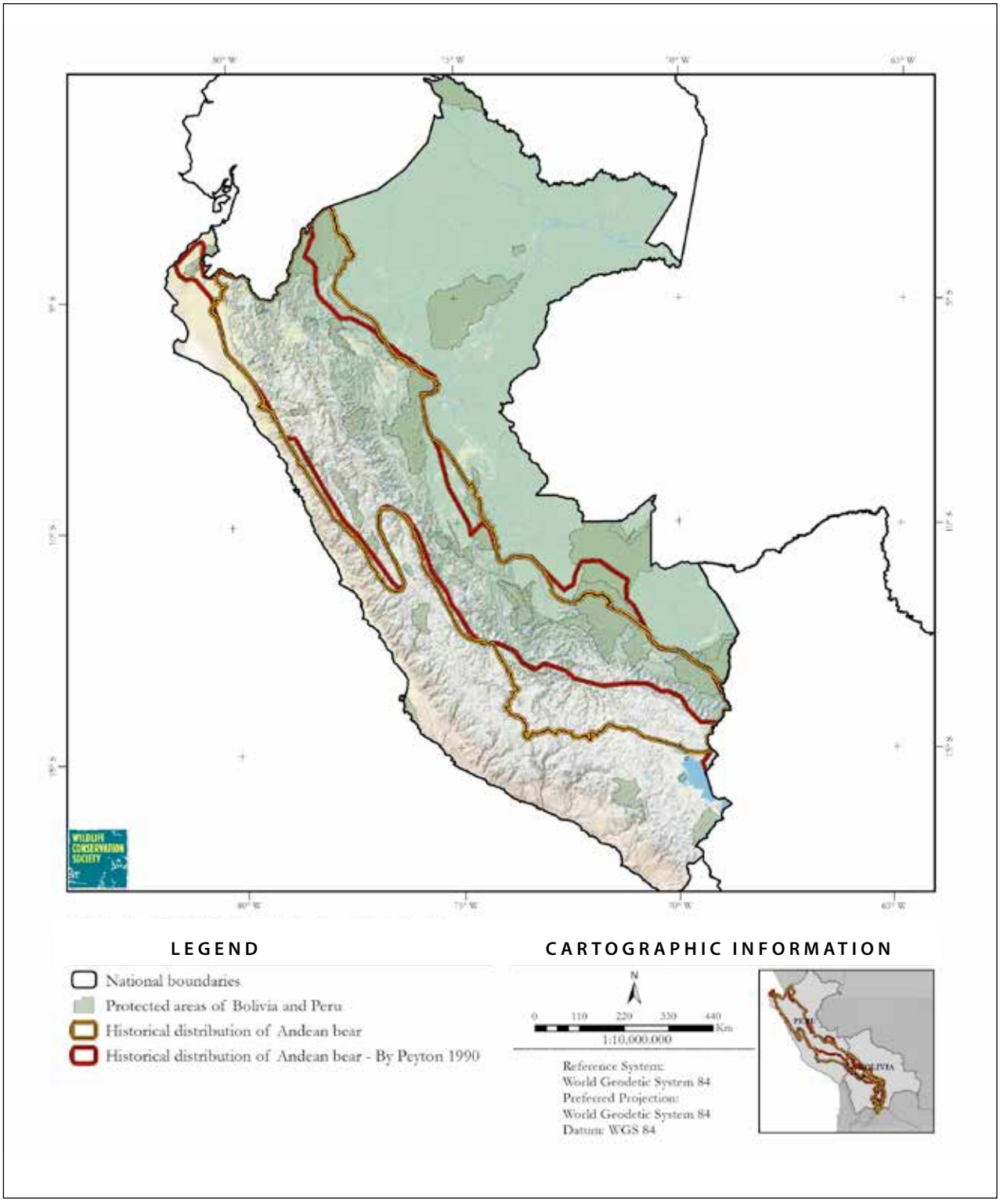


FIGURE 4. Revised Historical Distribution of Andean Bear in Bolivia

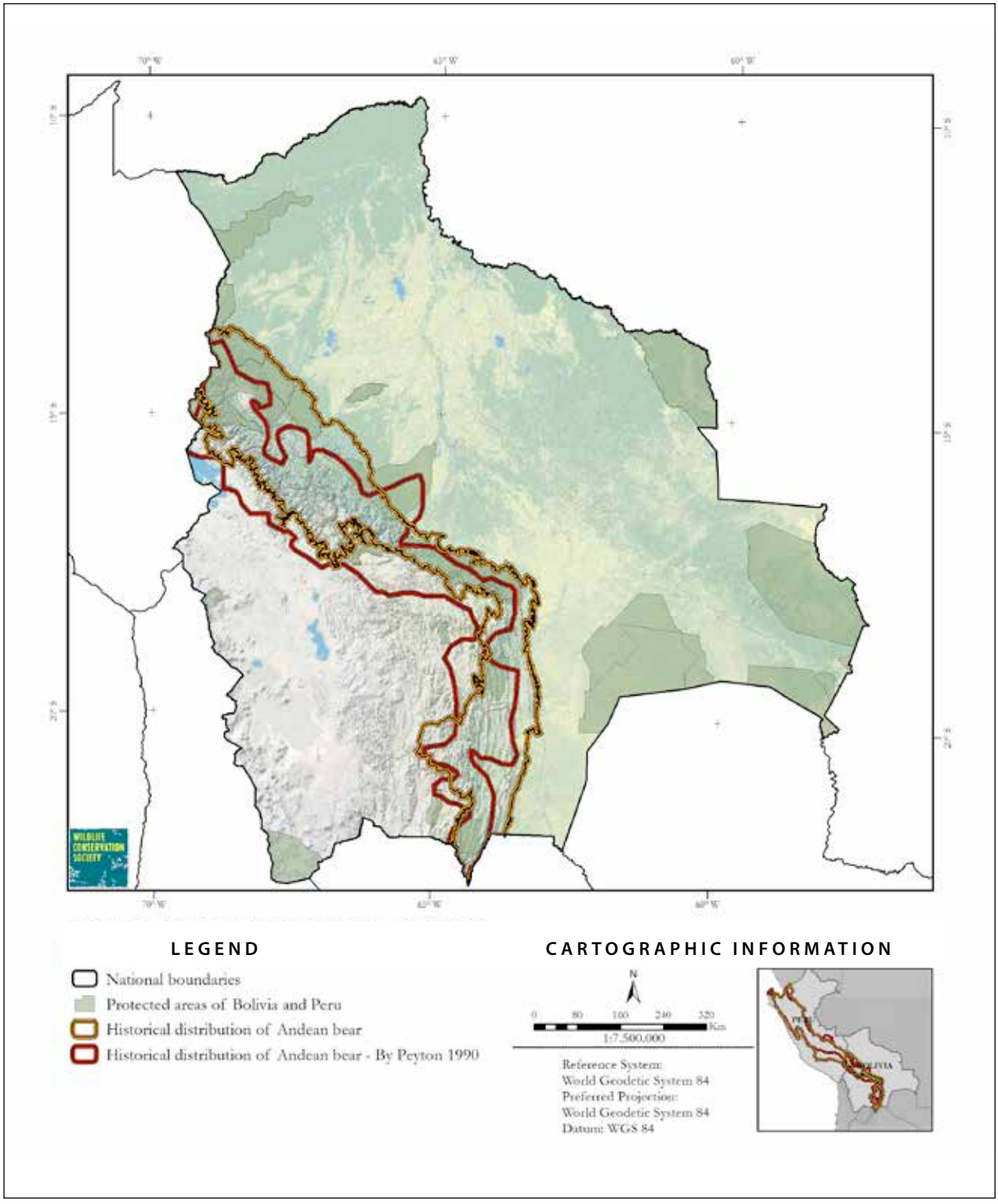


FIGURE 5. Areas With and Without Expert Knowledge for Andean Bear Distribution in Peru

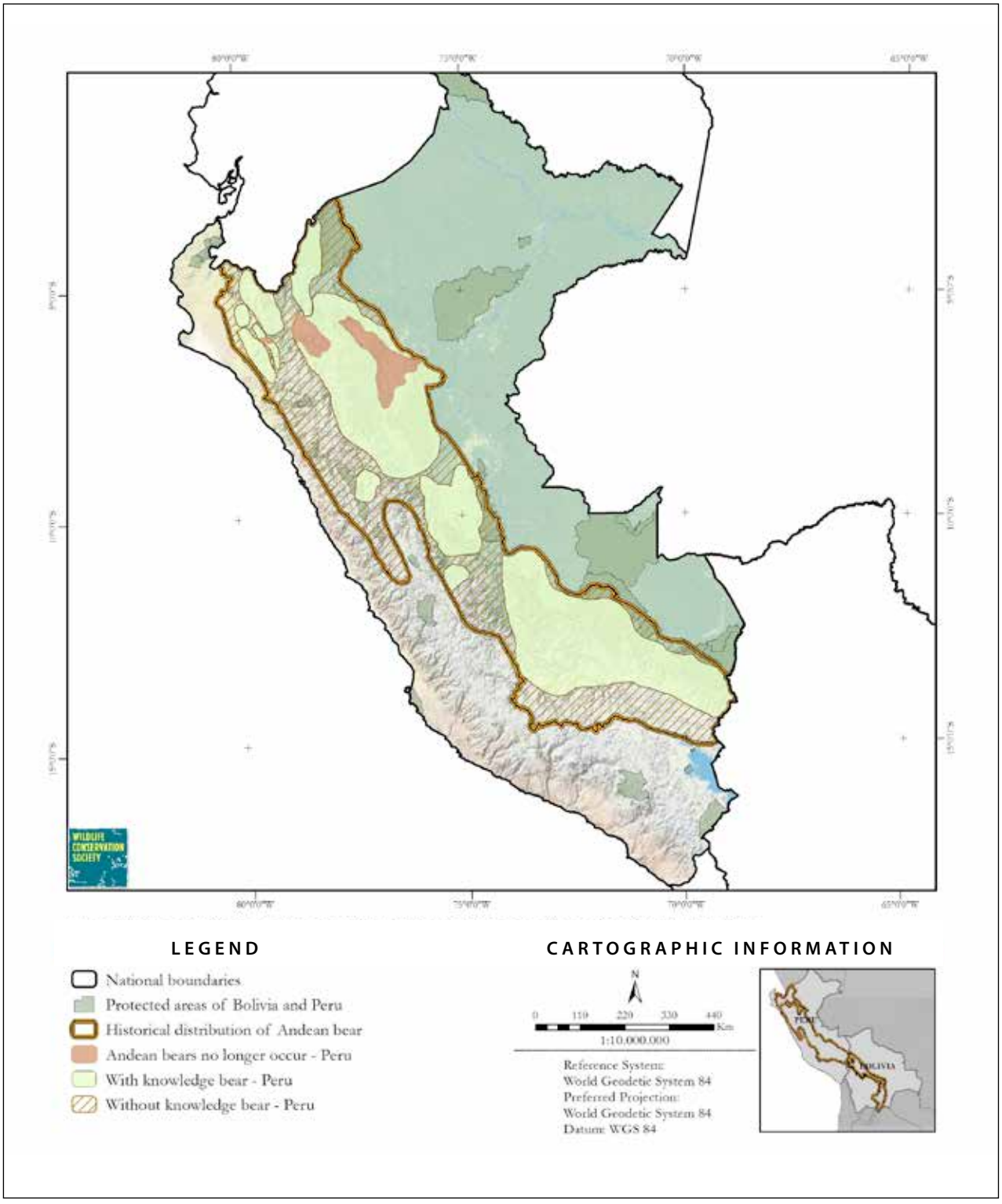


FIGURE 6. Areas With and Without Expert Knowledge for Andean Bear Distribution in Bolivia

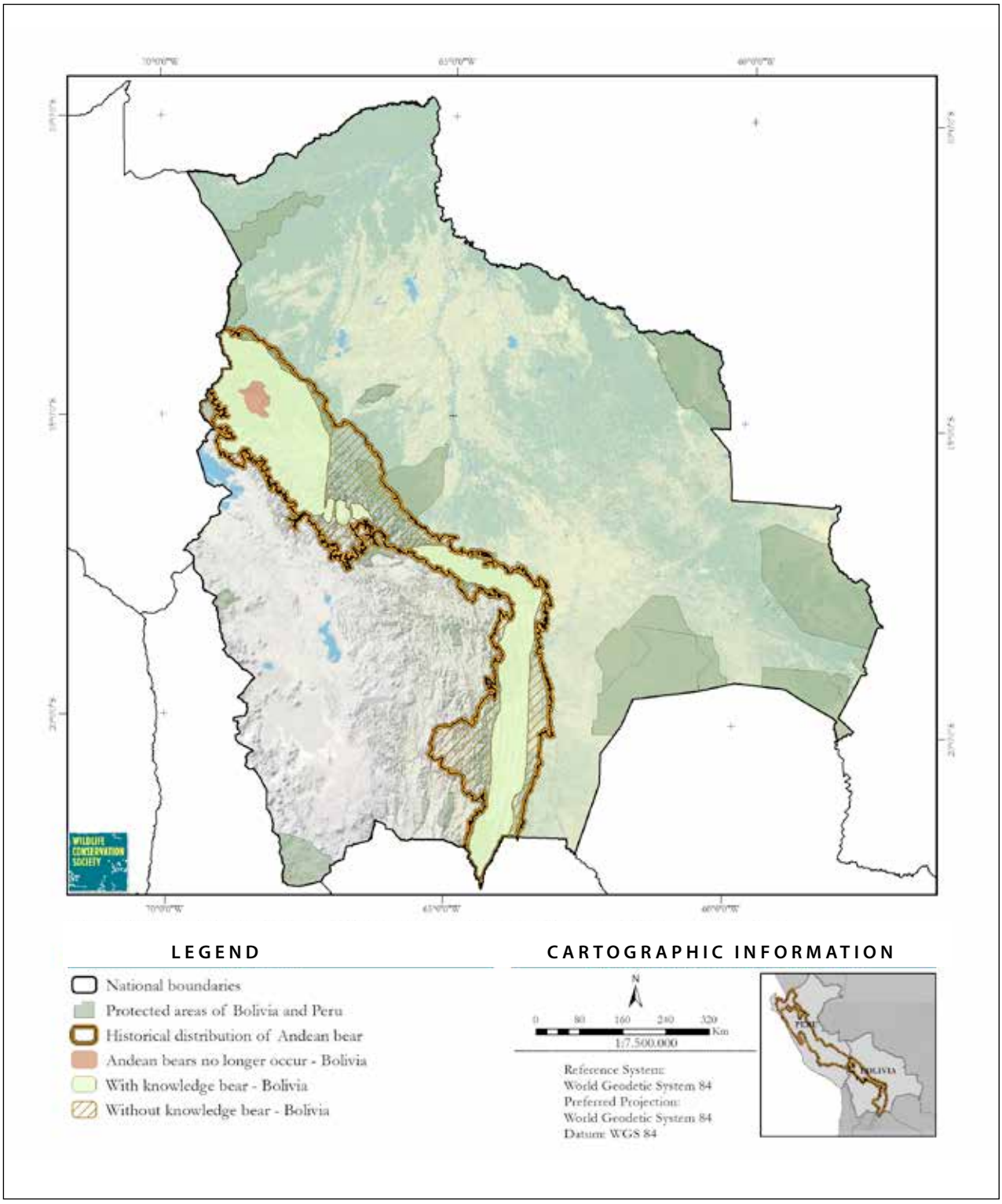


FIGURE 7. Areas in Peru where Andean Bears no longer occur

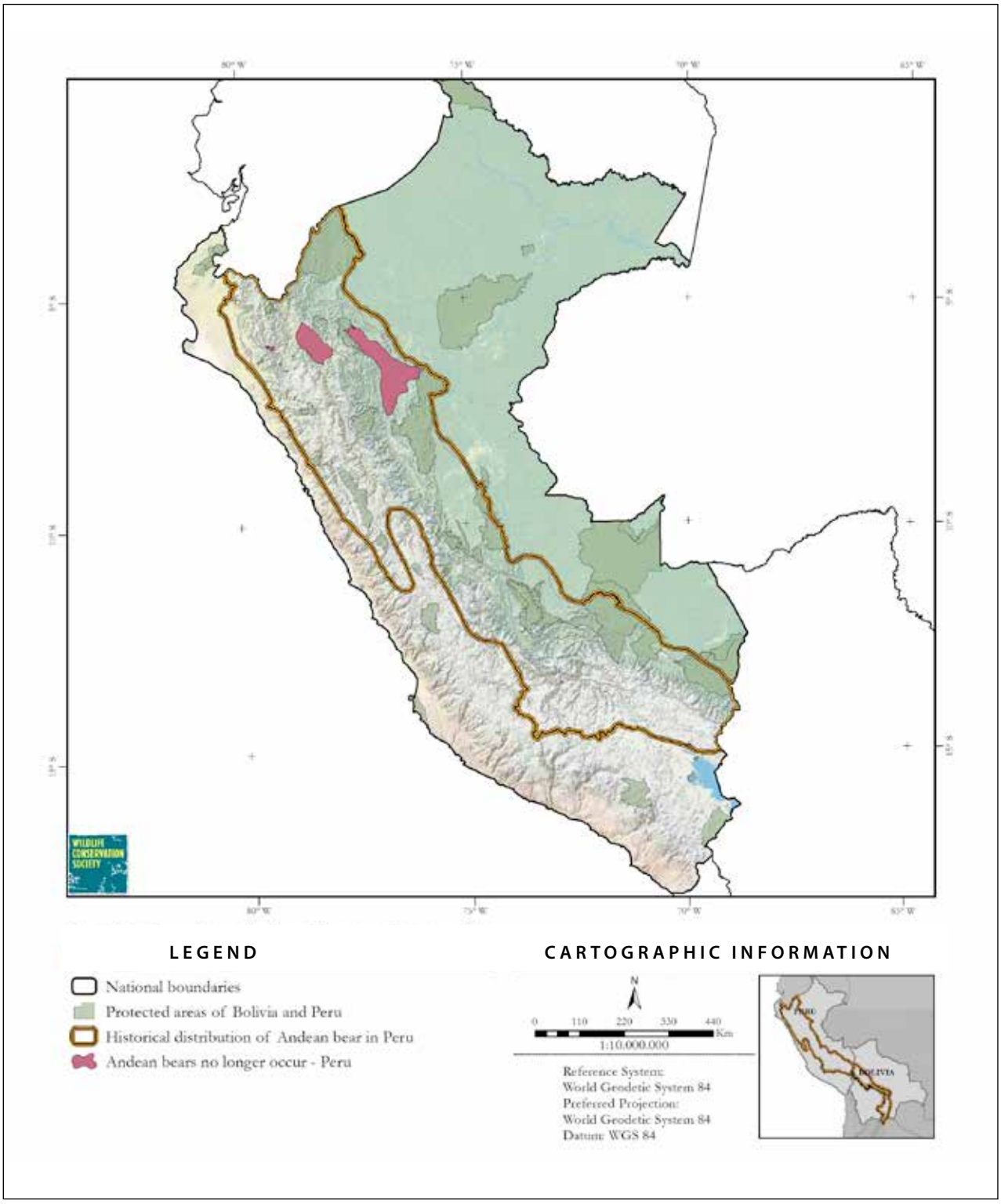


FIGURE 8. Areas in Bolivia where Andean Bears no longer occur

FIGURE 9. Priority Andean Bear Conservation Units in Peru identified by workshop participants

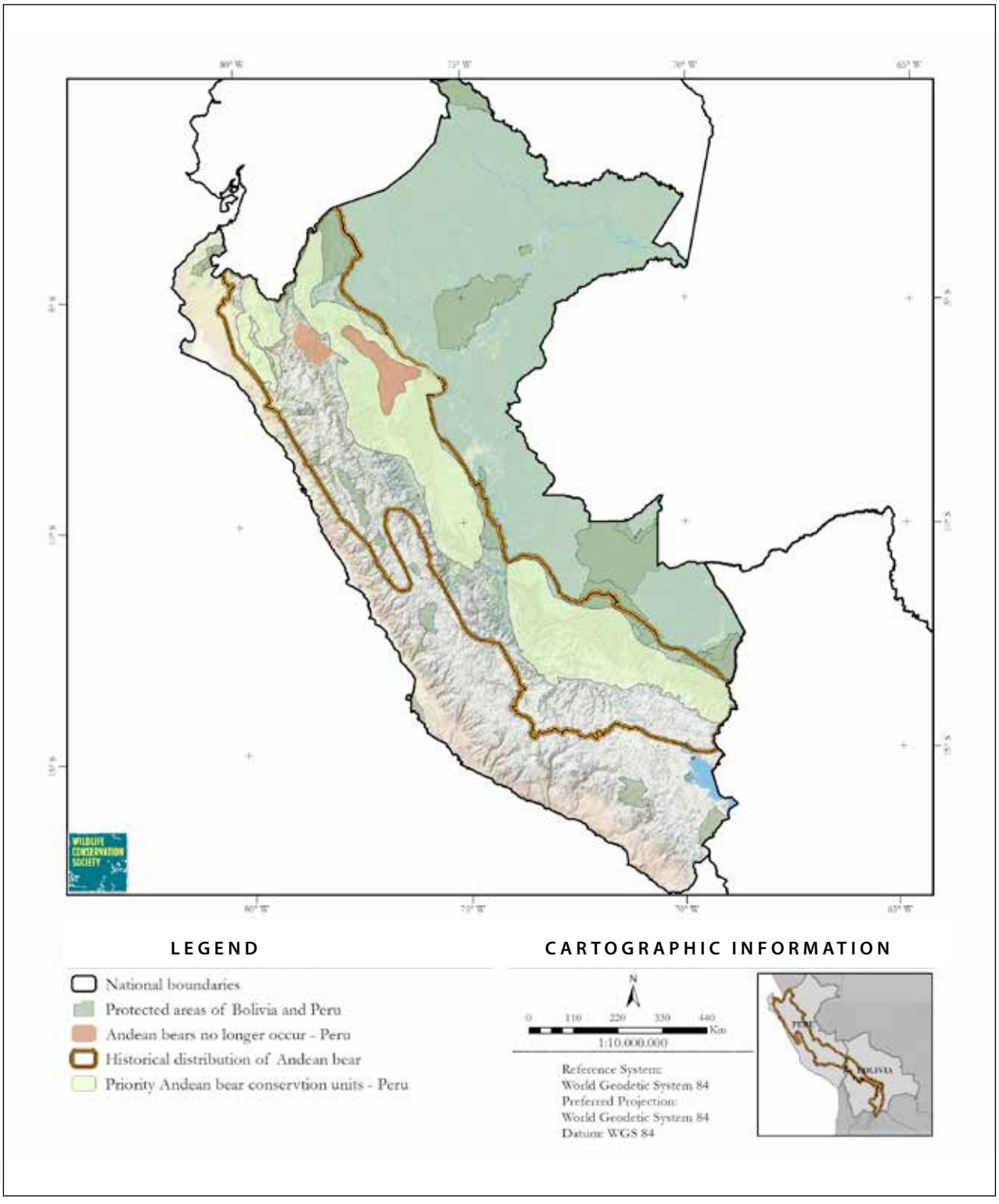


FIGURE 10. Priority Andean Bear Conservation Units in Bolivia identified by workshop participants

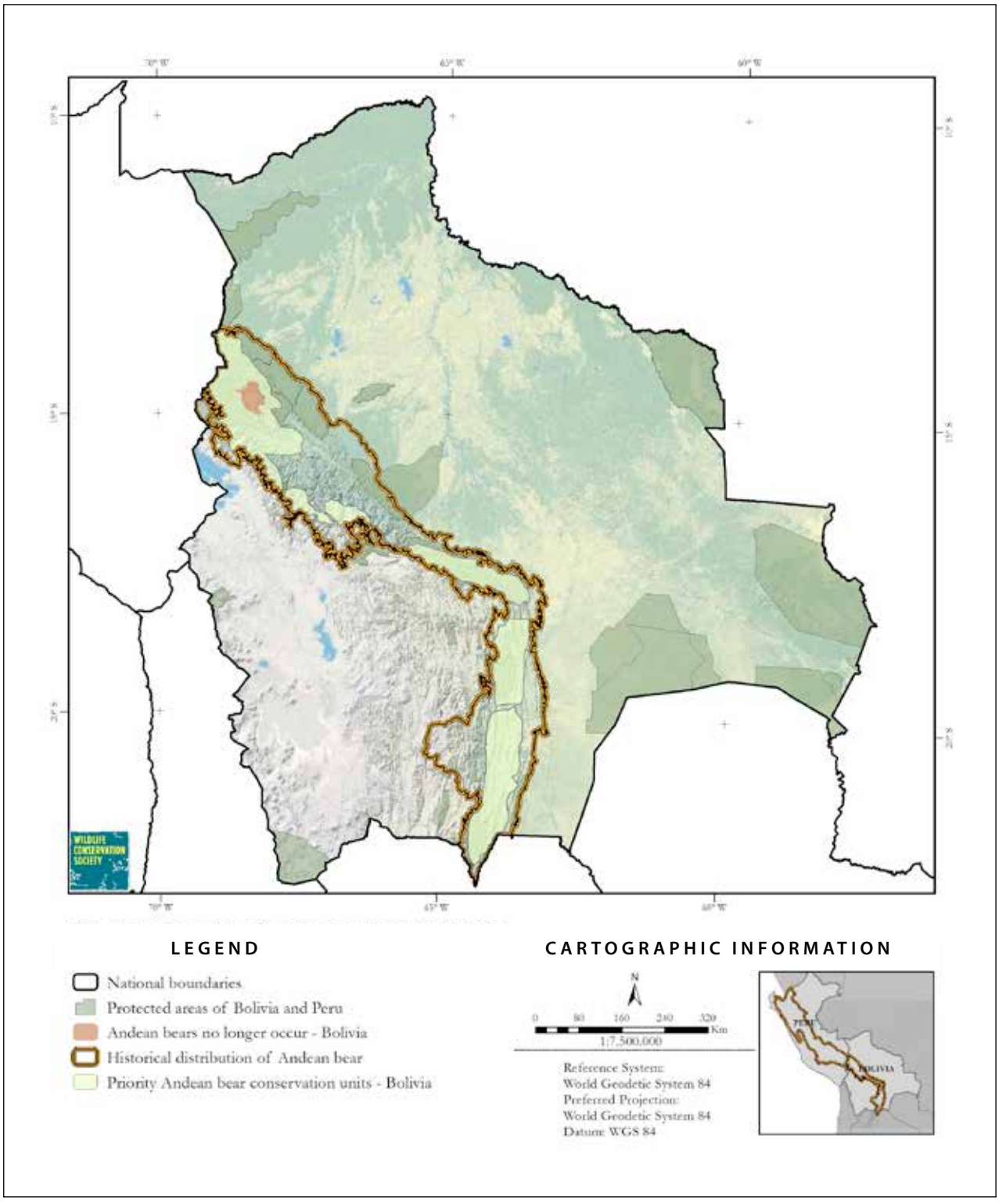


TABLE 2. Size and Percentage of Historical Distribution Range of Andean Bear Conservation Units (ABCU) identified by workshop participants in Bolivia and Peru

Polygon	Area in Peru (km²)	Peru %	Area in Bolivia (km²)	Bolivia %
Historical Distribution Range of *Tremarctos ornatus* in Peru & Bolivia	462,252.46	76.12	145,004.30	23.88
	Size of ABCU	**% Historical Range**	**Size of ABCU**	**% Historical Range**
ABCU 1 Peru	88,117.78	19.06		
ABCU 2 Peru	100,098.12	21.65		
ABCU 3 Peru	20,364.40	4.41		
Total ABCU Peru	208,580.3	45.12		
ABCU Norte La Paz			22,833.64	15.75
ABCU Lambate			2,508.88	1.73
ABCU Altamachi			2,438.00	1.68
ABCU Carrasco-Amboro			8,894.10	6.13
ABCU Iñao-Parabanó			8,930.84	6.16
ABCU Huacareta-Tariquia			15,701.54	10.83
Total ABCU Bolivia			61,307	42.28

REVIEWED POST-WORKSHOP RESULTS

Following the workshop, we further consulted with participating experts and reviewed data to produce final results regarding the extent of Andean bear knowledge in Bolivia and Peru. In total, we estimate that Andean bears historically occurred in almost 607,257 km² in Bolivia and Peru, roughly three quarters of that area in Peru and one quarter in Bolivia (Table 3). Experts identified 54.68% of the historical distribution polygon as areas where Andean bears are known to occur, 2.98% as areas where Andean bears are thought to no longer occur, and 42.34% as areas where no participating expert could express opinion about presence or absence (Table 3). The Bolivian and Peruvian proportions of those knowledge classes were very similar to the overall historical distribution proportions except for areas where Andean bears no longer occur, 91.11% of which were identified in Peru and only 8.89% in Bolivia.

We then made additional steps to analyze the results of the workshop particularly given concerns in differences between the interpretation of Andean Bear Conservation Units between the Bolivian and Peruvian working groups at the

TABLE 3. Adjusted Post-workshop Summary for Andean Bear Knowledge across the Historical Range in Bolivia and Peru

Polygon	Total area of polygon (Km²)	Area in Peru (Km²)	% Peru	Area in Bolivia (Km²)	% Bolivia
Historical range *Tremarctos ornatus*	607,256.76	462,252.46	76.12	145,004.30	23.88
Area with Knowledge	332,043.04	247,844.50	74.64	84,198.53	25.36
Area where No longer occur	18,075.82	16,469.24	91.11	1,606.58	8.89
Area without Knowledge	257,137.90	197,938.72	76.98	59,199.18	23.02

Mileniusz Spanowicz, WCS

workshop. The Peruvian Andean Bear Conservation Units were fewer (n=3) and markedly larger (mean=69,526.77 km^2) than those identified in Bolivia (n=6; mean=10,217.83 km^2), even though national human population density in Bolivia (9.46 persons per 1 km^2) is less than half that of Peru (22.95 persons per 1 km^2). The same analysis described below also served as a proxy to assess the connectivity between the identified Andean Bear Conservation Units.

For these analyses we used available data from the Sanderson (2002) global study "The Human Footprint and the Last of the Wild" which developed two measures of human influence: the Human Influence Index "HII" and the Human Footprint "HFP" (both with a resolution of 1km x 1km). The Human Influence Index measures the level of human impact and influence in terrestrial ecosystems through eight criteria: population density, infrastructure (major roads and railroads), navigable rivers, nighttime stable lights, urban polygons, land cover categories and coast lines (http://sedac.ciesin.columbia.edu/wildareas/methods.jsp), with total values between 0 (no human influence) and 64 (maximum human influence).

The Human Footprint is a quantitative analysis of the human influence based on geographic data on human population density, land cover change, access, and electric energy infrastructure (www.wcs.org/humanfootprint). The Human Footprint does not measure impact but does permits the identification of which areas have more human influence and uses a score of 0 (no human influence) to 100 (maximum human influence).

Using the Andean Bear Conservation Unit boundaries identified in Bolivia and Peru during the workshop (Figure 11), we mapped on the corresponding values and classes (0-16; 17-32; 33-48; 49-64) from the global Human Influence Index (Figure 12) and the global Human Footprint (0-25; 26-50; 51-75; 76-100) (Figure 13). Values within the previously identified Andean Bear Conservation Units for the Human Influence Index ranged between 0-60 (maximum possible=64), while values for the Human Footprint ranged between 0-70 (maximum possible=100). In both analyses the higher values within parts of some of the Andean Bear Conservation Units identified in the workshop confirmed our concern that some of the units had been defined too optimistically.

Nevertheless, in all following sections we have chosen to present one of these analyses, the Human Footprint (Figure 13), because there was almost complete agreement between the two analyses across the Andean bear distribution within the Central Andes. We have included the Human Influence Index results for comparison in Appendix V.

FIGURE 11. General Map of the Andean Bear Conservation Units

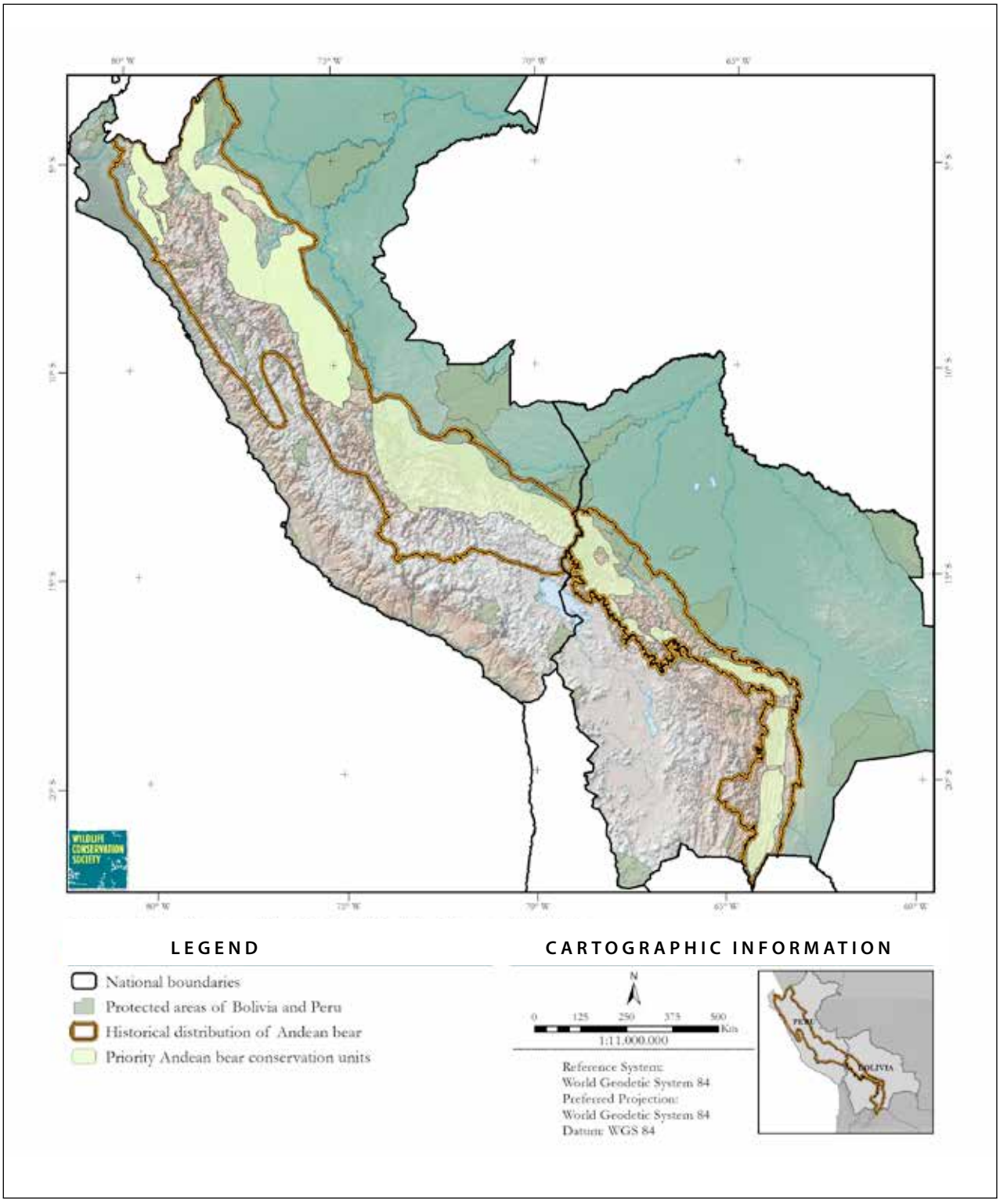


FIGURE 12. General Map of the Human Influence Index

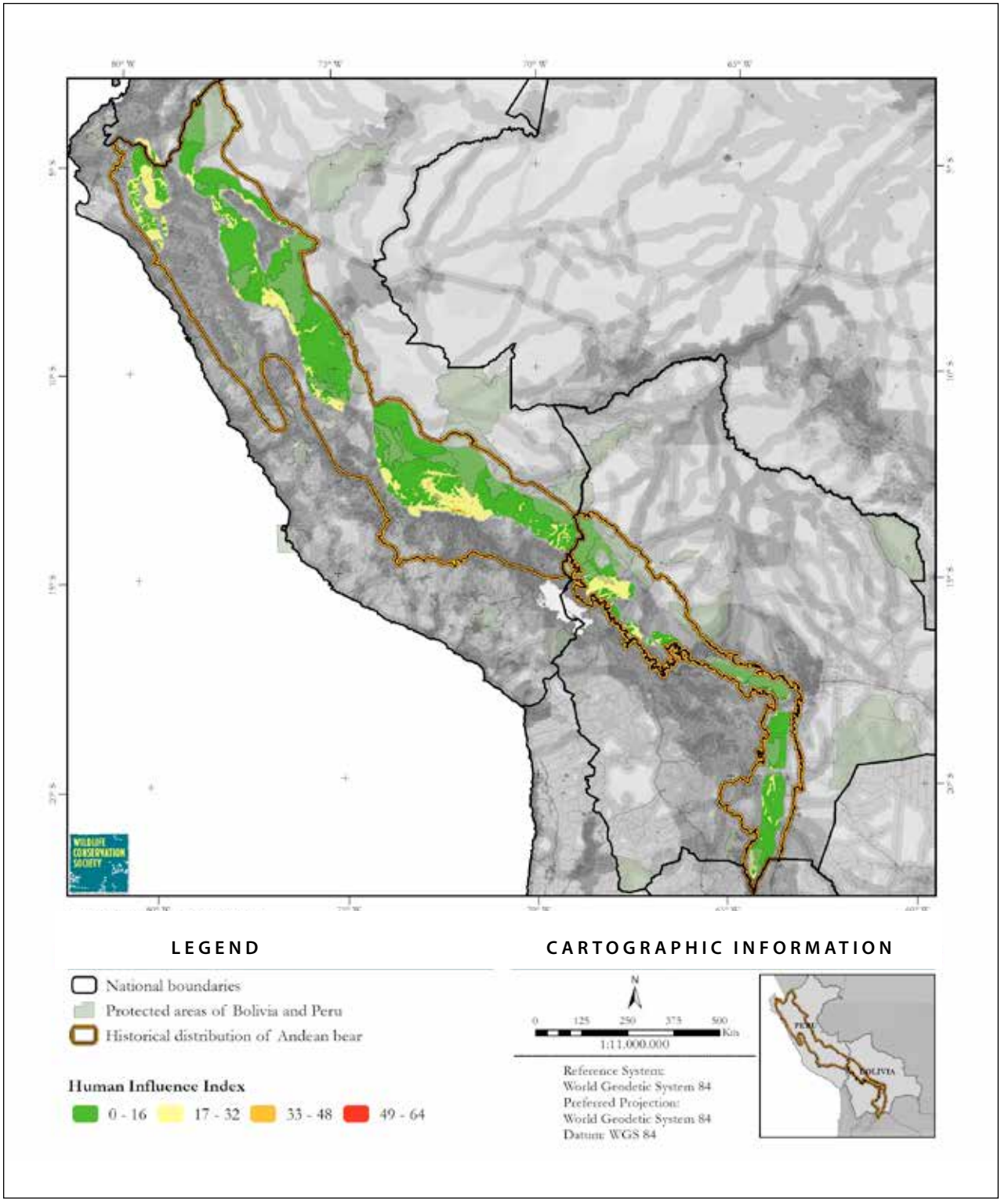


FIGURE 13. General Map of the Human Footprint

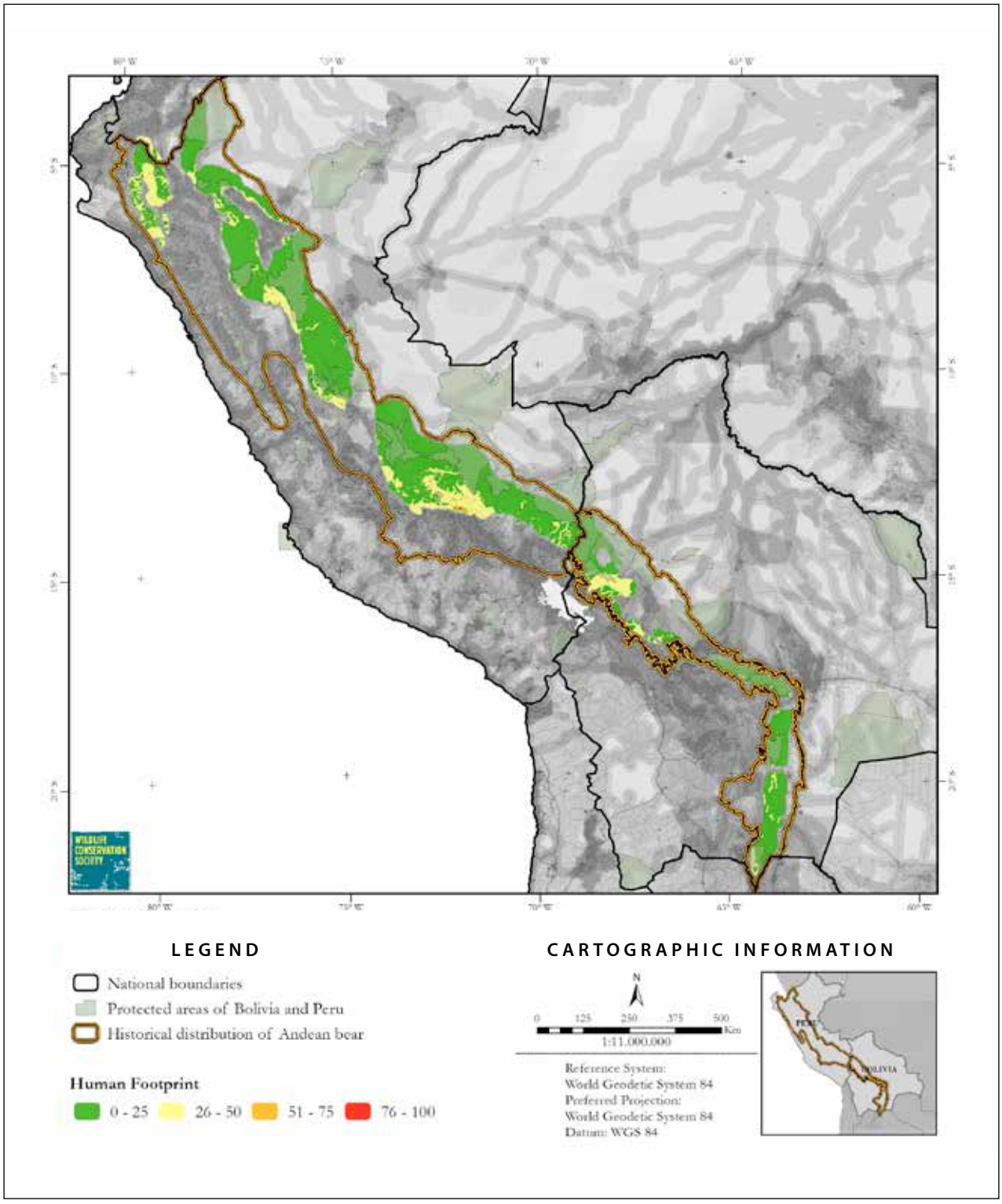


TABLE 4. Human footprint summaries for polygons identified by experts as areas where a) Andean bears are present, b) without knowledge about Andean bears, and c) Andean bears no longer occur

Variable	Andean Bears Present	Without Knowledge About Andean Bears	Andean Bears No Longer Occur	ABCUs
Total area (km^2)	332,043.04	257,137.90	18,075.82	350,689.63
Lower Human Footprint values (0-25) km^2	257,927.91	157,668.33	4,615.71	306,997.80
Higher Human Footprint values (>26) km^2	74,115.09	99,469.57	13,460.12	43,691.83
Percentage lower Human Footprint values	77.68	61.32	25.54	87.54
Percentage higher Human Footprint values	22.32	38.68	74.46	12.46

Indeed, an examination of the six polygons identified by workshop participants as areas where Andean bears no longer occurred confirmed that those polygons had high values within the Human Footprint (Table 4, Figures 12 & 13), thereby validating our approach to cut away areas with high values within workshop identified ABCUs. Almost 75% of the polygons identified as areas where Andean bears no longer occur had higher Human Footprint (HFP) values indicating high human influence, whereas only just over 25% of the polygons had lower HFP values indicating low levels of human influence. Whereas in polygons identified as areas where Andean bears are known to occur only 22% had higher HFP values and 78% with lower HFP values, and this contrast is even more dramatic in the proposed Andean Bear Conservation Units (ABCUs) where 87.5% had lower HFP values and low human influence. In areas with no expert knowledge from participants the relationship was 61% with lower HFP values and 39% with higher HFP values suggesting significant unidentified ABCUs maybe present. Future analyses might use the HFP analyses to identify further ABCUs for subsequent field verification.

In addition, using the FRAGSTATS Large Patch Index or LPI (McGarigal & Marks, 1995) we analyzed fragmentation levels within each knowledge class polygon for two levels of human activity in the Human Footprint (HFP) analysis (0-25 and 26-50) which account for >98% of the evaluated area. For the lowest human activity HFP category (0-25) this analysis revealed a high LPI of 32.4 (Table 5) indicating low fragmentation levels for the areas where participating experts confirmed the presence of Andean bears, in contrast to rather lower values for areas with confirmed absence (8.89) and areas without knowledge about Andean bears (7.13). For the second HFP category (26-50) the relationship was the inverse, with a relatively low LPI value for the area with confirmed presence (5.74) indicating significant fragmentation of areas with this higher level of human activities. As expected for areas with confirmed absence, fragmentation levels for areas with higher levels for human activities were much lower (50.75). Finally, for the area without knowledge there was an intermediate LPI value (16.24), again suggesting the potential in the future to further examine these areas for additional ABCUs in areas classified as without knowledge about Andean bears.

We therefore decided to use the global data sets to take a more conservative approach using cut-off points at 25% of the maximum allowed value: 25 or below for the Human Footprint. As such we reduced or expanded the boundaries of the previously identified Andean Bear Conservation Units to those areas that had the lowest values for human influence avoiding large human population concentrations and major thoroughfares. Consequently, there are very few areas within the final Andean Bear Conservation

TABLE 5. Fragmentation analyses for polygons identified by experts as areas where a) Andean bears are present, b) without knowledge about Andean bears, and c) Andean bears no longer occur

Knowledge Polygon Class	HFP Value Categories	% Polygon	# Patches	LPI
Area with knowledge of Andean bear presence	0_25	77.73	219	32.40
	26_50	21.89	811	5.74
Area without knowledge	0_25	61.36	414	7.13
	26_50	37.90	793	16.24
Area with knowledge of Andean bear absence	0_25	25.41	50	8.89
	26_50	71.51	42	50.75

Units that have high levels of human influence. When revising the ABCU borders we also took into account the limits of existing national protected areas, such that areas of Andean bear distribution with higher Human Footprint and/or Human Influence Index values within existing national protected areas in Bolivia and Peru were retained due to presumed existing management capacity. Finally, we also took into account the opinions of contributing experts and the revised Andean bear historical distribution, whereby we extended the limits of ABCUs to meet the boundary of the historical distribution (Figures 12 & 13).

The newly defined ABCUs actually expanded into parts of the polygons previously defined as without knowledge for Andean bears since they were areas with very low Human Footprint values and as such low levels of human activity. Therefore, the polygons for areas without knowledge were reduced by 61,364.68 km^2 from a total of 257,137.9 km^2 to 195,773.22 km^2. This reduction suggests that the possibility of identifying additional ABCUs in unknown areas is greater in Peru than Bolivia, because in Bolivia the reduction of areas without knowledge was from 59,199.18 km^2 to just 26,113.96 km^2, whereas in Peru the area without knowledge was originally greater, and under the new ABCU limits was reduced from 197,938.72 km^2 to a still significant area of 169,659.26 km^2.

DESCRIPTION OF MODIFIED PRIORITY ANDEAN BEAR CONSERVATION UNITS (ABCU) IN BOLIVIA AND PERU

Originally the working group identified nine ABCUs in the Central Andes, three for Peru and six for Bolivia with a total size of 270,968.63 km^2, however, following post-workshop revisions we reduced the number of ABCUs to seven, but increased the overall area within these ABCUs 29.42% to 350,689.63 km^2 (Table 6). The average size of the seven ABCUs is 49,890.53 km^2 (Range: 15,628.01 – 114,919.64 km^2).

We also calculated the percentage of each ABCU that is currently found under protection using three different categories of protected areas: 1) National Protected Areas; 2) Departmental (Bolivia) and Regional (Peru) Protected Areas; and 3) Municipal (Bolivia) and Private (Peru) Protected Areas (Table 6). This categorization recognized the differing protected area hierarchies between Bolivia and Peru.

ABCU CENTRAL ANDES 1: NORTHWESTERN PERU

The ABCU Central Andes 1 in northwestern Peru was originally relatively large (20,364.4 km^2), however, the levels of human influence are significant for this region due to roads and local communities (Figure 14), and using the general criteria

TABLE 6. Size and name of Andean Bear Conservation Units (ABCU) identified in Central Andes during the workshop and final post-workshop modified ABCU

Original Workshop ABCU Name	Km²	Post-Workshop Modified ABCU Name	Km²	% ABCU in National Formal Protection	% ABCU in Regional Formal Protection	% ABCU in Municipal/ Private Protection
ABCU 3 Peru	20,364.40	ABCU Central Andes 1: Northwestern Peru	33,463.08	3.53	0.01	0.7
ABCU 2 Peru	100,098.12	ABCU Central Andes 2: Northeastern Peru	43,487.51	16.91	2.75	0.34
		ABCU Central Andes 3: Central Peru	76,104.71	31.68	0.13	0.67
ABCU 1 Peru	88,117.78	ABCU Central Andes 4: Southern Peru-Northern Bolivia	114,902.25	45.09	0.86	0.31
ABCU Norte La Paz	22,833.64					
ABCU Lambate	2,508.88	ABCU Central Andes 5: Cotapata, Lambate y Altamachi	24,165.54	18.69	19.79	0
ABCU Altamachi	2,438.00					
ABCU Carrasco-Amboro	8,894.10	ABCU Central Andes 6: Carrasco-Amboro	15,629.12	75.17	2.35	0
ABCU Iñao-Parabanó	8,930.84	ABCU Central Andes 7: Iñao-Tariquia	42,937.41	13.83	11.89	2.13
ABCU Huacareta-Tariquia	15,701.54					
TOTAL	269,887.30	FINAL TOTAL	350,689.63	30.41	3.58	0.62

for ABCU definition used herein it is questionable whether this area would qualify as an ABCU due to very significant excessive fragmentation. However, the dry Pacific forests of northwestern Peru represent a unique ecosystem within the range of the Andean bear, and as such there was a strong feeling among workshop participants to maintain an ABCU in the best remaining patch of the ecosystem. Nevertheless, post-workshop we adjusted the ABCU according to Human Footprint criteria (Figure 14), and this significantly increased the size of the ABCU to 33,463.08 km².

The post-workshop adjusted ABCU Central Andes 1 (Figure 15) is a horseshoe shaped polygon in the dry pacific forests of northwestern Peru, which includes eight small national protected areas: Bosques Nublados de Udima, Calipuy, Chancaybaños, Cutervo, Laquipampa, Pagaibamba, Sunchubamba and Tabaconas Namballe, that in total cover 1,182.75 km², just 3.65% of the ABCU. One regional protected area: Bosque Moyan-Palacio of 3.74 km², just 0.01% of the ABCU, and finally four private protected areas: Bosques de Neblina y Páramos de Samanga, Chaparri and La Huerta del Chaparrí, that in total cover 234.44 km², just 0.7% of the ABCU. As such in total only 4.25% of this ABCU is under formal protection in a series of protected areas that are all rather small.

A close examination of this ABCU raises concerns about actual connectivity for the Andean bear population in both the western and eastern arms of the horseshoe, and we suggest that verifying presumed connectivity should be a priority conservation research action for this ABCU. Similarly, given the precarious shape of this ABCU from a connectivity perspective, future possibilities for maintaining connectivity should be evaluated and appropriate conservation actions developed. Finally, an updated evaluation of connectivity with southern Ecuador is required, although Kattan and colleagues (2004) suggested that important connectivity existed with Southern Ecuador up until the 2001 analysis included therein.

FIGURE 14. ABCU Central Andes 1: Northwestern Peru considering Human Footprint analysis (Post-Workshop Modified)

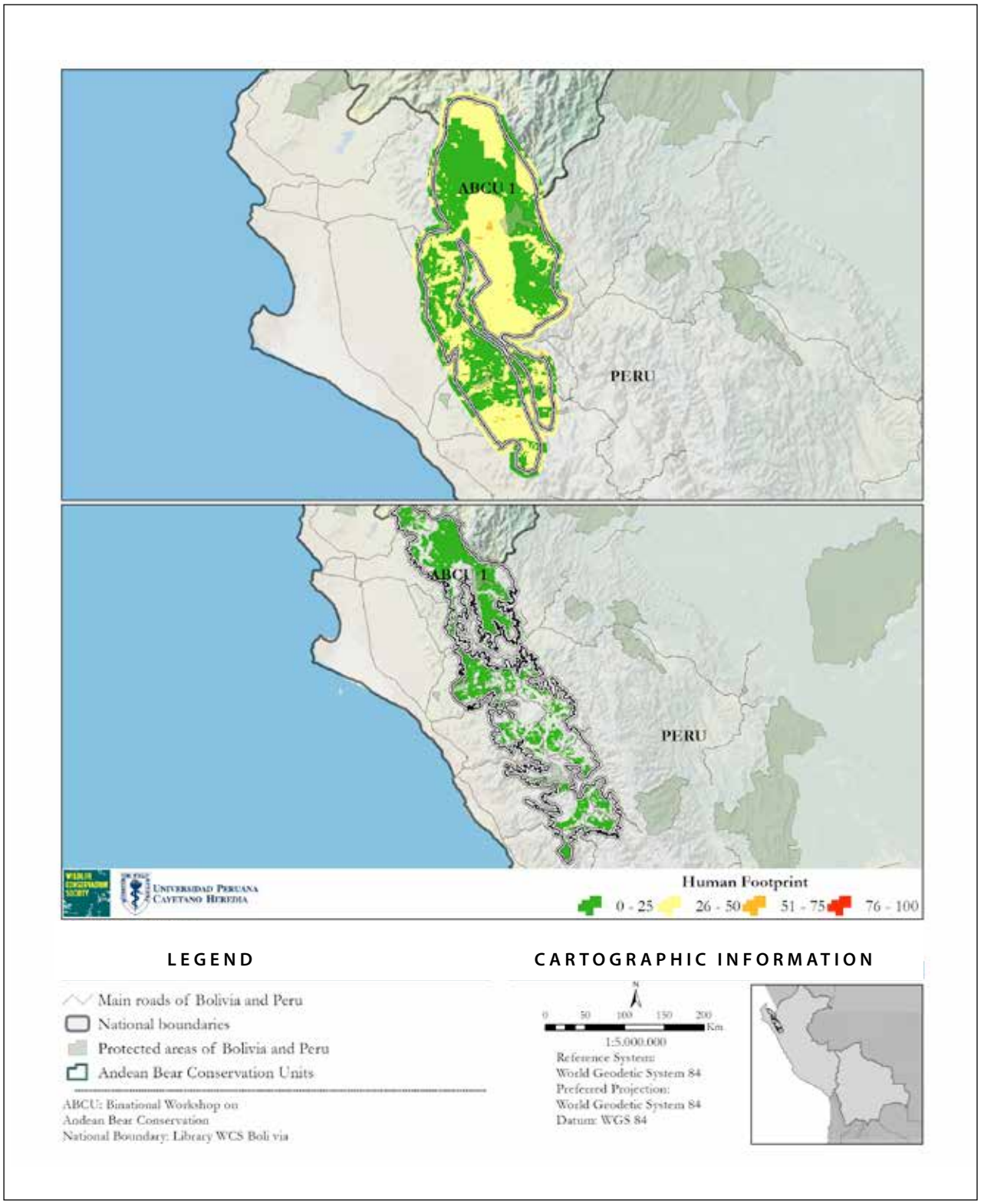


FIGURE 15. Final Post-workshop Modified ABCU Central Andes 1: Northwestern Peru

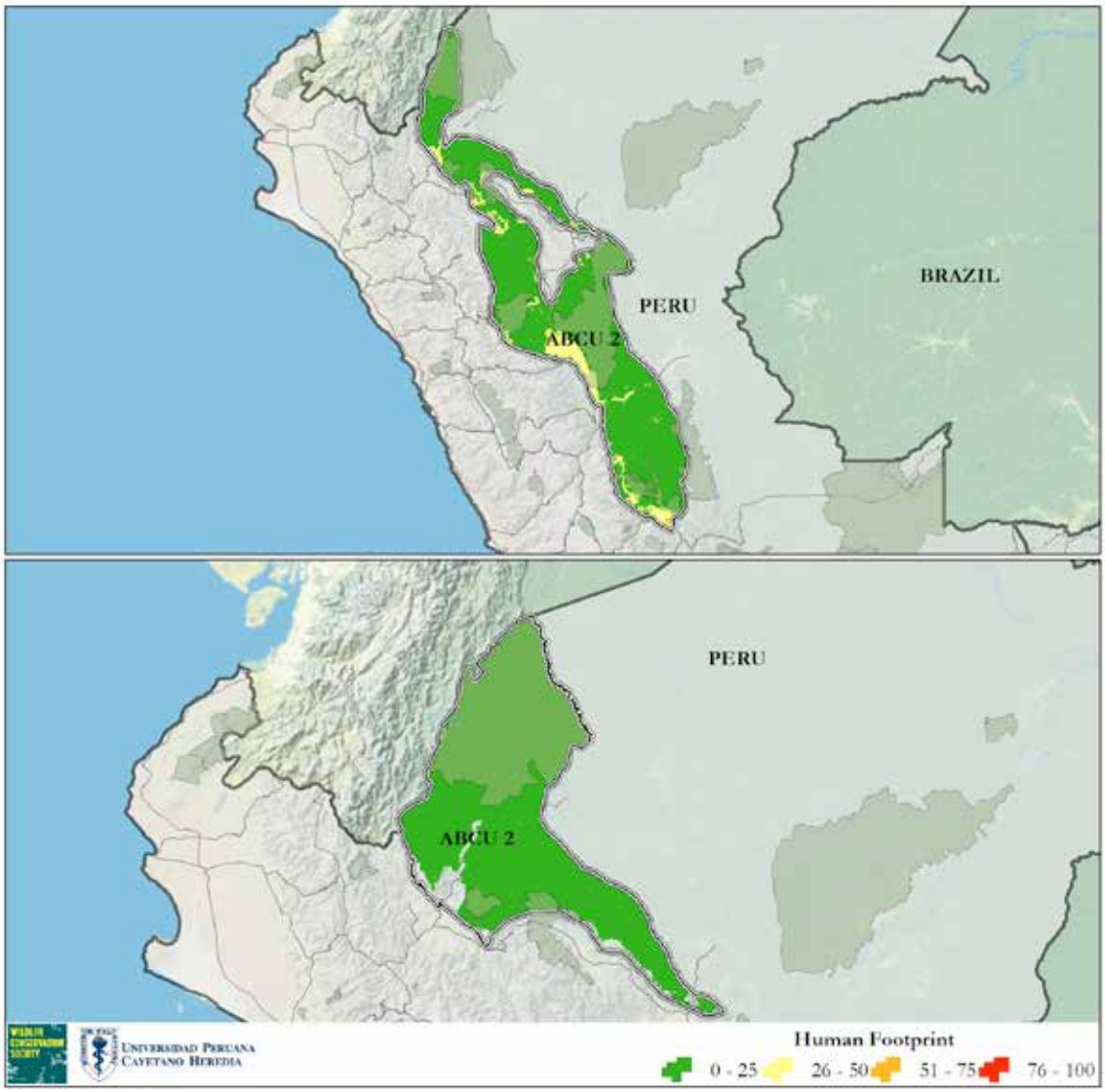
ABCU CENTRAL ANDES 2: NORTHEASTERN PERU

Following the Human Footprint analyses, which showed several areas within the ABCU with a high level of human influence, we divided the previously massive ABCU (100,098.12 km^2) into two smaller ABCUs, which from now on we refer to as ABCU Central Andes 2: Northeastern Peru and ABCU Central Andes 3: Central Peru. Although we divided these two ABCUs, collectively following the Human Footprint analyses the area under both ABCUs actually increased to a total of 119,608.19 km^2.

The ABCU Central Andes 2: Northeastern Peru now totals some 43,487.51 km2, includes portions of the Alto Mayo, Chayu Nain, Cordillera de Colan, Cordillera del Condor, Rio Nieva, Santiago Comaina and Tuntanain national protected areas that cover 16.91% of the ABCU (Figure 16), and is now defined by low levels of human influence. It also includes one regional protected area: Cordillera Escalera (2.75% of the ABCU area), and two private protected areas: Copallin and La Pampa del Burro (0.34% of the ABCU area). As such this ABCU has a total of 19.99% under protection, is located in extreme northeastern Peru (Figure 17), and borders with Ecuador. An evaluation of actual and future connectivity with potential ABCUs in southern Ecuador is required as an immediate conservation research action. Similarly, we would like to stress the need to establish whether effective connectivity exists between this ABCU and the neighboring ABCU Central Andes 3: Central Peru. Our analysis suggests connectivity may still exist, although we preferred to separate the two ABCUs because this suspected connectivity is along the lower elevations of the range for the Andean bear, which might be considered marginal habitat. There is also the need to evaluate if connectivity exists with the Huiquilla Private Conservation Area where Andean bear presence has recently been reported (Enciso, 2008; Enciso *et al*., 2012), as well as the southern and western portions of the Alto Mayo protected area where populations of Andean bear may be seriously threatened by habitat fragmentation related to agricultural activities and hunting respectively (Vela, pers. obsv., 2013).

Julie Larsen Maher, WCS

FIGURE 16. ABCU Central Andes 2: Northeastern Peru considering Human Footprint analysis (Post-Workshop Modified)



LEGEND

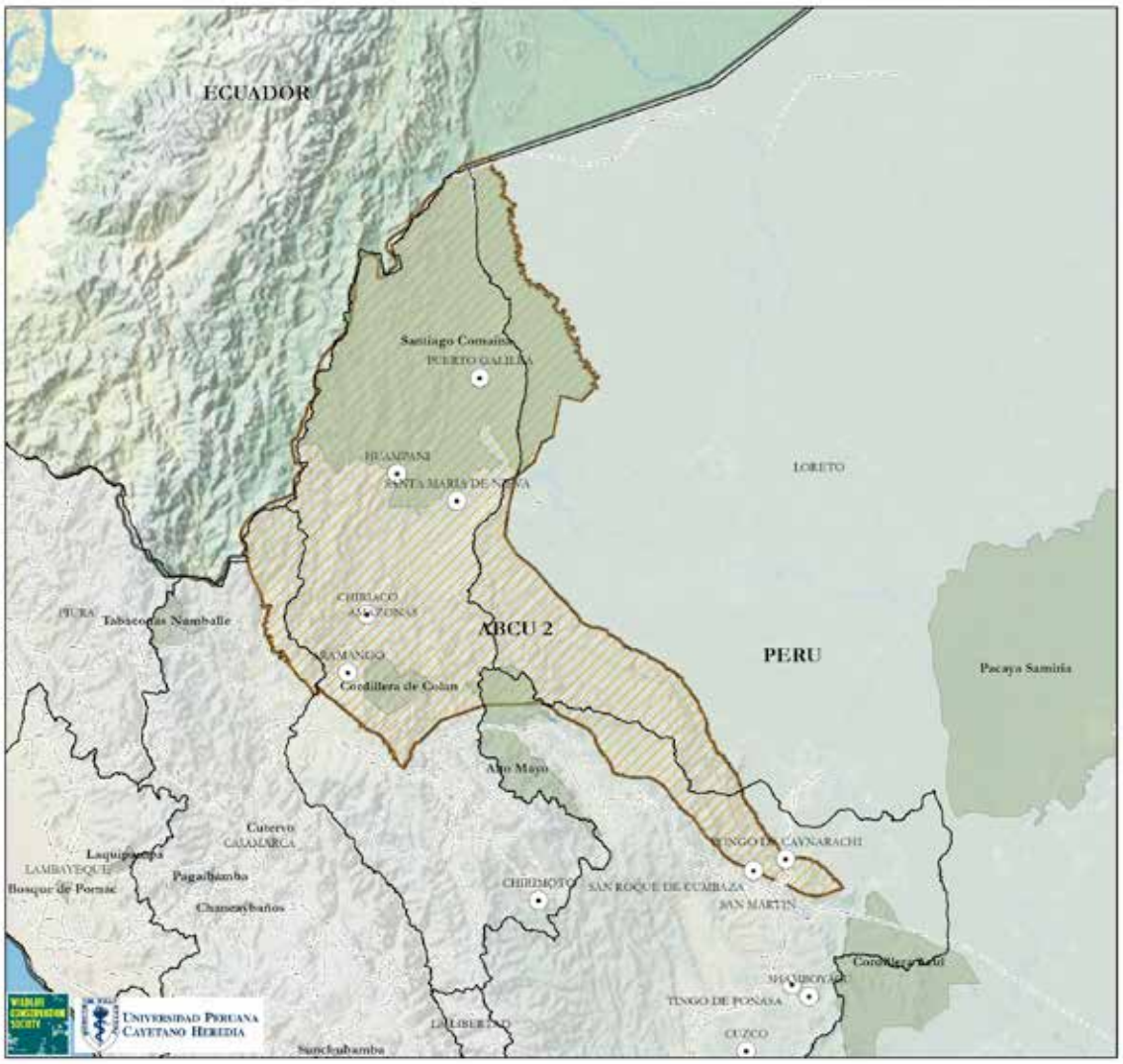
- Main roads of Bolivia and Peru
- National boundaries
- Protected areas of Bolivia and Peru
- Andean Bear Conservation Units

ABCU: Binational Workshop on Andean Bear Conservation
National Boundary: Library WCS Bolivia

CARTOGRAPHIC INFORMATION

N
0 60 120 180 240 Km
1:5.000.000
Reference System:
World Geodetic System 84
Prefered Projection:
World Geodetic System 84
Datum: WGS 84

FIGURE 17. Final Post-workshop Modified ABCU Central Andes 2: Northeastern Peru



LEGEND

- Main roads of Bolivia and Peru
- National boundaries
- Protected areas of Bolivia and Peru
- Andean Bear Conservation Units

ABCU: WCS Bolivia
National Boundary: Library WCS Boli via

CARTOGRAPHIC INFORMATION

N

0 30 60 90 120 Km

1:2.750.000
Reference System:
World Geodetic System 84
Preferred Projection:
World Geodetic System 84
Datum: WGS 84

ABCU CENTRAL ANDES 3: CENTRAL PERU

This ABCU is located in the center of Peru (Figure 18), and includes at least part of nine jurisdictional regions (Amazonas, Cajamarca, Huanco, Junin, La Libertad, Loreto, Pasco, San Martín, Ucayali) and six national protected areas (Río Abiseo, Cordillera Azul, El Sira, San Matias-San Carlos, Yanachaga-Chemillen and Yanesha; 31.68% of the ABCU area), as well as seven small private protected areas (Huaylla Belen-Colcamar, Huiquilla, Larga Vista I y II, Los Chilchos, Milpuj-La Heredad, and Panguana: 0.67% of the ABCU area) and one small regional protected area, Cordillera Escalera (0.13% of the ABCU area). After eliminating areas with a high Human Influence and Human Footprint, this ABCU is still a very large ABCU (76,104.71 km^2; Figure 19), and 32.48% of this area is found in the aforementioned protected areas. Once again potential connectivity with the previous ABCU Central Andes 2: Northeastern Peru needs to be evaluated as a priority conservation research action.

Mileniusz Spanowicz, WCS

FIGURE 18. ABCU Central Andes 3: Central Peru considering Human Footprint analysis (Post-Workshop Modified)

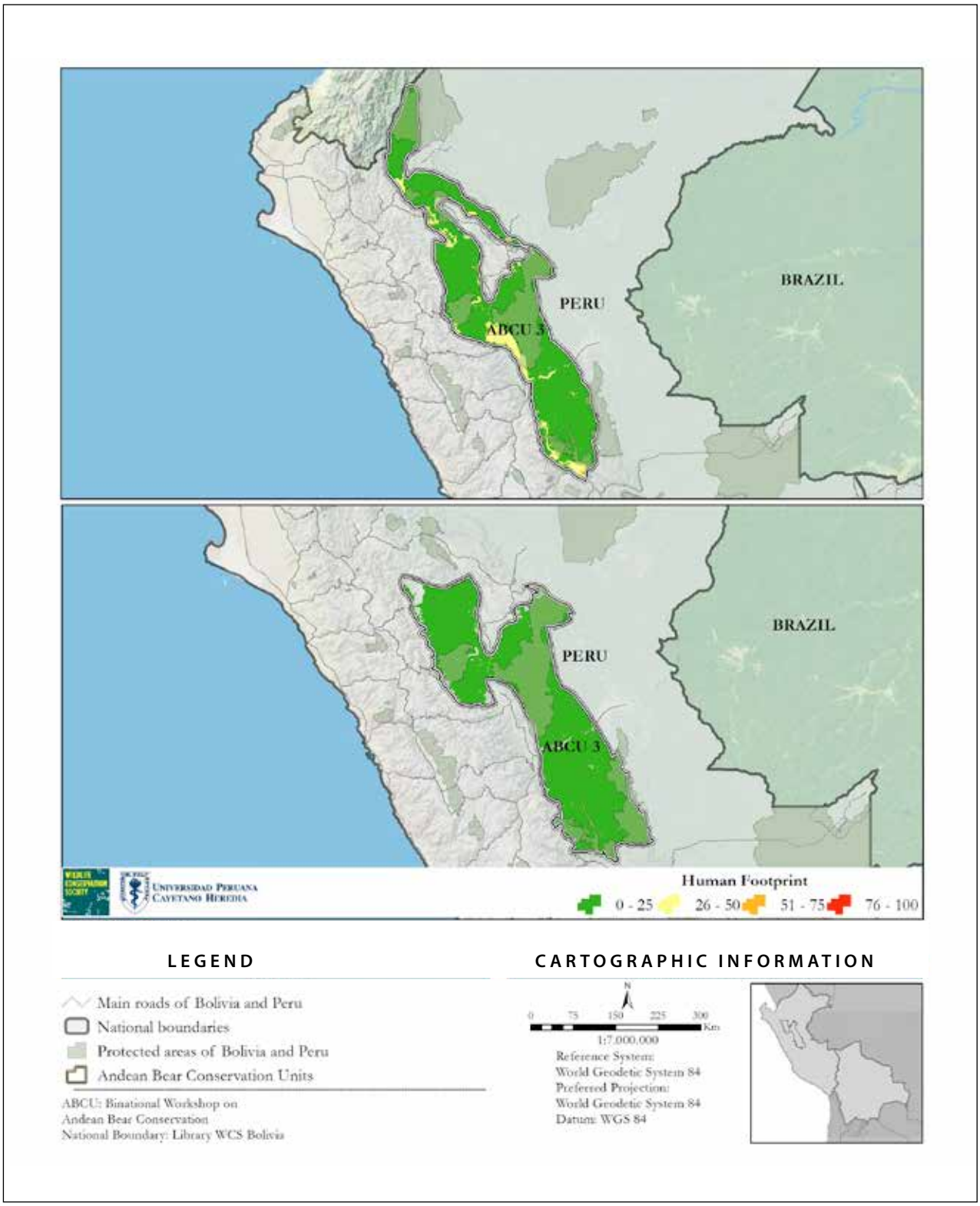
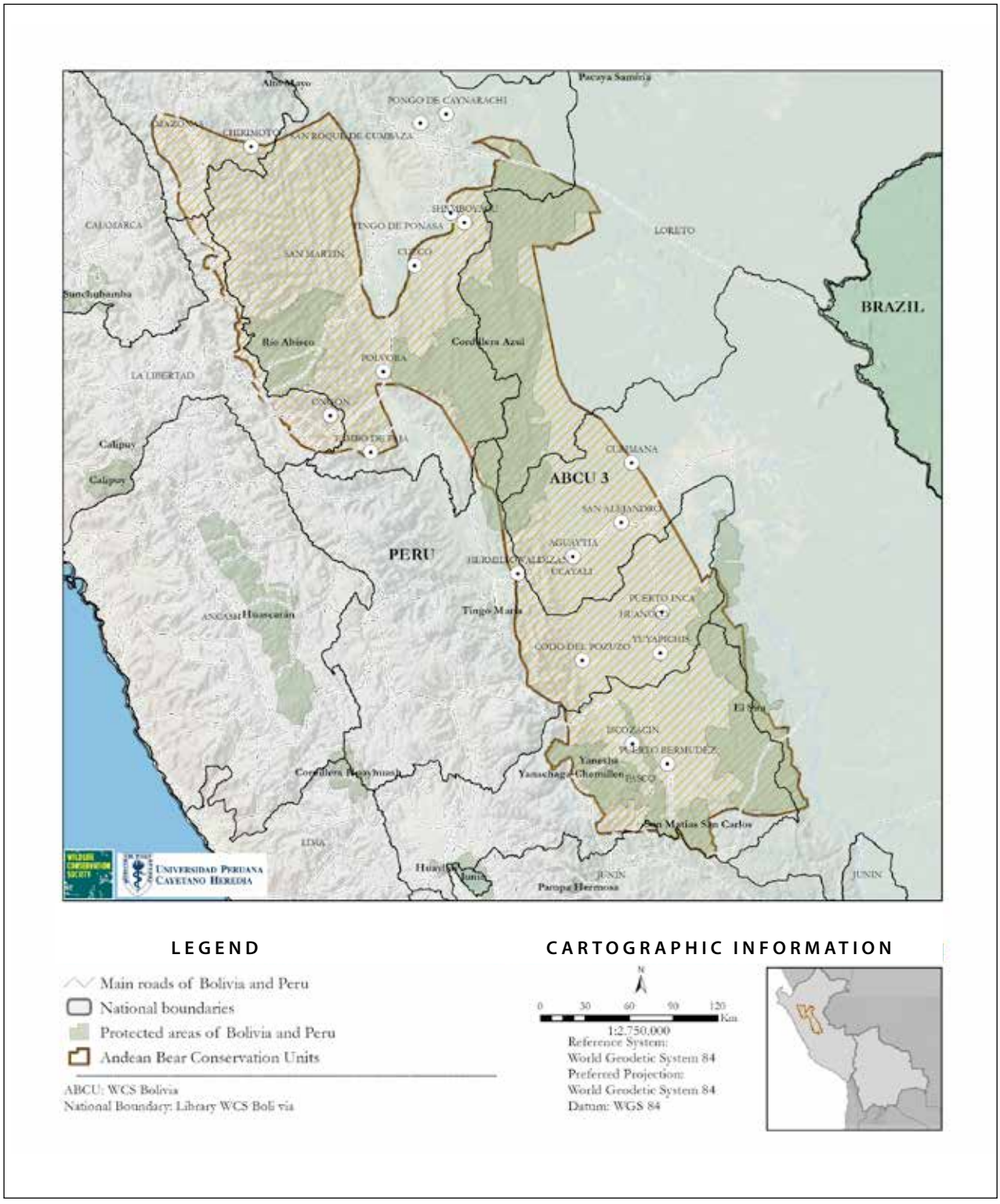


FIGURE 19. Final Post-workshop Modified ABCU Central Andes 3: Central Peru



ABCU CENTRAL ANDES 4: SOUTHERN PERU-NORTHERN BOLIVIA

It is important to emphasize that this ABCU combines the previously defined ABCU in southern Peru with the continuous ABCU in northern Bolivia and taken together this merged ABCU forms the largest proven swathe of Andean bear habitat (110,951.42 km^2) in the distribution of the Andean bear. Following the human footprint analysis (Figure 21) we increased the size of the ABCU Central Andes 4 in southern Peru and northern Bolivia to 114,902.25 km^2 (Figure 22), though its shape changed significantly with the southern portion eliminated including the Cotapata National Park, and the western limit extended to include more of Pilón Lajas Biosphere Reserve and Indigenous Territory (Figure 22).

Encouragingly, this huge ABCU includes several (13) national protected areas and sanctuaries (45.09% of the ABCU area): Amarakaeri, Ampay, Ashaninka, Bahuaja-Sonene, Machiguenga, Machupicchu, Manu, Megantoni, Otishi and Tambopata in Peru, and Apolobamba, Pilón Lajas and Madidi in the La Paz Department, as well as six municipal and private protected areas (0.31% of the ABCU area): Boa Wadack Dari, Bosque Nublado, Japu-Bosque Ukumari Llaqta, Pillco Grande-Bosque de Pumataki, Qosqoccahuarina and San Juan Bautista in Peru. Finally, this ABCU intersect with one regional protected area (0.86% of the ABCU area): Choquequirao in Peru. In total these areas cover 46.26% of the ABCU. However, it also includes 10 major roads and more than 20 secondary roads and development and associated threats to habitat along the Inter-Oceanic Highway may jeopardize the integrity of this ABCU in the future.

Interestingly, this ABCU probably has the most complete information on Andean bear distribution and habitat use in Bolivia (Paisley 2001; Rios-Uzeda *et al*., 2006, 2007; Wallace *et al*. 2010, 2013) and Peru (Figueroa & Stucchi, 2013), as well as excellent information on the distribution of human activities for most of the ABCU (WCS, unpublished data). As such it represents a great opportunity to "ground truth" the large-scale Human Footprint analyses made here with finer scale human landscape analyses (WCS, unpublished data).

Robert Wallace, WCS

FIGURE 20. ABCU Central Andes 4 – Southern Peru-Northern Bolivia considering Human Footprint analysis (Post-Workshop Modified)

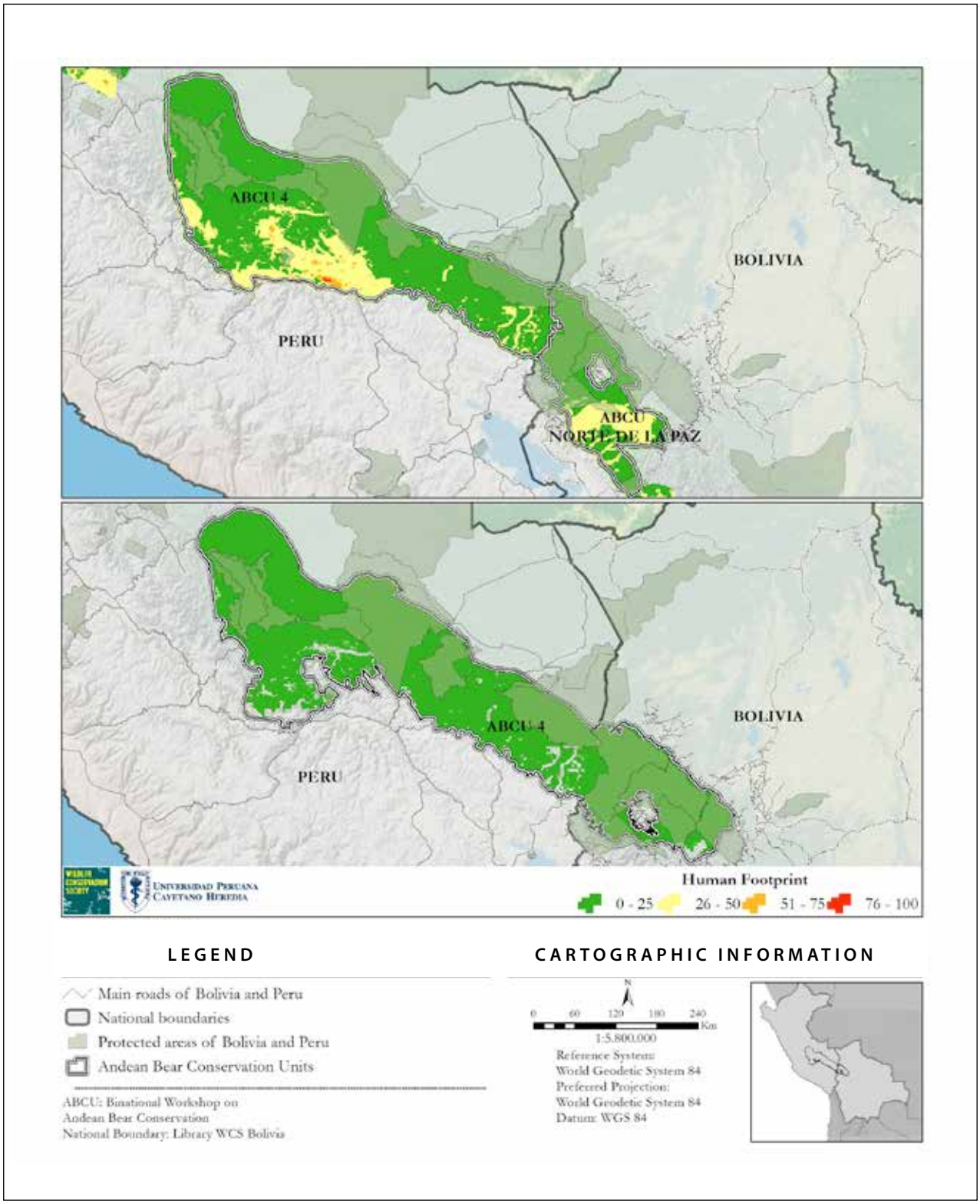
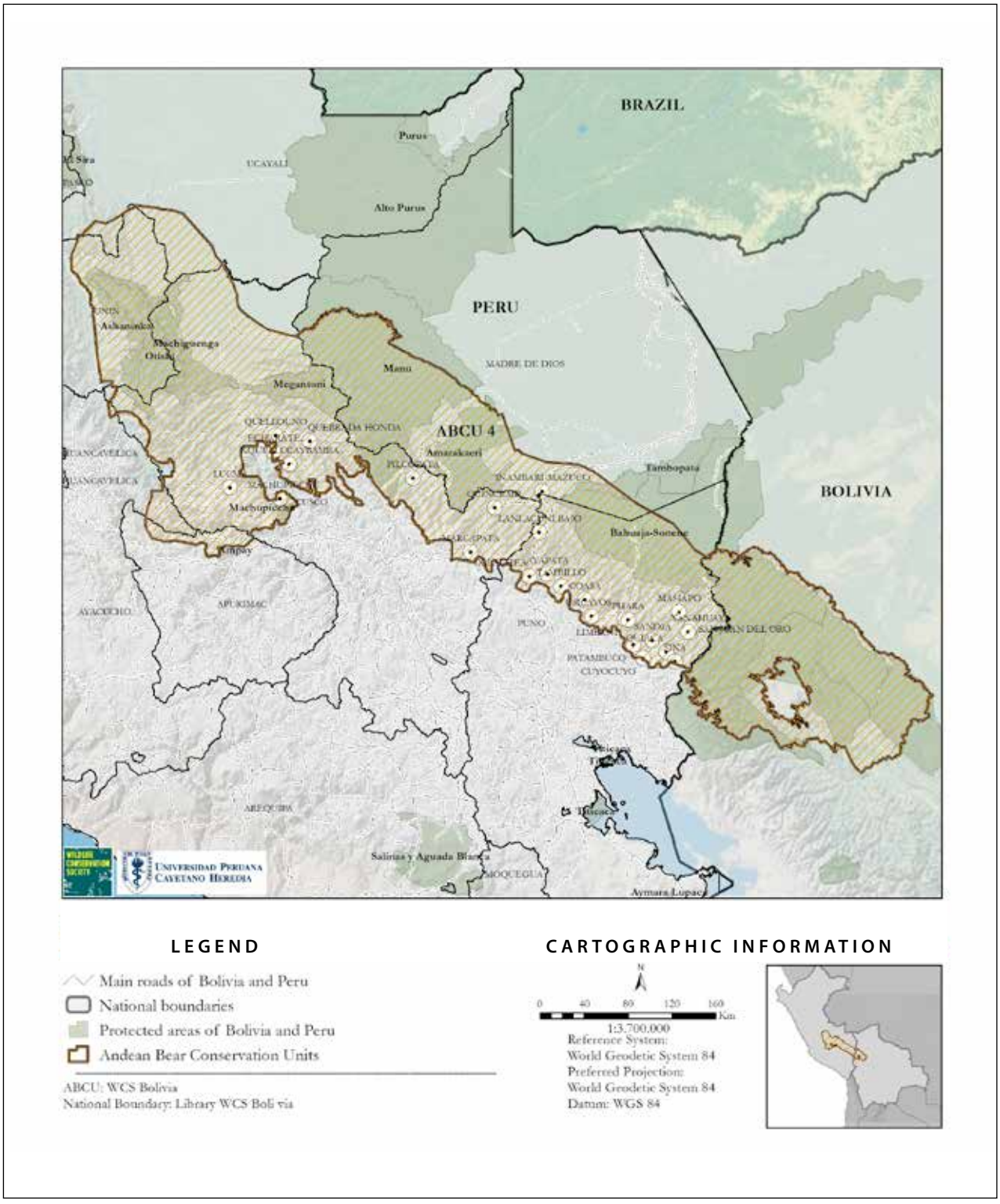


FIGURE 21. Final Post-workshop Modified ABCU Central Andes 4: Southern Peru-Northern Bolivia



ABCU CENTRAL ANDES 5: COTAPATA-LAMBATE-ALTAMACHI

Following analyses of human influence we merged the ABCU Central Andes: Lambate and ABCU Central Andes: Altamachi ABCU´s with the extreme southern portion of the Northern La Paz ABCU containing Cotapata that had been cut away from ABCU Central Andes 4. Originally when identified at the workshop, both the ABCU Lambate (2,508.88 km^2) and the ABCU Altamachi (2,438 km^2) were comparatively small, and post-workshop after analyzing the Human Influence were reduced even further in size. However, this area borders onto the relatively small Cotapata National Park for which connectivity for its Andean bear populations is a very important management objective. Hence, we combined ABCU Central Andes: Lambate with ABCU Central Andes: Altamachi and the extreme southern portion of ABCU Central Andes: Northern La Paz to form a redefined and larger ABCU Central Andes: Cotapata-Lambate-Altamachi (Figure 22).

This redefined ABCU is now 24,165.54 km^2 (Figure 23), 38.47% of the ABCU is covered by portions of three national protected areas: Cotapata, Isibore-Secure and Tunari (18.69% of the ABCU area), and two departmental protected areas: Incacasani Altamachi and an adjacent area in Altamachi which is in the process of being approved (19.79% of the ABCU area). Major conservation action priorities for this ABCU are to a) evaluate connectivity to the northwest with the ABCU Central Andes 4: Southern Peru-Northern Bolivia, b) similarly evaluate connectivity to the southeast with the ABCU Central Andes 6: Carrasco-Amboro, and c) most critically, confirm presumed connectivity within the ABCU, particularly along the Yungas road that descends from La Paz but also other important roads that cut across the ABCU Central Andes 5: Cotapata-Lambate-Altamachi (Figure 22). Here, Andean bears are known to occur very close to the roads (WCS, unpublished data) and establishing movement across the roads is the most pressing task for the confirmation of this ABCU.

Mileniusz Spanowicz, WCS

FIGURE 22. ABCU Central Andes 5: Cotapata-Lambate-Altamachi considering Human Footprint analysis (Post-Workshop Modified)

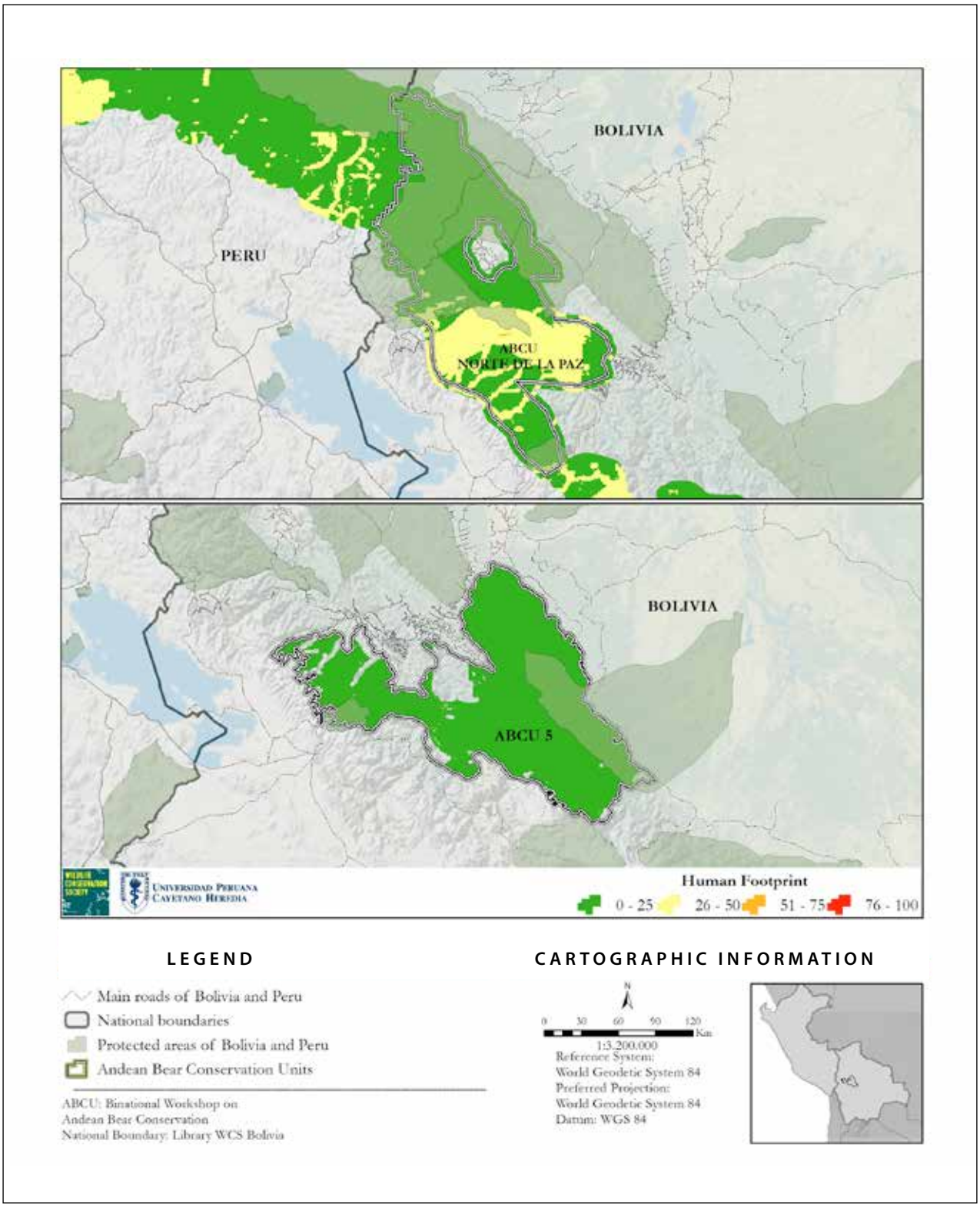
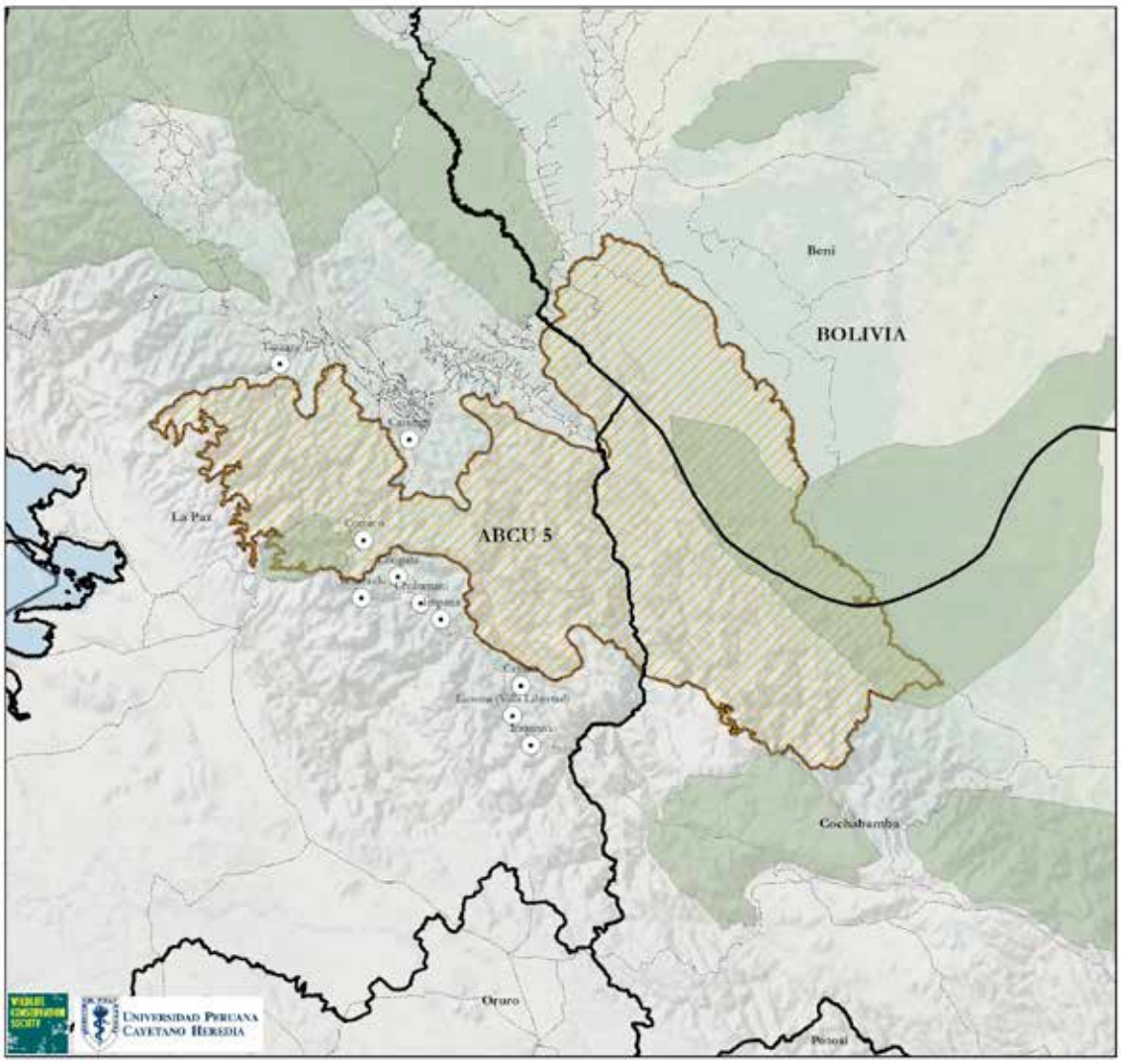


FIGURE 23. Final Post-workshop Modified ABCU Central Andes 5: Cotapata-Lambate-Altamachi



LEGEND

- Main roads of Bolivia and Peru
- National boundaries
- Protected areas of Bolivia and Peru
- Andean Bear Conservation Units

ABCU: WCS Bolivia
National Boundary: Library WCS Boli via

CARTOGRAPHIC INFORMATION

N

0 20 40 60 80 Km

1:2.000.000
Reference System:
World Geodetic System 84
Preferred Projection:
World Geodetic System 84
Datum: WGS 84

ABCU CENTRAL ANDES 6: CARRASCO-AMBORO

This ABCU is centered on the Carrasco National Park, Amboro National Park and Natural Area of Integrated Management and Cavernas del Repechón Wildlife Refuge. At the southern tip the ABCU intersects with the Rio Grande Valles Cruceños Departmental Protected Area. This ABCU has 77.52% of the area under protection (Figure 24) within these three national parks (75.17% of the ABCU area) and one Departmental Park (2.35% of the ABCU area). The Human Influence and Human Footprint analyses actually increased the original area, and the final ABCU is 15,629.12 km^2 (Figure 25). Important conservation action tasks will be to evaluate possible connectivity to the northwest and southeast with ABCUs Central Andes 5 and 7 respectively, especially because the expansion of the agricultural frontier is extremely relevant in this region of Bolivia, which may potentially affect connectivity within the currently defined ABCU.

Mieszko Pazdanowski, WCS

FIGURE 24. ABCU Central Andes 6: Carrasco-Amboro considering Human Footprint analysis (Post-Workshop Modified)

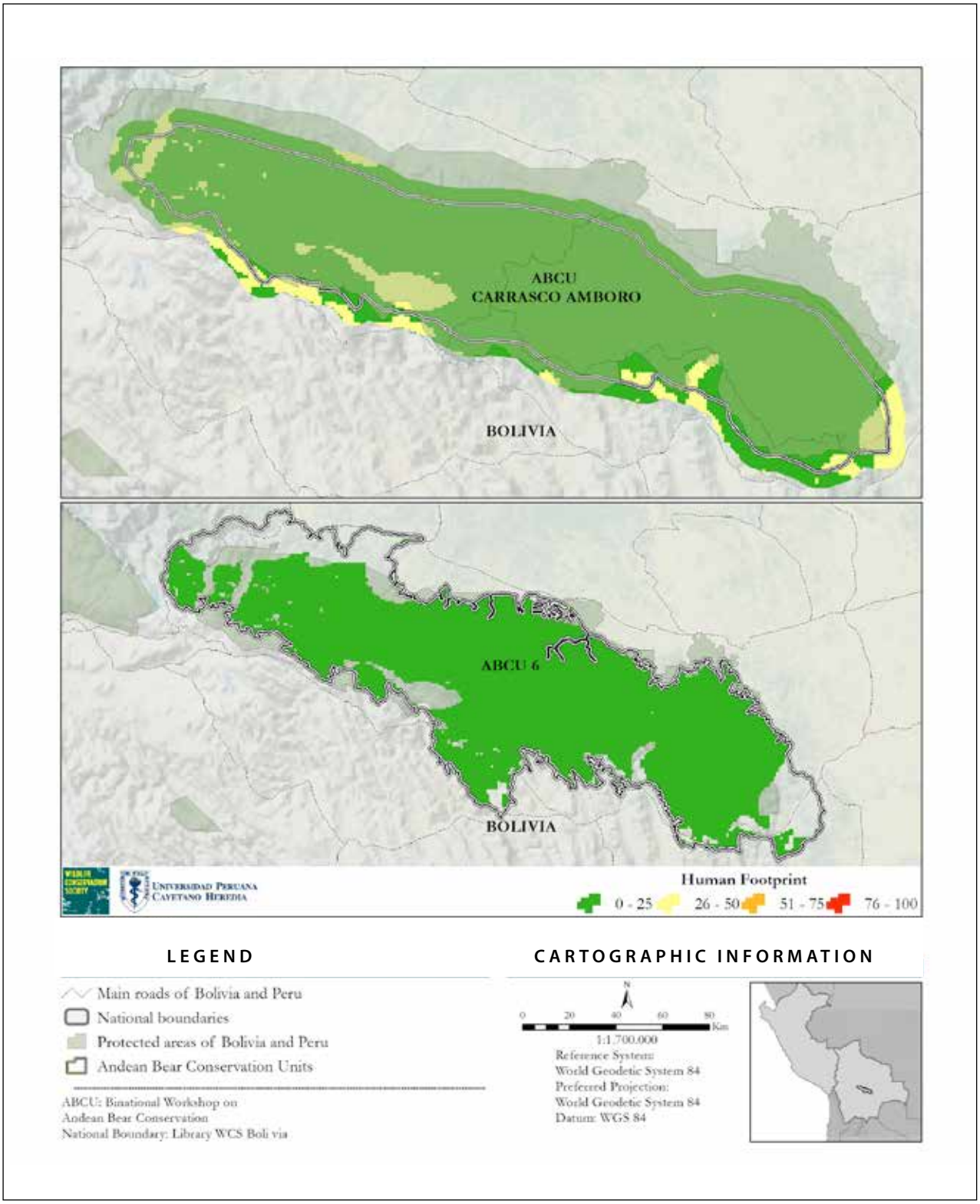
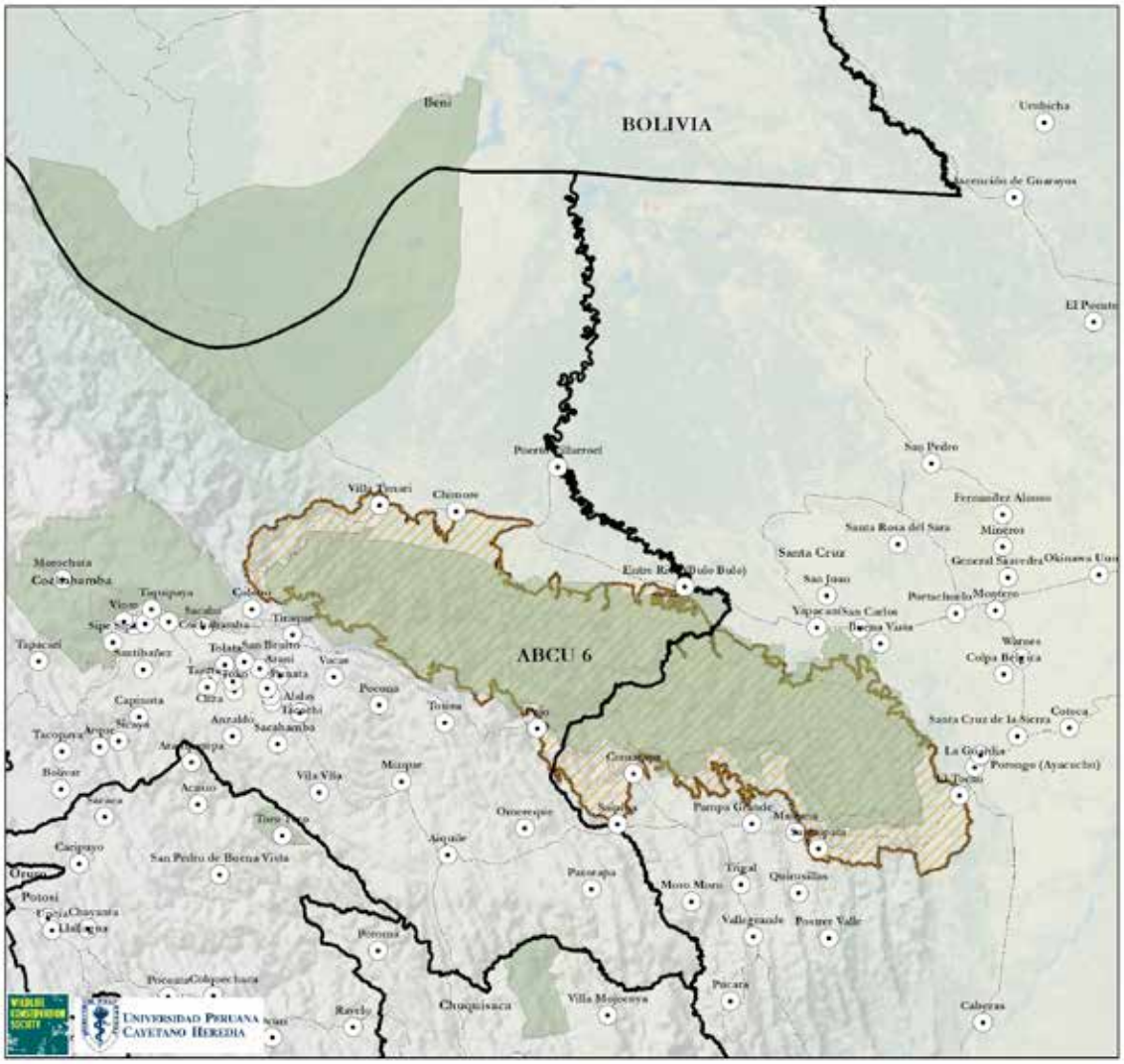


FIGURE 25. Final Post-workshop Modified ABCU Central Andes 6: Carrasco-Amboro



LEGEND

- Main roads of Bolivia and Peru
- National boundaries
- Protected areas of Bolivia and Peru
- Andean Bear Conservation Units

ABCU: WCS Bolivia
National Boundary: Library WCS Boli via

CARTOGRAPHIC INFORMATION

N

0 20 40 60 80 Km

1:2.000.000
Reference System:
World Geodetic System 84
Preferred Projection:
World Geodetic System 84
Datum: WGS 84

ABCU CENTRAL ANDES 7: IÑAO-TARIQUIA

This ABCU combined the two southernmost ABCU defined in the original workshop (Table 4) and is situated in southern Bolivia in the Santa Cruz, Chuquisaca and Tarija Departments (Figures 26), and indeed comprises the Austral continental distribution limit of the Andean bear. This ABCU includes the Aguarague, Iñao and Taruquia national protected areas (13.83% of the area), the Rio Grande Valles Cruceños departmental protected area (11.89% of the area), and the Parabano and Serrania-Sararendo municipal protected areas (2.13% of the area), with a total of 27.85% of the total area under protection. The Human Footprint and Human Influence Index analyses revealed that this area does not have high levels in most of the originally defined ABCU, and in fact we actually increased the size of the ABCU to 42,937.41 km^2 (Figures 27), and includes the Pilcomayo River that cuts across the ABCU. Conservation action priorities for this ABCU are once again to establish potential connectivity to the north with ABCU Central Andes 6, considering the intensification of agricultural activities in this region of Bolivia.

Julie Larsen Maher, WCS

FIGURE 26. ABCU Central Andes 7: Iñao-Tariquia considering Human Footprint analysis (Post-Workshop Modified)

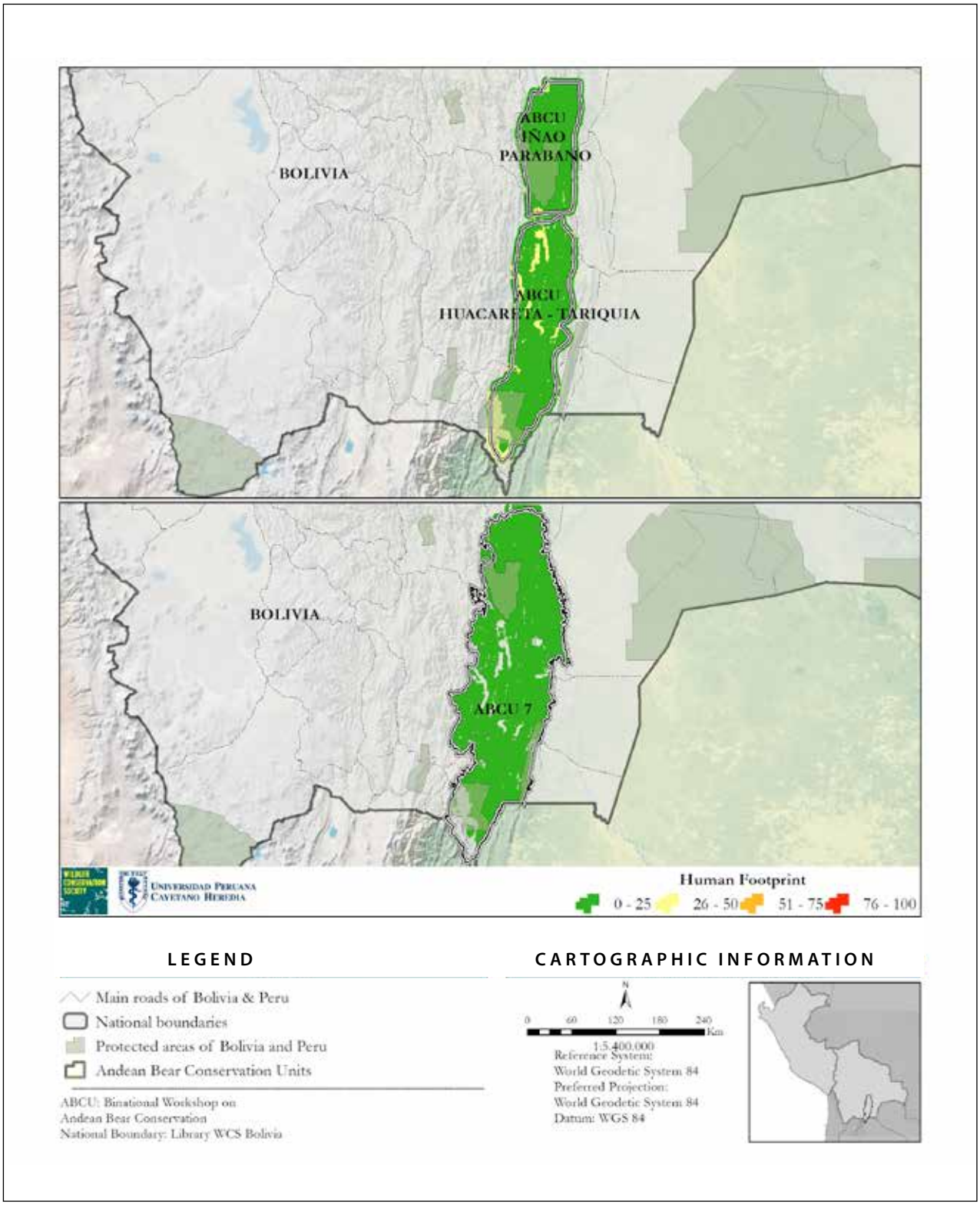
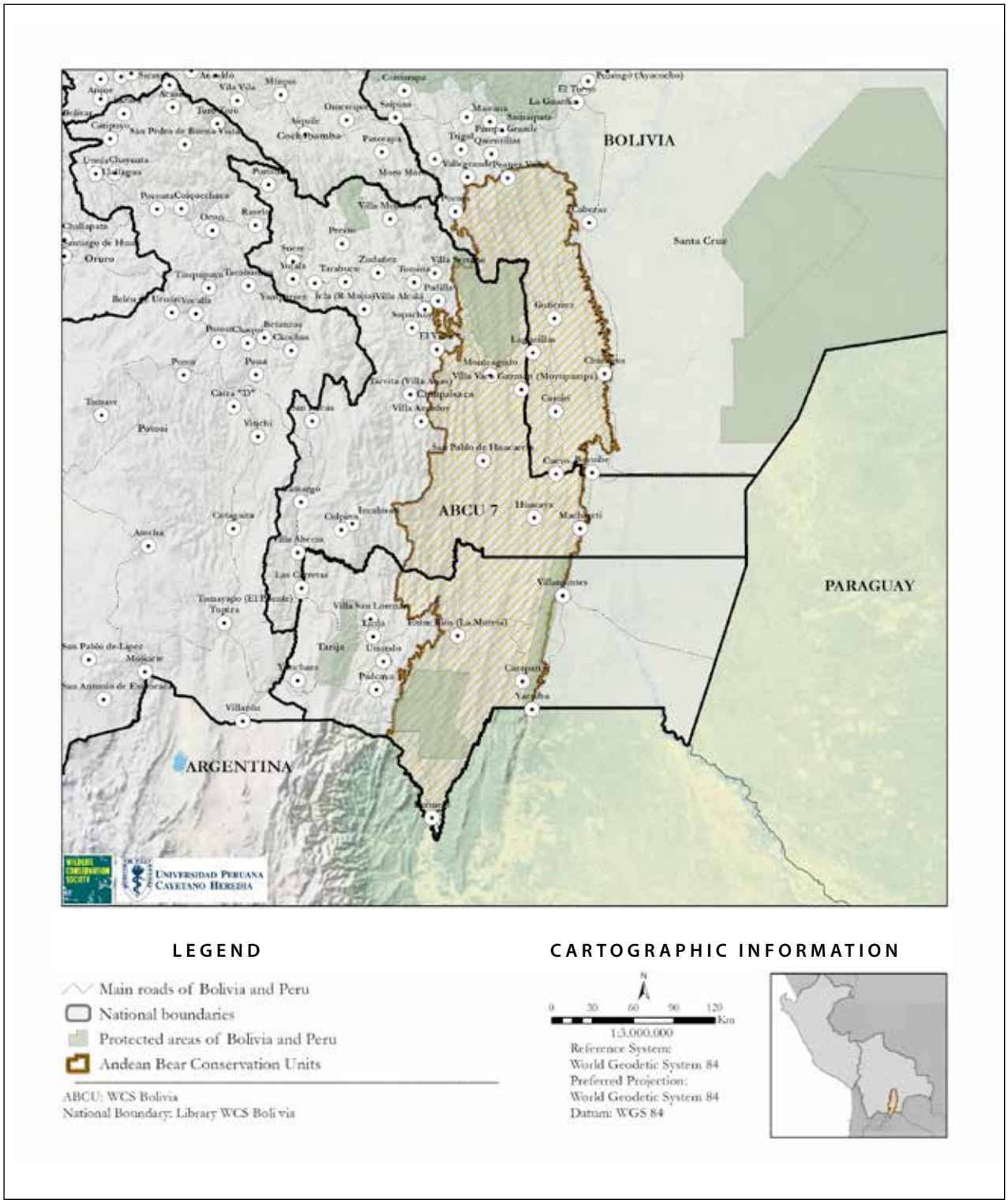


FIGURE 27. Final Post-workshop Modified ABCU Central Andes 7: Iñao-Tariquia



DISCUSSION

ANDEAN BEAR HISTORICAL RANGE

The historical range presented herein is considered an improvement on previously published versions (Peyton, 1990), in large part because the digital elevation and especially vegetation type information currently available and used for this exercise is of considerably better quality with the advent of GIS technology and increased availability of satellite images. Overall our version of the historical range increased by 1.8% from the area previously proposed by Peyton (1990). The historical range of a species is an important perspective with which to measure the decline of species to date, as well as with which to set conservation targets in the future.

According to this updated version of the historical range the total range of the Andean bear in Bolivia and Peru was once approximately 607,256.76 km^2. Whilst impressive this pales in comparison to the continental distribution of other large carnivores in Latin America. For example, the jaguar continental range was once approximately 19,000,000 km^2 (Sanderson *et al*., 2002), and the puma's continental range was once probably more than double that. Indeed, in general larger mammals have significantly larger distributions than smaller mammals (Gaston & Blackburn, 1996[a], 1996[b]). As such, pound for pound, the Andean bear has always been a relatively range-restricted species.

EXPERT KNOWLEDGE COVERAGE WITHIN THE ANDEAN BEAR HISTORICAL RANGE

In total the Andean bear experts that participated in this exercise felt comfortable expressing opinion about Andean bear presence in 54.68% of the revised historical range and absence in 2.98% of the revised historical range amounting to a total knowledge coverage of 57.66%. There were large 'holes' in knowledge coverage in central Peru that accounted for the majority of the areas where Andean bear knowledge was not available according to Andean bear experts (42.34%). Evidently, knowledge does exist for some of these areas in central Peru and we hope that in the future we will be able to improve the analyses herein.

There were concerns at the beginning of this initiative about the breadth of expert knowledge for this species, and knowledge coverage of 57.66% is considerably lower than species previously considered in a complete Range-Wide Priority Setting Exercise. For example, in 1999 the original jaguar analysis revealed 'knowledge holes' amounting to 17% indicating an overall knowledge area of 83% of the historical range (Sanderson *et al*., 2002), that was later increased in 2006 to 96% (Marieb, 2007). For more abundant, visible and easier to study species in the region, such as white-lipped peccaries and lowland tapirs, expert knowledge covered 99.1% and 99.6% of the historical range respectively (Taber *et al*., 2009). It is probable that knowledge coverage would increase somewhat if Ecuador, Colombia and Venezuela were included in this analysis as a complete Range Wide Priority Setting Exercise. Moreover, knowledge coverage of 57.66% underlines the need for basic survey work for Andean bears in Bolivia and Peru.

As mentioned previously, there is a particular need in Peru to assess large areas currently found outside the ABCUs within this document and without knowledge on Andean bears from the participating experts and evaluate whether additional ABCUs might be defined using the Human Footprint in association with protected area limits.

ANDEAN BEAR ACTUAL RANGE

Workshop participants were able to confirm six polygons, three in Bolivia and three in Peru, where Andean bears are considered as extirpated or where populations are significantly declined. Although these polygons accounted for just 2.98% of the revised historical range, this increases to 45.32% when areas where experts considered they could not reliably provide knowledge on Andean bear presence are considered. From a positive perspective this means that current knowledge suggests that Andean bears are still present in at least 54.68% of their historical range, but the confirmation on local extirpations underlines the need for conservation planning and actions for this species. Given that 42.34%

of the revised historical range has no knowledge coverage from participating experts, the need to engage additional experts is emphasized. It seems likely that upon further expert participation and/or fieldwork in these currently unknown portions of the Andean bear revised historical range, the percentage of areas where Andean bears still occur will increase dramatically.

By way of comparison, jaguars are considered extirpated in 39% of their historical range (Marieb, v2007), and white-lipped peccaries and lowland tapirs in 20% and 14% of their historical ranges respectively (Taber *et al*., 2009). As such, in Bolivia and Peru at least, Andean bears are still doing rather well, but as major transport and infrastructure projects increase in the Tropical Andes this situation is expected to deteriorate significantly over the next decade. Also, at a range wide level the situation for Andean bears maybe a little less promising, because, given higher human population densities, conservation pressures in the northern range countries of Ecuador (61 people per km^2), Colombia (41 people per km^2) and Venezuela (32 people per km^2) are almost certainly higher than Peru (24 people per km^2) and Bolivia (9 people per km^2).

Currently, 19.99% of the Andean bear's historical range in Bolivia and Peru is under formal protection. This actually exceeds the 17% recommended by the Convention on Biological Diversity as a 2011-2020 goal in the Aichi targets, but of course, Andean bears occur in the Tropical Andes - the most biologically diverse ecoregion in the world – and so the percentage under protection might be expected to exceed global recommendations. In any case, in Bolivia and Peru, as can be seen in the currently identified ABCU's there are a series of protected areas protecting Andean bears, at least some of which are large enough to be biologically significant for the Andean bear. The challenge into the future will be to secure the sustainable and effective management of these protected areas, and the broader ABCUs.

We compared the historical distributions of Andean bear, *Tayasu pecari*, *Panthera onca* and *Tapirus terrestris*, analyzing the relationship between perimeter length and area (Table 7), given that if the shape of the historical distribution is less circular then edge effects will be higher (Woodroffe & Ginsberg, 1998, Laurance *et al*., 2002, McKinney, 2005). To calculate historical ranges and perimeter lengths we used recent Range Wide Priority Setting

Mileniusz Spanowicz, WCS

TABLE 7. Historical range areas, range perimeters and perimeter to range ratios for four Latin American large mammal species

Historical Range Polygon	Area (km²)	Perimeter	Perimeter to Area Ratio*
Total *Tremarctos ornatus*	739,182.01	34,201.37	21.61
Total *Tayassu pecari*	14,220,487.57	66,617.84	213.46
Total *Panthera onca*	11,952,190.84	96,582.18	123.75
Total *Tapirus terrestris*	13,129,873.41	47,116.02	278.67
Bolivia & Peru *Tremarctos ornatus*	607,256.76	16,289.02	37.26
Bolivia & Peru *Panthera onca*	1,500,637.00	18,241.42	82.27
Bolivia & Peru *Tapirus terrestris*	1,571,924.04	21,848.66	71.95
Bolivia & Peru *Tayassu pecari*	1,558,063.58	22,068.38	70.6

***km² range area per km of perimeter**

exercises for jaguars, white-lipped peccaries and lowland tapir (Sanderson *et al*., 2002; Marieb, 2007; Taber *et al*., 2009). For Andean bear we used our adjusted historical range for Bolivia and Peru and merged this with previous best estimations for Ecuador, Colombia and Venezuela (Peyton, 1999).

At the overall global distribution scale there is clearly a major difference in the perimeter to area ratios for the Andean bear compared to the other three species, with those species having six to thirteen more km² per km of perimeter. Across the range Andean bears have just 21.61 km² per km of perimeter, although this value improves to 37.26 km² when only considering the range in Bolivia and Peru (Table 7). These differences suggest that the overall Andean bear distribution range is more susceptible to fragmentation than white-lipped peccaries, lowland tapirs and jaguars.

PRIORITY ANDEAN BEAR CONSERVATION UNITS (ABCU)

After considerable post-workshop analysis we propose a total of seven Andean Bear Conservation Units, three in Peru, one that bridges Peru and Bolivia and three in Bolivia. According to the experts these seven areas represent the best hope for the long-term conservation of Andean bears in the two countries that comprise almost 70% of the actual range. The proposed ABCUs cover approximately 57.75% of the estimated actual range of the species in Bolivia and Peru.

The original workshop defined Andean Bear Conservation Units range from relatively small areas of just 2,438 km² (ABCU Bolivia Altamachi) to massive areas of more than 100,098 km² (ABCU Peru 2). Post-workshop analyses using the Human Footprint analysis changed that range from 15,628 km² for the smallest ABCU Central Andes 6: Carrasco-Amboro to 114,902 km² for the largest ABCU Central Andes 4: Southern Peru-Northern Bolivia. For the purposes of further analyses we divided the ABCUs into three size classes:

i) Relatively small ABCUs of less than 25,000 km²,
ii) Medium-sized ABCUs of between 25,001 to 50,000 km²,
iii) Relatively large ABCUs of more than 50,001 km².

Of the seven identified Andean Bear Conservation Units, two are relatively small ABCUs (ABCU Central Andes 5: Cotapata-Lambate-Altamachi, ABCU Central Andes 6: Carrasco-Amboro), three are medium sized ABCUs (ABCU Central Andes 1: Northwestern Peru ABCU Central Andes 2: Northeastern Peru, ABCU Central Andes 7: Iñao-Tariquia), and two are relatively large ABCUs (ABCU Peru 3: Central Peru, ABCU Peru 4: Southern Peru-Northern Bolivia). As might be expected ABCUs have a greater percentage under protection than the overall range in Bolivia and Peru. Taken together a total of 34.6% of the ABCUs are under formal protection, although there is

considerable variation between ABCUs with the ABCU Central Andes 1: Northwestern Peru as little as 4.25%, contrasting with ABCU Central Andes 6: Carrasco-Amboro where 77.52% is under formal protection.

The Human Footprint (HFP) analyses within each identified ABCU are detailed in Table 8, and for all identified ABCUs over 99% of the area is found within the two lowest HFP categories (0-25 & 26-50), with no area in any of the ABCUs in the highest HFP category (76-100). Indeed, strikingly the lowest HFP category (0-25) accounts for at least 89% of the area for five of seven of the ABCUs, and at least 80% for six out of seven identified ABCUs. This underlines the excellent conservation status of the majority of the ABCUs.

The exception is the ABCU Central Andes 1: Northwestern Peru where only 43.23% of the ABCU is within the lowest HFP category. Fragmentation statistics are also rather different for this ABCU (Table 8), with low FRAGSTATS Large Patch Index (LPI) values (McGarigal & Marks, 1995) of 12.52 for the lowest HFP category (0-25) compared to the other six ABCUs (Range: 76.15 to 94.19), and higher LPI values of 26.88 for the second category (26-50) compared to others (Range: 1.24-10.45). When LPI approaches zero it signifies that small patches form the analysis area, and LPI values nearer 100 signify a large single patch. The Northwestern Peru ABCU is found in the Pacific dry montane forests that represent a very different ecosystem for the Andean bear and using the evolutionary distinctiveness argument, workshop participants felt that a large ABCU was required in this ecosystem.

TABLE 8. Fragmentation analyses Human Footprint analysis categories within each Andean Bear Conservation Units

Andean Bear Conservation Unit (ABCU)	HFP Value Categories	% Polygon	# Patches	LPI
ABCU Central Andes 1: Northwestern Peru	0_25	43.23	150	12.52
	26_50	56.15	203	26.88
	51_75	0.62	30	0.28
ABCU Central Andes 2: Northeastern Peru	0_25	92.65	4	91.89
	26_50	7.35	34	4.36
	51_75	0.00	1	0.00
ABCU Central Andes 3: Central Peru	0_25	93.71	9	92.99
	26_50	6.29	208	1.93
	51_75	0.01	3	0.00
ABCU Central Andes 4: Southern Peru-Northern Bolivia	0_25	94.26	18	94.19
	26_50	5.71	223	1.24
	51_75	0.03	9	0.01
ABCU Central Andes 5: Cotapata, Lambate y Altamachi	0_25	89.63	9	86.65
	26_50	10.36	46	4.76
	51_75	0.01	2	0.00
ABCU Central Andes 6: Carrasco-Amboro	0_25	80.13	13	76.15
	26_50	19.80	57	10.45
	51_75	0.08	2	0.06
ABCU Central Andes 7: Iñao-Tariquia	0_25	89.62	30	88.41
	26_50	10.29	223	4.88
	51_75	0.09	7	0.03

Available data on Andean bear population density is scarce and often statistically imperfect (Garshelis, 2011). However, recent estimates from camera trap surveys, genetic analyses, and telemetry based studies all converge on estimates of between 3 and 12 Andean bears per 100 km^2 (Rios-Uzeda *et al*., 2007, Viteri, 2007, Garshelis, 2011). Using this range of density estimates Table 9 details the theoretical population sizes for the seven Andean Bear Conservation Units identified herein. More than anything this projection stresses the pressing need to develop more reliable density estimates across a range of realities for the Andean bear. Fortunately camera-trapping technology is catching up with the rigors of Andean cloud forest conditions (Goldstein pers. comm. to R. Wallace, 2011; Wallace pers. obs., 2012), and can also deal with many of the recommendations made in the first forays into camera trapping for Andean bear in the region (Rios-Uzeda *et al*., 2007; Wallace pers. obs., 2012), and so in the short-term future density estimates for Andean bear are expected to dramatically improve. For the moment though, and according to currently available data, Table 9 provides us with a decision-making framework population sizes within the ABCUs.

For the two relatively small ABCUs (ABCU Central Andes 5: Cotapata-Lambate-Altamachi, ABCU Central Andes 6: Carrasco-Amboro), the question of how sustainable Andean bear populations really are remains pertinent. Using the lowest density estimate these smaller ABCUs have populations of around 500 animals, considered a minimum for population viability. Whether populations of this size are truly sustainable in the long-term is currently the subject of some debate in the minimum viable population literature (Reed *et al*., 2003; Traill *et al*., 2007), but even the smallest of these relatively small ABCUs are clearly important potential strongholds for Andean bear conservation, and under the medium and

TABLE 9. Theoretical Andean bear population sizes in seven Andean Bear Conservation Units using most recent estimates of population density

Name of Andean Bear Conservation Unit (ABCU)	Size (km^2)	Ratio of Edge to Interior Area	Theoretical Population Size using Lower Population Density Estimate 3 bears/100 km^2	Theoretical Population Size using Mid Population Density Estimate 7 bears/100 km^2	Theoretical Population Size using Upper Population Density Estimate 12 bears/100 km^2	Ratio Area vs Perimeter of Historical Range (Shape Index)
ABCU Central Andes 1: Northwestern Peru	33,463.08	5.5	1004	2,342	4,015	6.74
ABCU Central Andes 2: Northeastern Peru	43,487.51	7.3	1,304	3,044	5,218	1.90
ABCU Central Andes 3: Central Peru	76,104.71	12.9	2,283	5,327	9,132	2.03
ABCU Central Andes 4: Southern Peru-Northern Bolivia	114,902.25	19.5	3,447	8,043	13,788	3.10
ABCU Central Andes 5: Cotapata, Lambate y Altamachi	24,165.54	3.6	725	1,691	2,900	2.55
ABCU Central Andes 6: Carrasco-Amboro	15,629.12	2.6	469	1,094	1,875	3.21
ABCU Central Andes 7: Iñao-Tariquia	42,937.41	7.3	1,288	3,005	5,152	2.77
TOTAL	350,689.63		10,520	24,546	42,080	

upper population density estimates their viability is more promising, especially considering their potentially critical connectivity role between the larger ABCUs.

In the case of the ABCU at the southern limit of the Andean bear distribution in Bolivia recently published information has both supported and denied the presence of the species at its southern limit (Vargas & Azurduy, 2006; Rumiz *et al*., 2012). This debate is most fervent in Argentina where Andean bear presence has recently been denied (Rumiz, 2012), despite being previously published and accepted internationally (Del Moral & Lameda 2011; IUCN 2008 in Rumiz *et al*., 2012).

Populations of any organism at distributional extremes may be important for conservation because peripheral populations of species undergoing extensive distribution contractions may persist more than central populations (Channell, 2004). This is particularly true for those peripheral populations that diverge genetically from central populations and are potentially important for the protection of evolutionary processes in changing environments, as might occur in the context of climate change (Lesica & Allendorf, 2002; Hampe & Petit, 2005). From an Andean bear perspective we should therefore work to understand the status of peripheral populations, particularly those in the southern distributional limit, because of the present and potential importance of these populations under future climate change scenarios.

Using these lower population density estimates, the three medium-sized ABCUs (ABCU Central Andes 1: Northwestern Peru, ABCU Central Andes 2: Northeastern Peru, ABCU Central Andes 7: Iñao-Tariquia) might be expected to house populations of between 1004 to 1,304 Andean bears, far better long-term prospects and yet, in the case of the upper density estimates (4,015 to 5,018), just reaching some of the more recent estimates of large vertebrate population viability. Indeed, under the lower and more realistic Andean bear density estimates the only ABCUs that approach the 'magic number' of 5000 animals for a minimum viable population (Reed *et al*., 2003; Traill *et al*., 2007) would be the two larger sized ABCUs (ABCU Central Andes 3: Central Peru, ABCU Central Andes 4: Southern Peru-Northern Bolivia), surpassing this objective under the medium and upper population density estimate scenarios.

Here it is important to stress that this debate is essentially academic, as the total global populations of many of the most threatened vertebrates such as tigers and mountain gorillas do not reach this magic number for population viability, let alone individual populations. Nevertheless, irrespective of the debate regarding the population viability of the smaller identified ABCUs, clearly the larger ABCUs are potentially the most important for the long-term conservation of the Andean bear. As such we suggest considering the proposed ABCUs herein within a two-tiered system where the most important and priority ABCUs are the medium and larger sized ABCUs.

We suggest that these medium and large-sized ABCUs are the ABCUs where limited resources should first be invested for Andean bear conservation as in the long-term they represent the best scenario for viable populations. This first tier of five ABCUs covers approximately 89% of the areas identified as priority areas for the conservation of the Andean bear in Bolivia and Peru (ABCUs) including all the major habitat types for Andean bears, predominantly humid montane forests and neighboring Andean grasslands, but also the Pacific dry forests of northwestern Peru and the southern limits of Andean bear distribution in the dry montane valleys of southern Bolivia.

The two smaller ABCUs are also very important especially from a potential connectivity perspective, however, it is important to recognize that given the maximum possible size of Andean bear populations in these ABCUs, conservation investment will be more of a risk. Finally, it is also worth stressing that currently the populations of many neighboring ABCUs may still be connected and so establishing longer-term connectivity through strategic management activities should be considered, which in the longer term of course, is especially important for the smaller ABCUs.

In summary, to date this process has resulted in a set of maps regarding a) the historical distribution of the Andean bear in Bolivia and Peru, b) the current distribution of Andean bear in Bolivia and

Peru, c) a systematized database of Andean bear distributional records in Bolivia and Peru, and d) a proposed suite of priority areas for Andean bear conservation or Andean Bear Conservation Units (ABCUs). These results were presented in very preliminary form at the II Andean Bear Symposium in Lima (Wallace *et al*., 2008), and here we have revised them according to more specific geographic information on human influence.

NEXT STEPS AND RECOMMENDATIONS

We propose the following next steps and recommendations:

1) Develop more specific recommendations for priority conservation research actions to evaluate connectivity possibilities between identified Andean Bear Conservation Units.
2) Use the results to produce a scientific publication for an international audience.
3) Produce a list of priority sites for developing density estimates for Andean bears that will provide a range of reliable values across the range in Bolivia and Peru with which to better inform conservation decisions in the future.
4) Evaluate the response of Andean bear populations to different levels and combinations of threats. For example, at what point does habitat fragmentation affect Andean bears and when does conflict with people over crops or livestock significantly affect populations?
5) Over time, and for the actualization of the information included herein, we would like to more comprehensively include valuable data from areas with scarce information from other actors such as protected areas, national protected area authorities, universities and local communities through appropriately designed questionnaires.
6) Form a binational working group and develop a binational Action Plan for the Andean bear including specific priority conservation actions, for example, targeted conservation research on the species distribution, abundance and biology, environmental education and communication to the general public, and management programs for human-wildlife conflicts involving Andean bears.
7) Hold future meetings at a binational level to talk about, analyze, improve and evaluate priority interventions for the conservation of Andean bears.
8) Propose new national or local protected areas as a function of our revised binational analysis of Andean Bear Conservation Units.
9) Develop specific conservation actions to insure connectivity and corridors within the confirmed Andean Bear Conservation Units (ABCUs).
10) In the medium term, develop specific but comprehensive analyses and conservation plans with integrated and diverse conservation actions for the identified Andean Bear Conservation Units.
11) Perform evaluations regarding the presence of areas without knowledge about Andean bears, or with very poor knowledge within existing Andean Bear Conservation Units, especially areas where very little data exists such as central Peru and southern Bolivia.
12) Test the validity of the Human Footprint analyses utilized herein by comparing with available finer scale human landscape analyses.

Foto trampa cámara: Guido Ayala & María Viscarra, WCS

Foto trampa cámara: Guido Ayala & María Viscarra, WCS

Foto trampa cámara: Guido Ayala & María Viscarra, WCS

Literature Cited

Channell, R. 2004. The conservation value of peripheral populations: the supporting science. Pp. 1-17. In: T.D. Hooper (Ed.) *Proceedings of the Species at Risk 2004 Pathways to Recovery Conference*. 1 March 2–6, 2004, Victoria, B.C. Species at Risk 2004 Pathways to Recovery Conference Organizing Committee, Victoria, B.C.

Del Moral, J.F. & F.I. Lameda Camacaro. 2011. Registros de ocurrencia del oso andino (*Tremarctos ornatus* Cuvier, 1825) en sus límites de distribución nororiental y austral. *Revista del Museo Argentino de Ciencias Naturales* 13:7-19.

Enciso, M.A. 2008. Presence of Andean bear in the mountain forest and "pajonal" in Luya, Amazonas, northeastern Peru. *International Bear News* 17:16-17.

Enciso, M.A., D. Galvez-Roeder & J. La Torre. 2012. Pursuing the spectacled bear footprint at the Huiquilla's forest, northern Peruvian Yungas. *International Bear News* 21:45-47.

Figueroa, J. & M. Stucchi. 2013. Presencia del oso andino *Tremarctos ornatus* (Carnivora: Ursidae) en el Corredor de Conservacion Vilcabamba-Amboro, sureste del Perú. *Therya* 4:511-538.

Garcia-Rangel, S. 2012. Andean bear *Tremarctos ornatus* natural history and conservation. *Mammal Review* 42:85–119.

Garshelis, D. 2011. Andean bear density and abundance estimates — How reliable and useful are they? *Ursus* 22:47–64.

Gaston, K.J. & T.M. Blackburn. 1996[a]. Conservation implications of geographic range size-body size relationships. *Conservation Biology* 10:638–646.

Gaston, K.J. & T.M. Blackburn. 1996[b]. Range size-body size relationships: evidence of scale dependence. *Oikos* 75:479–485.

Hampe, A. & R.J. Petit. 2005. Conserving biodiversity under climate change: the rear edge matters. *Ecology Letters* 8:461–467.

Kattan, G., O. Lucía Hernández, I. Goldstein, V. Rojas, O. Murillo, C. Gómez, H. Restrepo & F. Cuesta. 2004. Range fragmentation in the spectacled bear *Tremarctos ornatus* in the northern Andes. *Oryx* 38:155-163.

Lesica, P. & F.W. Allendorf. 1995. When are peripheral populations valuable for conservation? *Conservation Biology* 9:753-760.

Marieb, K. 2007. *Jaguars in the new millennium data set update: The state of the jaguar in 2006*. Wildlife Conservation Society (WCS), New York.

McGarigal, K. & B. Marks. 1995. Fragstats*Arc. General Technical Report, USDA Forest Service, USA.

Paisley, S. 2001. Andean Bears and People in Apolobamba, Bolivia: Culture, Conflicts and Conservation. Ph.D. Thesis. Durrell Institute of Conservation and Ecology, UK.

Peralvo, M.F. F. Cuesta & F. van Manen. 2005. Delineating priority habitat areas for the conservation of Andean bears in northern Ecuador. *Ursus* 16:222-233.

Peyton, B. 1980. Ecology, distribution, and food habits of spectacled bears, *Tremarctos ornatus*, in Peru. *Journal of Mammalogy* 61:639-652.

Peyton, B. 1990. Spectacled bear conservation Action Plan. Pp 157-164 In: *Bears, Status Survey and Conservation Action Plan*, C. Servheen, S. Herrero and B. Peyton, eds. IUCN, Bear and Polar Bear Specialist Groups. IUCN, Switzerland and Cambridge.

Reed, J.M., D.D. Murphy & P.F. Brussard. 1998. Efficacy of population viability analysis. *Wildlife Society Bulletin* 26:244-251.

Rios, B., H. Gomez & R.B. Wallace. 2006. Spectacled bear (*Tremarctos ornatus*) habitat preferences in the northwestern Bolivian Andes. *Journal of Zoology* 268:271-278.

Rios-Uzeda, B., H. Gomez & R.B. Wallace. 2007. First density estimation of spectacled bear (*Tremarctos ornatos*) using camera trapping methodologies. *Ursus* 18:124-128.

Rodríguez, D., F. Cuesta, I. Goldstein, A.E. Bracho, L.G. Naranjo & O.L. Hernandez. 2003. Ecoregional strategy for the conservation of the spectacled bear (*Tremarctos ornatus*) in the northern Andes. WWF Colombia, Fundación Wii, EcoCiencia, Wildlife Conservation Society & Red Tremarctos.

Rumiz, D.I., A.D. Brown, P.G. Perovic, S.C. Chalukian, G.A.E. Cuyckens, P. Jayat, F. Falke & D. Ramadori**.** 2012. El Ucumar (*Tremarctos ornatus*), mito y realidad de su presencia en la Argentina. *Mastozoología Neotropical* 19:359-366.

Sanderson, E., K. Redford, C. Chetkiewicz, R. Medellin, A. Rabinowitz, J. Robinson & A. Taber. 2002. Planning to save a species: the jaguar as a model. *Conservation Biology* 16:58-72.

Sanderson, E., K. Redford, B. Weber, K. Aune, D. Baldes, J. Berger, D. Carter, C. Curtin, J. Derr, S. Dobrott, E. Fearn, C. Fleener, S. Forrest, C. Gerlach, C. Cormack Gates, J.E. Gross, P. Gogan, S. Grassel, J.A. Hilty, M. Jensen, K. Kunkel, D. Lammers, K. Minkowski, T. Olson, C. Pague, P.B. Robertson & B. Stephenson. 2008. The ecological future of the North American bison: Conceiving long-term, large-scale conservation of wildlife. *Conservation Biology* 22:252-266.

Taber, A., S.C. Chalukian, M. Altrichter, K. Minkowski, L. Lizárraga, E. Sanderson, D. Rumiz, A.M. Edsel, C. de Angelo, M. Antúnez, G. Ayala, H. Beck, R. Bodmer, B.B. Salvador, J.L. Cartes, S. de Bustos, D. Eaton, L. Emmons, N. Estrada, L. Flamarion de Oliviera, J. Fragoso, R. Garcia, C. Gomez, H. Gómez, A. Keuroghlian, K. Ledesma, D. Lizcano, C. Lozano, O. Montenegro, N. Neris, A. Noss, J.A. Palacio Vieira, A. Paviolo, P. Perovic, H. Portillo, J. Radachowsky, R. Reyna-Hurtado, J. Rodriguez Ortiz, L. Salas, A. Sarmiento Dueñas, JA. Sarria Perea, K. Schiaffino, B. de Thoisy, M. Tobler, V. Utreras, D. Varela, R.B. Wallace, & G. Zapata Rios. 2009. *El Destino de los Arquitectos de los Bosques Neotropicales: Evaluación de la Distribución y el Estado de Conservación de los Pecaríes Labiados y los Tapires de Tierras Bajas*. New York, Pigs, Peccaries and Hippos Specialist Group (IUCN/SSC); Tapir Specalist Group (IUCN/SSC); Wildlife Conservation Society; and Wildlife Trust. 210p.

Thorbjarnarson, J., F. Mazzotti, E. Sanderson, F. Buitrago, M. Lazcano, K. Minkowski, M. Muñiz, P. Ponce, L. Sigler, R. Soberon, A.M. Trelancia & A. Velasco. 2006. Regional habitat conservation priorities for the American crocodile. *Biological Conservation* 128:25-36.

Traill, L.W., C.J.A. Bradshaw & B.W. Brook. 2007. Minimum viable population size: A meta-analysis of 30 years of published estimates. *Biological Conservation* 139:159-166.

Vega Castelán, H. & C. Zaldívar Tevera. 2000. Manual Ordenamiento del Territorio Municipal, Centro de Servicios Municipales Heriberto Jara, A.C. CESEM,México.

Viteri, M.P. 2007. Conservation genetics of Andean bears (*Tremarctos ornatus*) in northeastern Ecuador: Molecular tools, genetic diversity and population size. Thesis, University of Idaho, Moscow, Idaho, USA.

Wallace, R. et al. "Resultados preliminares del I Taller Binacional sobre la Distribución y Estado de Conservación del Oso Andino en Bolivia y Perú", en Lima, Perú, el 12 de Noviembre de 2008.

Wallace, R.B., H. Gómez, Z.R. Porcel & D.I. Rumiz (Eds.). 2010. *Distribución, Ecología y Conservación de los Mamíferos Medianos y Grandes de Bolivia*. Editorial: Centro de Ecología Difusión Simón I. Patiño. Santa Cruz de la Sierra, Bolivia. 906 pp.

Wallace, R.B., H. Lopez-Strauss, N. Mercado & Z.R. Porcel. 2013. *Base de Datos sobre la Distribución de los Mamíferos Medianos y Grandes de Bolivia*. DVD Interactivo. Wildlife Conservation Society, La Paz, Bolivia.

Woodroffe, R. & J.R. Ginsberg. 1998. Edge effects and the extinction of populations inside protected areas. *Science* 280: 2126–2128.

APPENDICES

APPENDIX I. WORKSHOP ANNOUNCEMENT

Binational Workshop on the Distribution and Conservation Status of the Andean Bear in Bolivia and Peru

8th - 9th of November, 2008
Universidad Cayetano Heredia, Lima, Perú

Considering the number of persons interested in the research and conservation of the Andean bear in Peru and Bolivia that are expected to attend the I Congress of the Peruvian Society of Mammalogy and the II International Symposium on the Andean Bear, and considering the lack of a regional analysis of the status of populations for the southern part of the Andean bear range, several researchers associated with the Centro de Biodiversidad y Genética of the Universidad Mayor de San Simón in Bolivia, Centro para la Sostenibilidad Ambiental de la Universidad Peruana Cayetano Heredia in Perú, and the Wildlife Conservation Society (WCS) proposed the realization of a workshop on the distribution and conservation status of the Andean bear in Bolivia and Peru as an activity associated to both the I Congress of the Peruvian Society of Mammalogy and the II International Symposium on the Andean Bear.

The objectives of the workshop are

1. Update the knowledge about the distribution and potential connectivity of Andean bear populations in Bolivia and Peru.
2. Evaluate the conservation status of the Andean bear in Bolivia and Peru through the identification of "Andean Bear Conservation Units".
3. Determine priority areas for the conservation of the Andean bear in Peru and Bolivia.
4. Develop a binational working group on the Andean bear.
5. Identify and prioritize research and conservation actions at a binational level.

This effort is divided in two stages: a) recompilation and systematization of information in the months prior to the symposium analyzing the formats mailed to different stakeholders; b) during the 8th and 9th of November, 25-30 people will review and complete the final analysis and systematization. The preliminary results of the analysis will be presented during one of the afternoon workshops of the II International Symposium on the Andean Bear.

For more information please contact Dr. Robert Wallace (rwallace@wcs.org)

CONSULTA PARA EVALUAR EL ESTADO DE CONSERVACIÓN DEL OSO ANDINO A TRAVÉS DE SU DISTRIBUCIÓN HISTÓRICA Y ACTUAL PARA BOLIVIA Y PERÚ

Estimado

De nuestra mayor consideración.

A tiempo de saludarle, le hacemos conocer que nos encontramos recopilando información sobre el oso andino (*Tremarctos ornatus*), para poder realizar una evaluación preliminar del estado de conservación y estimación de su distribución actual y poder generar una estrategia binacional (Bolivia y Perú) para esta especie tan carismática, simbólica y representativa. Es importante mencionar que la iniciativa actual es un esfuerzo conjunto del Centro de Biodiversidad y Genética de la Universidad Mayor de San Simón en Bolivia, Centro para la Sostenibilidad Ambiental de la Universidad Peruana Cayetano Heredia en Perú, y la Wildlife Conservation Society (WCS). También es importante mencionar que la iniciativa esta vinculado al II Simposio Internacional sobre el Oso Andino como al I Congreso de la Sociedad Peruana de Mastozoología que se realizaran en Perú en noviembre de 2008.

Todo este esfuerzo se enfoca a generar información fidedigna acerca de la distribución histórica y actual del oso andino en Bolivia y Perú, para determinar áreas y acciones potenciales para la conservación a largo plazo de esta especie. Para esto se han elaborado y adaptado formularios usados anteriormente de manera exitosa para jaguares y tapires en Latín América, que se encuentran explicados y adjuntos a este mensaje.

Tomando en cuenta su conocimiento sobre el tema, nos tomamos la libertad de solicitar su colaboración para el llenado de los siguientes formularios y mapas:

FORMULARIO A: Localidades de observación del oso en los últimos 20 años

FORMULARIO B: Amenazas a la conservación del oso andino a través de su área de distribución

FORMULARIO C: Unidades de Conservación del Oso (UCO).

Adjuntando versiones de los formularios en Excel para su llenado en digital y los mapas en formato KML para su llenado en GoogleEarth, adjuntando sus respectivas instrucciones de llenado.

Nos permitimos recordarle que Usted recibirá los créditos respectivos por la información suministrada en cualquier documento que se genere.

Aprovechamos esta oportunidad para agradecerle anticipadamente su participación y colaboración en este esfuerzo binacional para evaluar el estado de conservación del oso andino.

Esperamos su respuesta hasta el día viernes 29 de agosto, al correo electrónico rwallace@wcs.org, o de ser necesario impreso a nombre de Alicia Kuroiwa a "Casa Honorio Delgado" Av. Armendariz 445, Miraflores, Lima-18, Perú o Robert Wallace, Casilla de Correo 3-35181 S.M., La Paz, Bolivia, sin otro particular y agradeciendo su apoyo en este emprendimiento nos despedimos.

Atentamente,

Robert B. Wallace
Director
Programa de Conservación Gran Paisaje Madidi-Tambopata
Wildlife Conservation Society

APPENDIX III. INSTRUCTIONS FOR THE QUESTIONNAIRES CONCERNING THE DISTRIBUTION OF THE ANDEAN BEAR (*TREMARCTOS ORNATUS*)

Instrucciones para el llenado de formularios sobre la distribución nacional del Oso Andino (***Tremarctos ornatus***)

Agradeciéndoles por su participación, les recordamos que en un esfuerzo conjunto de Wildlife Conservation Society en Bolivia y Perú, además de la Fundación Cayetano Heredia del Perú y el Centro de Biodiversidad y Genética de la Universidad Mayor de San Simón en Bolivia, están haciendo un intento de evaluar el estado de conservación del oso andino *(Tremarctos ornatus)* a través de su área de distribución histórica en ambos Países para elaborar línea base que describa su distribución geográfica a nivel binacional en el territorio boliviano y peruano. En el informe técnico final serán reconocidas todas las personas e instituciones que contribuyan con esta información.

Para ello se tiene previsto desarrollar una base de datos sobre avistamientos a nivel binacional de oso andino, a través de consultas a investigadores e instituciones que tengan información al respecto en los últimos 20 años. Esto nos permitirá obtener reportes de las localidades en donde han sido observados en los últimos 20 años, determinar el grado de conocimiento sobre el oso, las áreas ocupadas actualmente por la especie y las áreas importantes para su conservación a largo plazo dentro del territorio boliviano y peruano.

En este sentido, nuestros objetivos son:

- Determinar el grado de conocimiento sobre el oso andino a través de su área de distribución histórica en Bolivia y Perú
- Obtener reportes de las localidades en donde han sido observados en los últimos 20 años
- Determinar las áreas ocupadas actualmente por la especie
- Determinar las áreas importantes para su conservación a largo plazo

Esta metodología fue adaptada de la metodología original desarrollada durante el taller sobre el tigre asiático *(Panthera tigris)* que Wildlife Conservation Society (WCS) convocó junto con World Wildlife Fund for Nature (WWF) en 1996. En Latínoamérica la metodología ha sido utilizada para jaguares, tapires, pecaríes de labio blanco y actualmente está siendo utilizado para un esfuerzo binacional sobre cóndores andinos. Conceptualmente la metodología sigue lo propuesto por Sanderson *et al.* (2002) y Marieb (2006). Si usted desea recibir estos dos trabajos, puede escribirnos un email.

Con el fin de establecer un marco de referencia común para analizar los datos sobre oso, utilizamos un mapa de Ecoregiones de Bolivia y Perú, los cuales son una revisión del mapa de ecorregiones de Ibisch, *et al.* (2003) y WWF (2001). El área de distribución histórica del oso se distribuye en 6 ecorregiones en Bolivia y 7 en Perú (Descripción resumida de las mismas en el Anexo 1).

Para cada ecorregión usted estará registrando localidades puntuales de avistamiento de osos, áreas de distribución que conozca y áreas críticas para su conservación. Para cada uno de estos tipos de datos espaciales deberán responder preguntas adicionales en formularios adjuntos al mapa. También se le pedirá que registre áreas de las que no tiene certeza para estimar la distribución del oso, de tal manera que podamos determinar los vacíos en nuestro conocimiento.

Si tiene información adicional más allá del área de distribución histórica de la especie por favor inclúyala, rotulando las áreas y llenando los formularios. Estas áreas adicionales son de particular importancia. Si tiene alguna duda por favor contáctenos.

INSTRUCCIONES

I. Por favor verifique que los siguientes documentos le hayan sido enviados:

Archivo de Mapas digitales	Mapa de poblaciones de referencia, caminos de referencia, Ecorregiones y formularios: Localidades de Observación, Amenazas y Unidades de Conservación.
Archivo de mapas manuales	Mapa de Ecorregiones de Bolivia o Perú (WWF-Perú) para imprimir y ser llenado manualmente.
Formularios	FORMULARIO A: Localidades de observación del oso andino en los últimos 10 años. FORMULARIO B: Amenazas a la conservación del oso andino a través de su área de distribución. FORMULARIO C: Unidades de Conservación del oso andino (UCO). Áreas con una o más poblaciones permanentes según su criterio. Puede incluir áreas con categoría de conservación Estatal, áreas de conservación privada o áreas sin protección.

II. Por favor lea estas instrucciones por completo y revise los archivos para llenar los formularios A, B y C antes de empezar. Si tiene cualquier pregunta o falta alguno de los documentos, por favor póngase inmediatamente en contacto con nosotros para que podamos solucionarlo.

Se les está dando la opción de poder llenar los mapas ya sea de manera digital (con ayuda del programa Google Earth), o para los que prefieren lo hagan de manera manual.
NO SE PREOCUPE SI NO PUEDE LLENAR TODOS LOS FORMULARIOS O TODOS LOS CAMPOS, LLENE AQUELLOS CAMPOS PARA LOS QUE UD. TIENE DATOS. TODA INFORMACIÓN RECIBIDA SERÁ DE MUCHA UTILIDAD.

III. Llenado de los mapas digitales

Estimado colega, para llenar los mapas adjuntos a los formularios primero es necesario que usted tenga instalado el programa Google Earth, en caso contrario puede obtenerlo en la siguiente página web:
http://earth.google.com/

¿CÓMO VISUALIZAR LA INFORMACIÓN ENVIADA?

Una vez instalado el Google Earth, usted puede ver el archivo de oso andino Perú.kmz o de oso andino Bolivia.kmz, cargándolo desde la barra de tareas (Open file). Observará que automáticamente el programa realizará un acercamiento al área de trabajo. En caso que no pueda visualizar las coberturas, asegúrese que el nombre del archivo esté marcado en la barra lateral izquierda del panel de "Lugares".

CONTENIDO DEL ARCHIVO ENVIADO

El archivo enviado contiene información agrupada en carpetas que podrá observar en el panel izquierdo de "Lugares":

1) Poblaciones de referencia
2) Caminos de referencia
3) Ecorregiones
4) Carpeta "Formularios" en la que encontrará tres subcarpetas, cada una de ellas corresponderá a los formularios enviados:
   a. Localidades observadas
   b. Amenazas a la conservación
   c. Unidades de conservación.

MANEJO DE LA INFORMACIÓN

Usted puede seleccionar las coberturas que desea visualizar de manera independiente, marcando en su respectiva casilla o dentro del panel izquierdo de "Mis Lugares" (My places). También es posible darle transparencia a una o a todas las coberturas mientras se encuentren activas; seleccione (haciendo un clic) la cobertura que desea transparentar y se habilitará un barra en la parte inferior, mueva el botón de manera transversal hasta obtener la transparencia deseada.

CREACIÓN DE LA INFORMACIÓN DE LAS CARPETAS:

En la barra lateral del panel de lugares, desglose la carpeta respectiva y la carpeta de formularios.
En Google Earth sólo se puede introducir puntos con coordenadas geográficas en formato de grados, minutos y segundos (64° 22" 32 S) o grados decimales (-64,1234), la opción para introducir la coordenada UMT no se encuentra habilitada. Si sus datos se encuentran en UTM, será necesario convertirlos a coordenadas geográficas utilizando los archivos de conversión adjuntos o cualquier otro tipo de convertidor.

Localidades observadas (relacionado al Formulario A)

- Seleccione la carpeta A) Localidades observadas.
- Apriete el botón derecho del "mouse" y seleccione AÑADIR
- Luego seleccione MARCA DE POSICIÓN, Se le habilitará la ventana de propiedades de "marca de posición" y en el mapa aparecerá un icono.
- En la ventana de propiedades "marca de posición":
  i. Coloque el nombre del Registro, Ej. P1.
  ii. Si tiene coordenadas, puede introducirlas.
  iii. Si no tiene coordenadas, usted puede desplazar el icono hasta la posición deseada.
- Si usted tiene varios avistamientos y desea cambiar el estilo simultáneamente seleccione la carpeta A) Localidades observadas botón derecho del mouse, Propiedades, y en la viñeta de Estilo, Color seleccione "compartir estilo" y realice los pasos anteriores.

Importar datos a Google Earth

Si tiene varios puntos y desea importarlos directamente al Google Earth, existen varios programas gratuitos, le sugerimos la siguiente página web:
http://www.gpsvisualizer.com/map?form=googleearth

Para utilizar este programa usted deberá tener todos los datos en una Hoja de Excel (Ver Ejemplo 1), los campos deben ser creados en inglés y el separador de decimales debe ser un punto (.) y no una coma (como en español).

NOTA: Si sus datos están en otra proyección UTM es necesario convertirlos a coordenadas geográficas.

Ejemplo 1:

nombre	latitud	longitud	color
P1	-15.3535385	-67.0889301	azul
P2	-16.0937667	-67.7058833	azul

Entre a la página http://www.gpsvisualizer.com/map?form=googleearth, en la sección de "Upload your GPS data files here:", ubicada a mano derecha en su pantalla, seleccione EXAMINAR y busque el archivo deseado, luego presione CREATE KML FILE. Una vez creado el archivo ábralo y automáticamente se observarán los puntos en el GoogleEarth, arrastre la carpeta que contiene los puntos a la de "A) Localidades observadas",

B) Amenazas a la conservación (relacionada al formulario B)

- Seleccione la carpeta B) Amenazas a la conservación
- Apriete el botón derecho del mouse y seleccione AÑADIR
- Luego seleccione POLÍGONO.

Para dibujar el polígono correspondiente al área, puede hacerlo de dos formas:

- Mantenga presionado el botón derecho del Mouse y mueva el cursor por el área deseada.
- O también pude hacer clic en el botón derecho del mouse para marcar sólo los vértices y así crear un área.

En la ventana de propiedades de polígono:

- Coloque el nombre del polígono
- En la viñeta de "estilo, color" cambie el color a VERDE y seleccione Relleno+Contorno.

C) Unidades de conservación (relacionado al formulario C)

- Seleccione la carpeta C) Unidades de conservación
- Apriete el botón derecho del mouse y seleccione AÑADIR
- Luego seleccione POLÏGONO

Para dibujar el polígono correspondiente al área, puede hacerlo de dos formas:

- Mantenga presionado el botón derecho del Mouse y mueva el cursor por el área deseada.
- O también pude hacer clic en el botón derecho del mouse para marcar sólo los vértices y así crear un área.

En la ventana de propiedades de polígono:

- Coloque el nombre del polígono
- En la viñeta de "estilo, color" cambie el color a FUCCIA y seleccione Relleno+Contorno.

GUARDAR LA INFORMACIÓN

Seleccione la carpeta "Formularios" en el botón derecho del mouse y seleccione "guardar como", guarde el archivo con los siguientes datos:

NOMBRE, FECHA (día, mes, año)_PAÍS
JuanCarlosPerez_02_MARZO_2008_Bolivia

Puede guardar el archivo con las siguientes extensiones KML o KMZ.

IV. LLENADO DE LOS MAPAS DE MANERA MANUAL

Imprima los mapas adjuntos. En el archivo mapas físicos.

a. Delineando el área de su conocimiento

En el mapa de distribución histórica del oso *(Tremarctos ornatus)* dibuje polígonos de color rojo, delineando aquellas áreas dentro del área de distribución histórica del oso donde Ud. considera que se tiene suficiente información sobre el osos (al menos presencia / ausencia) para responder las siguientes preguntas. Dibuje una **X** grande y negra a través de aquellas áreas donde no tengan seguridad para completar el siguiente ejercicio.

b. FORMULARIO A: Observaciones puntuales sobre oso andino

En el mapa de Ecorregiones de Bolivia o Perú (en la parte que corresponda a su observación) dibuje una marca puntual (un **signo** de **más** "**+**") utilizando el color azul en cada localidad en donde uno o más osos hayan sido observados en los últimos 10 años. Se considera que cada punto representa un área circular con un radio de 20 km. Agrupe todas las observaciones dentro del área de un círculo de aproximadamente 20 km. bajo el mismo punto. Trate que la intersección entre la línea vertical y horizontal del signo "+" marque con exactitud la localidad puntual.
Codifique cada marca puntual de manera única con un número, con el prefijo "P" (p. ej. P1, P2, P3, etc.). Coloque una marca puntual si ha cumplido con las siguientes condiciones:

1. Usted o alguien en cuyo juicio confía ha visto uno o varios osos andinos en libertad, o
2. Usted o alguien en cuyo juicio confía ha visto osos alimentándose de un animal muerto adulto o juvenil , o
3. Usted o alguien en cuyo juicio confía ha encontrado un animal devorado por oso andino y no hay confusión con otros carroñeros, o
4. Usted o alguien en cuyo juicio confía ha colectado la piel, huesos, u otros restos de oso andino, con la documentación apropiada o prueba indiscutible de su origen, y
5. Si la evidencia posee menos de 10 años de antigüedad.

Para cada marca puntual, indique en el formulario "A" las fechas de la primera y última observaciones en esa localidad (si corresponde), las coordenadas exactas de esa localidad (si las tuviera, preferiblemente en latitud/longitud del sistema UTM especificando la zona ó en coordenadas en geográficas decimales), el número de los distintos tipos de observación hechos en esa localidad, el número de osos observados, estimado y los tipos de hábitat y uso de la tierra en la misma.

c. FORMULARIO B: Amenazas a la conservación del oso andino a través de su área de distribución

En el mismo mapa, ahora dibuje uno o varios polígonos utilizando el marcador verde, delineando aquellas áreas donde sabe con cierta seguridad que existen osos. Dentro de cada polígono escriba un código único para identificarlo, rotulado como "R" y luego un número (p. ej. R1, R2, R3, etc.).
Estime el porcentaje de área del polígono en el cual los osos son amenazados por diversas causas (p. ej. cacería, envenenamiento, conversión del hábitat, etc.)
NOTA: Utilice un formulario por polígono para completar la información requerida.

d. FORMULARIO C: Unidades de conservación del osos andino (UCO)

En el mismo mapa ahora dibuje uno o varios polígonos usando el color fucsia, delineando aquellas áreas que son críticas para la sobrevivencia del oso andino (Unidades de Conservación del Oso Andino o UCO). Dentro de cada polígono, escriba un código único para identificar el polígono, utilizando "U" y luego un número (por ejemplo U1, U2, U3, etc.). Una UCO está definida como un área:

Tipo 1. Con una comunidad estable de recursos alimenticios, que se sabe o se cree que contiene una población residente de osos lo suficientemente grande (por lo menos 10 parejas procreando) que potencialmente sea autosustentable para los próximos 100 años; o

Tipo 2. Que contenga menos osos, pero con un hábitat adecuado y una base de recursos alimenticios estable y diversa, de tal manera que las poblaciones de osos en el área se puedan incrementar si las amenazas son mitigadas.

Una UCO no necesita estar restringida a o contener áreas protegidas
Para cada una de estas áreas indiquen en el formulario C la siguiente información:

a. Si es una UCO tipo 1 o tipo 2 (véase la descripción anterior) y la evidencia utilizada para asignarlo.
b. Lo que sabe o cree que es el estado general de la población de osos en el área (aumentando, estable o desconocida). Estime el tamaño poblacional (más de 500, entre 500 y 100, entre 50 y 100, entre 10 y 50 o menos de 10). ¿En qué se basa para aseverarlo?, ¿Cuáles son las especies que consume el oso en esa área?, ¿Cuáles son las amenazas para el oso en esa UCO?
c. ¿Qué características tendría esa UCO con respecto a los factores que contribuyen a la sobrevivencia a largo plazo de los osos (p. ej. conectividad de hábitat, calidad del hábitat, tamaño del hábitat, presión por cacería, estado de conservación de la población, envenenamiento)?, ¿Qué tan importante es cada uno de estos factores, en relación con los otros, para la conservación de los osos en esta UCO?
d. ¿Qué sistemas legales de tenencia de la tierra se aplican a esta UCO? Estime el porcentaje de área de la UCO bajo cada sistema de tenencia de la tierra. ¿Qué tan efectiva es la protección real (al contrario de la protección esperada legalmente) de cada sistema de tenencia de la tierra, para esta UCO? (p. ej. un ganadero o una comunidad preocupada por la conservación de los osos puede proporcionar más protección efectiva que un parque nacional con poca vigilancia).

V. LLENADO DE LOS FORMULARIOS EN EXCEL

a) FORMULARIO A: Observaciones puntuales sobre oso andino

El cual está dividido en tres partes, que son simplemente una continuación y el código de la observación o localidad corresponde a la misma observación en las tres partes. Codifique cada marca puntual de manera única con un número, con el prefijo "P" (p. ej. P1, P2, P3, etc.).

Para cada marca puntual, indique en el formulario "A" las fechas de la primera y última observaciones en esa localidad (si corresponde), las coordenadas exactas de esa localidad (si las tuviera, preferiblemente en latitud/longitud del sistema UTM especificando la zona ó en coordenadas en geográficas decimales), el número de los distintos tipos de observación hechos en esa localidad (pensar en individuos), la ecorregión (según el mapa adjunto), los tipos de hábitat y uso de la tierra en la misma, las actividades humanas en el sitio mismo de observación (en estos tres últimos casos marcar con una X donde se realizo la observación), la metodología de investigación que se estaba empleando el momento de la observación, las actividades humanas próximas al sitio de observación. Al final de este formulario esta una sección en la que se debería llenar la información adicional o especifica que no está incluida en la primera parte. Por ejemplo, en otro tipo de registro se puede anotar senda, trilla, rasgados, restos alimenticios.

b). FORMULARIO B: Amenazas a la conservación del oso andino a través de su área de distribución

Tanto en la tabla Definición del área de distribución del oso como en la de Amenazas a la distribución del oso, en la columna Notas/específicos se debe ser lo más específico posible, y mejor si se anota una pequeña justificación de la respuesta.

NOTA: Utilice un formulario por polígono para completar la información requerida.

c). FORMULARIO C: Unidades de Conservación del Oso Andino (UCO)

Una UCO está definida como un área:

Tipo 1. Con una comunidad estable de recursos alimenticios, que se sabe o se cree que contiene una población residente de osos lo suficientemente grande (un estimado de por lo menos 10 parejas procreando) que potencialmente sea autosustentable para los próximos 100 años; o

Tipo 2. Que contenga menos osos (un estimado de menos de 10 parejas procreando), pero con un hábitat adecuado y una base de recursos alimenticios estable y diversa, de tal manera que las poblaciones de osos en el área se puedan incrementar si las amenazas son mitigadas.

Una UCO no necesita estar restringida a o contener áreas protegidas.

Para cada una de estas áreas indiquen en el formulario C la siguiente información:

a. Si es una UCO tipo 1 o tipo 2 (véase la descripción anterior) y la evidencia utilizada para asignarlo.
b. Lo que sabe o cree que es el estado general de la población de osos en el área (aumentando,

estable o desconocida). Estime el tamaño poblacional (más de 500, entre 100,y 500, entre 50 y 100, entre 10 y 50 o menos de 10). ¿En qué se basa para aseverarlo?, ¿cuáles son las especies que consume el oso en esa área?, ¿cuáles son las amenazas para el oso en esa UCO?

c. ¿Qué características tendría esa UCO con respecto a los factores que contribuyen a la sobrevivencia a largo plazo de los osos (p. ej. conectividad de hábitat, calidad del hábitat, tamaño del hábitat, presión por cacería, estado de conservación de la población)?, ¿Qué tan importante es cada uno de estos factores, en relación con cada uno, para la conservación de los osos en esta UCO?

d. ¿Qué sistemas legales de tenencia de la tierra se aplican a esta UCO? Estime el porcentaje de área de la UCO bajo cada sistema de tenencia de la tierra. ¿Qué tan efectiva es la protección real (al contrario de la protección sancionada legalmente) de cada sistema de tenencia de la tierra, para esta UCO? (p. ej. un ganadero o una comunidad preocupada por la conservación de los osos puede proporcionar más protección efectiva que un parque nacional con poca vigilancia).

NOTA: Utilice un formulario por polígono para completar la información requerida.

REFERENCIAS BIBLIOGRÁFICAS

Ibisch, P.L., S.G. Beck, B. Gerkmann y A. Carreteros. 2003. Ecoregiones de Bolivia. En: Ministerio de Desarrollo Sostenible y Planificación (Editores: Mérida, G., M. Oliveira y P.L. Ibisch) 2003. Estrategia Nacional de Biodiversidad de Bolivia. Resumen Ejecutivo. Editorial FAN, Santa Cruz.

Marieb, K. 2006. Jaguar in the new Millenium data set update: The state of the jaguar in 2006. A report prepared by the Wildlife Conservation Society's Jaguar Conservation Program. Technical Report. March 27.

Sanderson, E. W., K. H. Redford, Amy Vedder, Peter B. Coppolillo, Sarah E. Ward. 2002. A conceptual model for conservation planning based on landscape species requirements. Landscape and Urban Planning, 58: 41-56.

WWF. 2001. Terrestrial Ecoregions of the World: Biomes and Biogeographical Realms. Neotropic. http://www.worldwildlife.org/science/ecoregions/neotropic.cfm

WWF-WCS. 1997. A Framework for Identifying High Priority Areas and Actions for the Conservation of Tigers in the Wild. World Wildlife Fund-US and Wildlife Conservation Society.

WWF-PERU. Global 200: Mapa de Ecorregiones Prioritarias en el Perú. http://www.wwfperu.org.pe/donde_trabajamos/ecorregiones/index.htm

APÉNDICE IV: GEOGRAPHICAL REGIONS FOR THE ANDEAN BEAR *(TREMARCTOS ORNATUS)*

BOLIVIA

Resumen de la descripción del Mapa de las Ecorregiones de Bolivia *(Ibisch et al., 2003)*

Bosque Tucumano Boliviano	
Ubicación geográfica	Chuquisaca, (L. Calvo, H. Siles, B. Boeto, Sud Cinti, Tomina) Santa Cruz, (Cordillera, Florida, Vallegrande), Tarija (Arce, O´Connor).
Altitud	Entre 800 a 3.900 msnm.
Paisaje	Laderas escarpadas, valles, cimas.
Vegetación	Bosques semihúmedos (semi-) deciduos con lapacho *(Tabebuia lapacho)* hasta siempre verdes en pisos inferiores (con Myrtaceae: *Blepharocalyx saliciflius, Myrcianthes spp*., y Lauraceae) En pisos superiores (18000/2200 m hasta 2500/3200 m) Bosques siempre verdes con pino *(Podocarpus parlatorei)* y bosques deciduos con *Alnus acuminata*. Más arriba, en altitudes hasta 3900 m se encuentran relictos de *Polylepis crista-galli*, que podrían considerarse como parte de la ecoregión de Bosque-Tucumano; hoy consiste de matorrales y pajonales semejantes a la puna semihúmeda. Los limites altitudinales entre los pisos de Myrtaceae y de pino bajan al sur.
Áreas Protegidas	Reserva Nacional de Flora y Fauna Tariquia, Parque Nacional y Área Natural de Manejo Integrado Amboró.
Chaco Serrano	
Ubicación geográfica	Chuquisaca (L. Calvo, H. Siles, B.Boeto, Zudañez, Sud Cinti), Santa Cruz (Cordillera), Tarija (Gran Chaco, O´Connor, Arce).
Altitud	Entre 700 a 2.000 msnm.
Paisaje	Serranías bajas de las últimas estribaciones de la Cordillera Oriental de los Andes, valles bajos, pie de monte.
Vegetación	Bosque seco deciduo (menos de 25 m).
Áreas Protegidas	Una pequeña parte de la Reserva Nacional de Flora y Fauna Tariquia.
Bosques Secos Interandinos	
Ubicación geográfica	Chuquisaca, Cochabamba, La Paz, Potosí, Tarija.
Altitud	Entre 500 a 3.300 msnm.
Paisaje	Valles más o menos disectados, pequeñas planicies.
Vegetación	Bosque seco deciduo (10 a 20 m). En su mayoría destruido o fuertemente perturbado. Diferentes formaciones y tipos florísticos; importantes bosques de la vegetación potencial, natural, espcificamente: bosques mixtos con *Schinopsis haenkeana* y *Aspidosperma quebracho-blanco* (2300 a 3000m) , bosques de churquis (*Prosopis ferox*, especialmente en Potosí), bosques con *Acacia visco y Prosopis alba* (debajo de los 2300 m), bosque con *Schinopsis brasiliensis* (800 a 1300 m, especialmente en La Paz). Parcialmente con suculentas columnares muy altas (*Neoraimondia herzogiana*, Cactaceae).
Áreas Protegidas	Áreas pequeñas y en su mayoría fuertemente perturbadas en los Parques Nacionales Amboró, Carrasco, Tunari y Toro Toro.
Bosque Montano (Yungas)	
Ubicación geográfica	La Paz, Cochabamba, Santa Cruz.
Altitud	Entre 1000 a 4200 msnm. (incluye el Páramo Yungueño).
Paisaje	Valles profundos y disectados con laderas escarpadas.
Vegetación	Bosque húmedo siempre verde mediano a bajo,. Mosaico de diferentes fases de sucesión causada por derrumbes naturales. Hay varios pisos altitudinales con diferentes tipos de vegetación siempre verde.
Áreas Protegidas	Parque Nacional Madidi, Área Natural de Manejo Integrado Nacional Apolobamba, Área Natural de Manejo Integradi Cotapata, Reserva de la Biosfera y Territorio Indígena Pilón Lajas, Parque Nacional y Territorio Indígena Isidoro Secure, Parque Nacional Carrasco, Parque Naciona y Área Natural de Manejo Integrado Amboró.

Bosque Amazónico subandino (Faja subadina)	
Ubicación geográfica	Beni (Ballivián), Cochabamba (Ayopaya, Chapare, Tiraque, Carrasco), La Paz (Iturralde, F. Tamayo, Larecaja), Santa Cruz (Ichilo, Sara, A. Ibáñez).
Altitud	500 – 1000 msnm.
Paisaje	Últimas estribaciones de los Andes hacia la llanura, serranías con valles profundos y crestas pronunciadas.
Vegetación	Bosque húmedo siempreverde, varios estratos, frecuente epífitas y lianas. Azonal: Palmares con *Mauritia flemosa.*
Áreas Protegidas	Parque Nacional y Área Natural de Manejo Integrado Madidi, Reserva de la Biosfera y Territorio Indígena Pilón Lajas, Parque Nacional y Territorio Indígena Isidoro Sécure, Parques Nacional Carrasco, Parque Nacional y Área natural de Manejo Integrado Amboró.
Puna Semihúmeda	
Ubicación geográfica	Cochabamba (Arque, Ayopaya, Carrasco, Chapare, Quillacollo, Tapacari), Chuquisaca (sobre todo Nor Cinti, Sud Cinti, Zudañez, Azurduy, Oropeza).
Altitud	Entre 3.200 a 4.200 msnm.
Paisaje	Serranías, mesetas altas, valles.
Vegetación	Pajonal con arbustos, césped bajo en lugares húmedos, pajonal más o menos abierto, matorrales de arbustos resinosos, restos de bosques de diferentes especies de *Polylepis* (especialmente *P. besseri ssp. sudtusalbida, P. b.ssp. besseri, P. tomentella).* Azonal: bofedales.
Áreas Protegidas	Parque Nacional Tunari, Reserva Biológica de la Cordillera de Sama.

PERÚ

Yungas Bolivianas	
Ubicación geográfica	Extremo sur-este del Perú y centro-oeste de Bolivia. Límites entre latitudes 13º y 17º y longitudes 69º y 63º (Madre de Dios y Puno).
Altitud	400-3500 msnm.
Paisaje	Transición en pendiente oriental de los Andes entre selva alta y puna. Topografía compleja. Cimas.
Vegetación	Bosque de niebla, bosque tropical y subtropical húmedo y bosques siempre verdes. Gran cantidad de epifitas(orquídeas y bromelias).
Áreas Protegidas	Parque Nacional Bahuaja-Sonene.
Yungas Peruanas	
Ubicación geográfica	Centro del Perú. Recorre varios departamentos de norte a sur (Amazonas , Cajamarca, San Martín, Huanuco, Pasco, Junín, Cuzco y Madre de Dios).
Altitud	Encima de 2500 msnm.
Paisaje	Escarpado, montañoso, valles y cimas.
Vegetación	Bosques montanos deciduos y siempre verdes. Vegetación muy diversa.
Áreas Protegidas	Parque Nacional Cutervo, Parque Nacional Tingo Maria, Parque Nacional Manu.
Bosques Montanos de la Cordillera Real Oriental	
Ubicación geográfica	Recorre desde el sur de Colombia hasta el norte del Perú (Cajamarca, Amazonas y Piura). Localizada en pendiente occidental de los andes centrales.
Altitud	900-2100 msnm.
Paisaje	Colinas, pequeños bosques y ceja de montaña.
Vegetación	Cambia dramáticamente con altitud. Bosques tropicales siempre verdes (sesonal broad-leaved) y bosque de niebla. Alto endemismo, depresiones conectan amazonia y andes.
Áreas Protegidas	Santuario Nacional Tabaconas Namballe y Parque Nacional Ichigkat Muja - Cordillera del Cóndor.

Bosques Secos del Marañón	
Ubicación geográfica	Noroeste del Perú (Cajamarca).
Altitud	0-1000 msnm
Paisaje	Valles.
Vegetación	Tropical residuo y bosque seco, páramo.
Áreas Protegidas	Santuario Nacional Tabaconas Namballe.
Bosques Secos Piura-Tumbes	
Ubicación geográfica	Norte del Perú. (Tumbes, Piura, Lambayeque y Cajamarca) y sur de Ecuador. Entre el Pacífico y la pendiente occidental de los Andes.
Altitud	Debajo de 1300 msnm.
Paisaje	Plano, pequeñas colinas, áreas costeras y pequeñas cadenas de montañas hacia el interior del continente.
Vegetación	Bosques secos estacionales, chaparral y cactáceas.
Áreas Protegidas	Parque Nacional Cerros de Amontape, Zona Reservada Tumbes y Coto de Caza El Angolo.
Bosques Húmedos del Ucayali	
Ubicación geográfica	San Martín, Ucayali , Huanuco y Amazonas.
Altitud	200-1100 msnm.
Paisaje	Plano, pies de la cordillera.
Vegetación	Bosques transicionales entre bosques húmedos elevados y bosques inundables.
Áreas Protegidas	Parque Nacional Cordillera Azul, Bosque de Protección Alto Mayo, Zona Reservada Cordillera de Colán y Reserva Comunal Llanesha.
Bosques secos del centro- Valles interandinos	
Ubicación geográfica	Junín, Huancavelica, Ayacucho, Apurímac y Cuzco.
Altitud	500-2500 msnm.
Paisaje	Valles, ríos.
Vegetación	Bosque casi homogéneo constituido por árboles caducifolios, siendo la especie representativa el pasallo. Bosques subhúmedos constituidos por árboles caducifolios, epifitas y algunas cactáceas filamentosas.
Áreas Protegidas	Santuario Nacional Ampay, Reserva Paisajistica Sub Cuenca del Cotahuasi y Santuario Histórico Pampa de Ayacucho.

Fuente: World Wildlife Fund Scientific Report (WWF, 2001)

ISBN: 978-99974-812-1-4