



Darwin Initiative for the Survival of Species

Annual Report 3

**Genetic diversity and management implications for high
Andean guanaco populations in Peru.**

1. Darwin Project Information

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Project Title	Genetic diversity and management implications for high Andean guanaco populations in Peru.
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Partner Organisation(s)	CONOPA
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2. Project Background

The Guanaco 1 project involves collaboration between Cardiff University, UK and CONOPA (Coordinadora de Investigación y Desarrollo de Camélidos Sudamericanos), a Peruvian NGO based in Lima, Peru. The project specifically aims to address issues relating to the conservation management of the Peruvian guanaco population through direct surveys and genetic analysis. By characterising the demography and genetics of these fragmented populations we will enable a rational management programme to be established. The development of a management plan will result from the Population and Habitat Viability Assessment (PHVA) workshop for the Peruvian guanaco that is being held in Lima on 16th-17th May and at which all the key stakeholders will be present.

3. Project Purpose and Outputs

The main purpose of the project is to characterise the demography and genetics of highly endangered and fragmented Peruvian guanaco populations to enable the establishment of a realistic conservation management plan during the final months of the project. In year 2 of the project, an intensive period of fieldwork was conducted by CONOPA scientists. Faecal samples were collected non-invasively from six Peruvian guanaco populations together with important information on the biology and behaviour of the animals. In Year 3, the genetic analysis of these samples was completed (March 2006).

The second purpose of this project is to build capacity in conservation genetics in Peru. This has been achieved by providing intensive training for two Peruvian scientists, both qualified veterinarians working in CONOPA, in molecular genetic techniques, data analysis and conservation biology. The second trainee, Katherine Yaya (KY) completed an eight-month training period in Cardiff on 15th March 2006 (two months longer than scheduled). Both trainees received training in the laboratory

in Lima during the project. In addition, KY completed a final year undergraduate conservation biology module, run by MWB, in Cardiff in December 2005.

The third goal of the project is to train a cohort of Peruvian scientists in conservation biology and population and habitat viability analysis. This training was in the form of two, one month courses, the second of which was held in Lima from 13th June to 7th July 2005. Nineteen students were enrolled on the course, 16 of whom obtained a diploma upon completion of the course assessments and three obtained a certificate of attendance.

Alterations were made to the original project timetable at the beginning of the project and were discussed in detail in the first annual report. The effect that these have had on the operational plan for year 3 is as follows: The UK post-doc Ciara Dodd (CD) travelled to Lima on 1st June 2005 rather than in April as originally scheduled. This was to allow the maximum possible period of time in the laboratory in Cardiff, since the samples proved much more difficult to work with than anticipated. This did not effect the organisation of the course, arrangements for which were primarily made by Jane Wheeler (JCW) and CONOPA staff. MWB also travelled to Lima to teach on the first 2 weeks of the course.

KY visited Cardiff between 14th July 2005 and 15th March 2006. This training period was for eight rather than six months as originally scheduled, partly due to the availability of affordable airfares and to enable KY to receive adequate training in data analysis after the completion of the laboratory work. However, laboratory work remained problematic and continued up until KY's departure so she will continue to be trained in analysis up until the end of the project.

CD and MWB returned to Lima for the final project meeting on 29th March 2006 for two weeks. It was originally intended to hold the PHVA stakeholders workshop during this visit, between 5th-7th April 2006. However, presidential elections were held on the 11th April and therefore the organisers of the workshop (CONACS and CONOPA) felt that it would be better to postpone this meeting until 16th-17th May. Instead, a one day conference was held on 6th April, at which the results of the genetic analysis and the population modelling were disseminated by CD, MWB, KY and JCW.

4. Progress

This Darwin Initiative project began on 1st July 2003 and up to the beginning of this reporting period the project has progressed as follows. Progress in years 1 and 2 is detailed in the first and second annual reports, but is summarised below. The project was launched in the host country, Peru in July 2003. The first conservation biology course was held in Lima in June 2004. Due to significant difficulties encountered in obtaining permits from INRENA, fieldwork and sampling was delayed until April 2004, but was completed by December 2004. In years 1 and 2, trainee Jorge Rodriguez (JR) received two six-month periods of laboratory training in Cardiff and attended MWB's undergraduate conservation biology module.

The progression and achievements of the project within this reporting period, 1st April 2005 to 31st March 2006 are discussed in detail below.

Laboratory work

Samples from the remaining two guanaco populations in Yanaque, (Moquegua) and Vilani, (Tacna) were collected in December 2004. KY brought the samples to Cardiff in July 2005 for analysis.

The goal of the lab work during year 3 has been to complete the mtDNA control region sequencing for 10 guanaco individuals per population where available, and to obtain 16 multilocus microsatellite genotypes from faecal material for 20 individuals per guanaco population. Achieving this goal has been extremely challenging, in particular samples from the Calipuy population have proved to be exceptionally difficult to work with. DNA extracted from these samples consistently failed to amplify

in PCR reactions both for mtDNA and microsatellites in Lima and in Cardiff. Many of the problems encountered with the samples have been discussed at length in previous reports. In order to address the difficulties with the problematic samples, KY, under guidance from CD, tested new extraction protocols and made further modifications to existing protocols.

A method that proved successful for these samples was the CTAB extraction protocol. This method is normally used for extracting DNA from plant material and has been shown by a laboratory colleague to be the method of choice for extracting DNA from insect gut samples. Further modifying the Qiagen Stool Kit protocol, for example by increasing the initial incubation period and buffer volume, and decreasing the final elution volume, also proved effective at extracting amplifiable guanaco DNA.

There have been associated problems with the amplification of DNA from these samples. It has not been possible to amplify long fragments (650 bp) of the mitochondrial control region from many of the faecal DNA extracts. This problem was overcome for some samples by using the Qiagen Multiplex Kit for PCR amplification. However, the resultant sequences were often not of good quality. Therefore two shorter overlapping fragments were amplified both of which worked well and produce good quality sequences. However, even shorter overlapping fragments have been required to obtain good quality sequences from difficult samples, particularly those for Calipuy. Therefore new primers were designed to address this problem and sequencing was finally completed in March 2006.

The problem with fragment length has not been as apparent with the microsatellite genotyping, since the maximum allele size being amplified is approximately 260 bp. However, other difficulties have arisen with the microsatellite analysis. DNA obtained from faecal samples is by its very nature degraded and therefore one would expect amplifiable fragments of DNA to be shorter than those obtained from DNA extracted from blood or tissue. In addition, genomic DNA, in which the microsatellites are located, is contained in the nucleus and therefore there is only one copy per cell compared to several hundreds for mitochondrial DNA. When amplifying microsatellites from faeces it is necessary to amplify the same sample a minimum of three times to ensure that the result is reproducible. Common amplification errors that occur are allelic dropout where one or other allele fails to amplify giving a false homozygote; and false alleles, where an erroneous allele may amplify and give an incorrect genotype. Both of these errors have occurred in the microsatellite loci being used in this project. Therefore, it has been necessary to repeat the PCRs for some samples up to seven times to ensure that a reliable genotype is obtained. Allelic dropout (stochastic non-amplification of one allele, leading to false scoring) has been more apparent in the loci with larger amplicons and these larger fragments were also more likely to fail completely compared with ones which are smaller. Despite these problems, both in terms of time and expense (finance had to be vired from other budget headings) the genotyping was completed in March 2006.

As a result of the problems encountered in this project, KY has now become extremely proficient at extracting and amplifying DNA from difficult material. These skills will prove to be invaluable for ongoing and future work within CONOPA and KY will use her knowledge to train other members of the CONOPA laboratory.

During the eight months that KY has spent in the laboratory in Cardiff, she has been trained in DNA extraction techniques, PCR amplification and optimisation for mtDNA and microsatellites, gel electrophoresis and DNA sequencing. She has learned to analyse microsatellite data using the programmes Genescan and Genotyper and to align and edit DNA sequence chromatograms using the programme Sequencher. Throughout the process, the techniques have been demonstrated to KY and until reaching proficiency, she has conducted these activities under the supervision of CD. KY completed exercises to demonstrate that she understood how to use the programmes which were checked by CD who corrected and explained any errors. In addition CD wrote a step by step protocol for using Sequencher and the subsequent

steps involved in obtaining haplotypes from individual sequences. This protocol is available for use by CONOPA for future work and will be included in the final report.

These analytical skills will be invaluable to the work in CONOPA particularly for future projects if they outsource sequencing and genotyping to companies (such as Macrogen in South Korea, who carry out such analysis more cheaply than is feasible in many developing countries). This company returns sequence and genotype files in a format for analysis with these and similar programmes. Currently KY and JR are the only members of CONOPA with the appropriate skills to conduct this analysis but are in the process of transferring their knowledge to other lab members.

Laboratory work in Lima concentrated on completing the visualisation of microsatellite multiplexes from DNA extracted from blood and faeces on silver stained gels. JR achieved this by the end of October 2005 and further optimisation of this work was not necessary, since the skill to achieve this is now present in CONOPA. JR also worked on SSCP analysis of mtDNA haplotypes. Although progress was made with this technique up until December 2005, it has not been possible to achieve the required level of resolution to separate haplotypes that differ by only a few substitutions. This is most likely because of the lack of temperature controlled electrophoresis equipment in the lab in Lima. Another technique which may be suitable for this purpose (DDGE) was attempted in Cardiff, but again requires the use of specialised equipment to pour a gradient denaturing gel and this equipment is not available in the lab in Lima. However, the need for separating mtDNA haplotypes in this manner is no longer an issue in CONOPA. Future work requiring sequencing will be outsourced to a company (such as Macrogen) which offers sequencing at a very competitive price and produces high quality results.

An undergraduate veterinary student from Cornell University, Sara Gomez-Ibañez (SGI) arrived at CONOPA in June for a 2 month placement to gain experience in many aspects of camelid medicine and research. She chose CONOPA as her training placement as a direct result of the Darwin Initiative project, information about which she obtained from the project website (<http://www.cardiff.ac.uk/biosi/research/biodiversity/staff/dodd.html>). As part of her placement she was trained in the laboratory by JR in PCR, SSCP and gel electrophoresis, using techniques that he learned from the Darwin project training.

KY has applied the techniques that he has learned by co-supervising an undergraduate project student in the laboratory. In addition KY assisted two visitors to the lab, a Peruvian colleague Owsaldo Ramirez (OR) working on guinea pig genetics and an Argentinean PhD student Virginia Burgi (VB) studying guanaco populations in Patagonia, who visited Cardiff for 3 months and 3 weeks respectively. KY is also working with developing sexing primers for camelids. Primers designed by JR last year worked well with blood samples, but are less reliable with faecal DNA due to the size of the fragment that they amplify. KY is working with a new set of primers to see if these will be better for faecal sample analysis.

KY continues to work on the molecular etiopathogenesis of Enterotoxemia in Alpacas and is applying skills learned under the Darwin Project to help resolve a major health problem in Peru's alpaca population.

As a result of the work conducted in this project and from the skills that she has learned, KY has applied for a Darwin Fellowship to continue her research in to camelid health. She will utilise the guanaco samples collected for this project in combination with those held in the archive at CONOPA for other camelid species. She has also applied for Royal Society funding to enable her to conduct field work to collect further samples from domestic camelids and reservoir hosts of the parasites of interest.

These activities demonstrate that KY is acquiring the research skills necessary for her to develop and establish active research and training programmes and to be establishing herself as an independent scientist by the end of the project. This fulfils one of the key objectives within the logical framework.

All progress within the project has been monitored in Cardiff and in Lima through weekly lab meetings held by MWB and JCW respectively. These meetings provide the opportunity to outline progress and discuss problems and future work with the project team and in Cardiff provides the opportunity to discuss ideas with other lab members and tap into their expertise where required. Contact was maintained between CD (whilst in Peru) and MWB via a weekly email update outlining the progress and or issues arising during the week. In addition there have been a number of specific project and planning meetings with MWB and JCW.

Conservation Biology Course

The second conservation biology course was held between 13th June and 7th July 2005 and hosted by Facultad de Medicina Veterinaria, Universidad Nacional Mayor de San Marcos, Lima. The structure of this course followed that of the previous year, but with some modifications.

Again the core course material was delivered by CD and MWB in an intensive first two weeks, consisting of lectures, practical exercises and discussion. The lectures covered topics ranging from an introduction to conservation biology, threats to biodiversity, small population biology and extinction, to the application of genetics to conservation and population and habitat viability assessment. Students were required to gather information about an endangered species of their choice which they would then use in a practical exercise on PHVA using the programme VORTEX at the end of the second week. This modelling exercise was assessed by MWB. All the core lectures were delivered by CD and MWB in English, but each student was provided with a Spanish translation of each presentation. The Spanish translation of the course will be provided in the Final Report.

The second two weeks of the course consisted of talks by invited speakers covering all aspects of conservation projects in practice in Peru. Speakers were invited from governmental, university and conservation organisations and a variety of NGOs within Peru. Many speakers who gave presentations on the first course also lectured on the second course. Two special topic days were organised to which members of the public were invited. These days were advertised in the local newspapers, at the university and on the CONOPA website. These two days were well attended and received by those present. Posters and leaflets were produced for advertising the course, all of which featured the Darwin and project logos.

The CGIAR International Potato Centre (CIP) in Lima organised a one day workshop as part of the course. Staff from the centre delivered a series of talks on many aspects of potato (and its relatives) conservation, diversity and genetics. This workshop provided the students with an excellent opportunity to visit an international research centre and to learn about the importance of the conservation of plant genetic resources.

Applicants for the course were invited from governmental organisations such as INRENA, CONAM, CONACS, Peruvian NGOs, universities and international conservation organisations. Nineteen students enrolled onto the course, the breakdown of which is detailed in the 30 month report, after their applications had been evaluated by JCW and Domingo Hoces (DH). Sixteen course participants were awarded a diploma and three a certificate of attendance at the end of the course. Details of course assessments are given in the second annual report. Students that did not satisfactorily complete the assessments were awarded a certificate of attendance. Coursework exercises were assessed by CD and JCW.

As with the first course, a web user group was established by the students who participated, through which they keep in touch and are working together in many different areas of conservation. Collaboration between two course students (Janet Cisneros and Susy Nuñez (SN), and two speakers, Jessica Amanzo of Cayetano Heredia University and Jorge Rodriguez (JR) of CONOPA, led to plans for

interdisciplinary research on the woolly tapir, the spectacled bear and the peccary and the submission of at least three research proposals,

At the conclusion of the course all of the lectures were compiled on to a DVD together with additional background information that was given to all students and course speakers.

As a spin-off from these courses, one student, SN organised a conservation biology course "Técnicas Moleculares Aplicadas a la Biología de la Conservación" held at the Facultad de Ciencias Biológicas, Universidad Nacional de Trujillo, in northern Peru from 10th-12th March 2006. The course was attended by young professionals, university professors and students and attracted more than 90 attendees from Trujillo and throughout northern Peru.

Guanaco PHVA Workshop

Although outside the period of this report, we feel it is important to mention the PHVA workshop here since much of the planning has already taken place. The PHVA stakeholders workshop was planned as a three day event between 5th-7th April 2006. However, since the Peruvian Election was held on 9th April it was decided to postpone the event until 16th-17th May 2006 in order to avoid any problems associated with political demonstrations or unrest, and to maximise media interest and reporting of the workshop. Instead, a one day dissemination conference was organised for the 6th April 2006 at which the results of the genetic analysis and the Vortex population viability modelling were presented by JCW, KY, CD and MWB. This conference was filmed and the presentations will be played at the Workshop in May as it will not be possible, due to budgetary and time constraints, for CD and MWB to return to Peru. The programmes for both events are included in an appendix at the end of this report.

Other Progress

Within CONOPA other members of the laboratory continue to benefit from the training received by JR and KY through ongoing skills training. Language skills learned by KY whilst in Cardiff have resulted in her becoming highly proficient in spoken and written English. She is therefore well equipped to access scientific literature in English language journals thus increasing the scope of her scientific knowledge base. In addition, a new project to map the genetic diversity of the Peruvian alpaca is being developed by CONOPA that is a direct outcome of this project.

During 2005 and 2006 CONOPA has consolidated its position as a lobbying force in the area of scientific research on South American Camelids. Through a formal agreement signed with CONACS, CONOPA now holds the position of high level advisor and works regularly with CONACS for conservation of the South American Camelids. The two institutions are working hand in hand to organize the PHVA and to set up a subsequent publicity campaign for guanaco conservation. The CONACS authorities, aware of their limited term with the upcoming change of government, view CONOPA as the point of continuity in conservation of the wild camelids.

The projected operational timetable up until the end of the project is outlined in the table below.

Table 5: Operational Timetable for Year 4 (1st April 2006 to 30th June 2006)

Date	Activity
April 2006	Analysis of results (CD,) PHVA modelling (MWB) Conference in Lima 6 th April – present results (JCW, MWB, CD, KY) Complete and submit vicuna mtDNA paper to <i>Heredity</i>
May 2006	PHVA workshop 16-17 th May Prepare management plan
June 2006	Write final report Complete and submit guanaco genetics paper to <i>Conservation Genetics</i> Complete and submit guanaco population census/behaviour paper to <i>Oryx</i> Complete and submit guanaco parasite paper – target journal undecided Complete and submit vicuna microsatellite paper to <i>Conservation Genetics</i>

5. Actions taken in response to previous reviews (if applicable)

Issues raised in the review of the second annual report have been addressed here. In this report we have provided details of the community surveys conducted as part of the sampling process (the questionnaire is included in an appendix at the end of the report) and have attempted to outline lessons that will result in the successful conclusion of the project objectives particularly where response to government is required.

In the review of the second annual report, the reviewer commented “*Lessons are not explicit in the report, but there is some indication that ongoing issues with the classification of endangered camelids in host country and subsequent policy (particularly with regard to animal products) may well have a significant role to play in Year 3 of this project. As such the project team will need to position itself so that it can respond to government accordingly.*” CONOPA has positioned itself at the center of this debate through its seniority in Peru’s National Plan for Science, Technology and Innovation in South American Camelids. With the presentation of the Darwin guanaco project results organized by CONOPA and CONACS as equals the impact of CONOPAS role has been strengthened. The progressive consolidation of CONOPA as a lobbying organization which has major impact on vicuña, and now guanaco, conservation has been documented by Anna Karp as part of her “Darwin Initiative – Evaluation of Closed Projects March 2005”.

With regard to the issue relating to sample sizes, it has not been possible to increase these for this project. However for population genetic analysis 15 individuals per population is considered to be sufficient for studies using microsatellites (see Beaumont and Nichols, 1996) and 10 per population is more than usually analysed for phylogeographic analysis. We are very confident that our data will be adequate for such analyses and as a world-leading laboratory in conservation genetics, we have a great deal of experience in such analysis. However CONOPA will continue to sample guanaco in the future to fill in population gaps and will seek funding for the analysis of these samples through grant monies from the Interamerican Development Bank tied to Peru’s National Plan for Science, Technology and Innovation in South American Camelids. CONOPA is ranked as the lead Peruvian institution in the fields of genetics and wild South American Camelids under this plan.

6. Partnerships

Continuing the collaborative link with Juan Carlos Marin (JCM) from Universidad de Chile, JCMs guanaco samples have been genotyped to build into the Peruvian dataset for this project. The results of the vicuña mtDNA analysis, which also includes many samples provided by JCM, are in the final stages of submission to *Heredity*.

Collaboration with JCM has been particularly important for this project since it has enabled the addition of important guanaco populations that would otherwise have been impossible to sample, for example populations from Bolivia. Additional collaboration with Ricardo Baldi of CENPAT, Argentina, to incorporate guanaco samples from Patagonia as well as data generated on guanaco in the DI vicuña project (N251) will further enhance the outputs of this project and sets the results of the Peruvian analysis in a species-wide context. Prospects for further south-south collaboration have been enhanced with the establishment of collaborative links between CONOPA, Universidad de Chile and CENPAT. VB's visit to Cardiff at the outset of her PhD, in November 2005, allowed links with CONOPA to be established, which should flourish into research collaboration for south-south funding.

CONOPA has signed a new collaboration agreement with CONACS during this period which has greatly facilitated their political reach and research impact.

They are also working closely with subcontractors at the Centro de Documentación para la Conservación at La Molina University who are doing the ground work for INRENA's Plan Director, which will redefine the boundaries and priorities of Peru's national parks by the end of 2006. This collaboration has grown out of the results of the previous Darwin Vicuña project which defined four geographically and genetically distinct vicuña populations that need to be protected and managed separately. The USFWA and the Andean Vicuña Convention both have made adjustment to Peru's park system to assure protection of these four groups is obligatory and the Plan Director is seeking to comply. CONOPA is participating in drawing the boundaries for the vicuña and defining the boundaries for guanaco conservation.

7. Impact and Sustainability

During this reporting period a number of activities have promoted the project within the host country and elsewhere.

A number of articles in national and international publications have raised awareness of the Guanaco 1 project and of guanaco conservation. These are detailed in Table 2.

The CONOPA website (www.conopa.org) became fully operational in 2005 and contains a wide variety of information and publications relating the project and to camelids in general. The website is available in both Spanish and English and constitutes an important resource for anyone requiring information about camelids and the activities of CONOPA.

A spin-off course from the Conservation Biology course was held in Trujillo from 10th-12th March 2006 (details are given in section 4) and reached a wide audience in northern Peru. Full details of this course will be included in the final report.

Hugo Castillo (HC) a researcher at CONOPA attended "Conferencia Internacional de Camelidos Sudamericanos", in Arequipa from 30th-31st March 2006. At this conference he presented a very well received talk entitled "Situación del guanaco en el Perú". In his presentation he discussed the methods, objectives and outcomes of the Guanaco 1 project and highlighted the forthcoming dissemination conference and PHVA. A copy of this presentation will be provided in the final report.

Exit strategy

The major scientific and conservation output of this project is a Population and Habitat Viability Assessment (PHVA), which will take place in May 2006, two months before the end of the project. The PHVA will utilise population demographic and genetic data obtained throughout the project to formulate a management plan for the Peruvian populations of the guanaco. This PHVA workshop will involve key stakeholders who produce and implement the management plan. This meeting is being jointly organized by CONOPA and CONACS. All relevant players will participate with the objective of arriving at a declaration to save the guanaco from extinction and formalize procedures for a management plan. A copy of the programme is included in the appendix at the end of this report. By organizing the meeting jointly it is possible to reach a broader audience and have more impact. Subsequent to the meeting the results will be made public and a campaign to educate the public will be undertaken for which CONOPA and CONACS are jointly seeking to add to available funding.

CONOPA now has the facility to produce high quality genetic data using the techniques learned by JR and KY during the course of the project and has an increased capacity to develop and complete new projects which can already be demonstrated through the two grant applications recently submitted on camelid parasites by KY and other projects which are in the process of development.

In order to ensure the ongoing capacity within CONOPA for addressing conservation and scientific issues of camelid conservation in Peru, it is anticipated that CONOPA will be able to achieve the following functions by the end of the project.

- a. *High quality reproducible genetic data can be produced for population, phylogeographic and phylogenetic analysis from good quality and challenging DNA samples.* JR and KY are able to produce this data in the laboratory in CONOPA. Microsatellite multiplex genotypes can now be produced using silver staining, but also using fluorescent methods by sending PCR products to MacroGen, which can be processed cost effectively. It has not been possible to completely resolve mtDNA haplotypes using DDGE or SSCP analysis, but CONOPA intends to outsource future sequencing to MacroGen. JR and KY are able to analyse these data using the appropriate methods. They are already able to apply their knowledge to use new types of analysis and know where to find information and programs to enable them to do this. Training/troubleshooting will continue via email until the end of the project to ensure that they are highly proficient in the use of various types of genetic analysis.
- b. *JR and KY will be able to work independently and train others in laboratory methods.* JR has been supervising and training final year project students in Lima and has taught some classes in molecular biology in the university. KY has provided laboratory training and supervision of thesis students in Lima who have been working on projects such as sexing the *Pava aliblanca*, an endangered cracid. She has also co-supervised an undergraduate project student working on birds in Cardiff. Both trainees have demonstrated that they are able to transfer the skills that they have learned in this Darwin project to other students and colleagues in the laboratory.
- c. *JR and KY will be able to use their genetics expertise to solve problems and apply this knowledge to new problems and write grant applications.* KY has already obtained funding from CONCYTEC to investigate the molecular etiopathogenesis of enterotoxaemia in alpacas. She has also written two applications whilst in Cardiff to investigate the genetics of camelid parasites and to collect further samples for parasitological analysis. JR has been involved in the development of projects on woolly tapir and taruca.

8. Post-Project Follow up Activities (max 300 words)

KY submitted an application for a Darwin Fellowship in March 2006. This proposed project is a direct outcome of the current Darwin project and will utilise the samples that were collected for this work. The Fellowship aims to investigate the molecular genetics of camelid endoparasites and their transmission and will provide important information regarding camelid health. The results will have a direct impact on conservation management and health of wild camelids since the transmission of parasites is not currently considered when animals are translocated between populations.

A campaign to raise awareness of guanaco conservation, organised jointly between CONOPA and CONACS is discussed in section 4. These activities will continue past the end of the project and CONOPA's involvement is crucial to the success of this campaign and will provide continuity with the upcoming change of government in Peru.

9. Outputs, Outcomes and Dissemination

Outputs

Most of the agreed outputs for the period have been achieved. Those which still need to be completed are detailed below.

(11a) The two papers on the mitochondrial diversity for the guanaco and population census study have not yet been completed. This is primarily because the sampling was delayed at the start of the project so that the samples for the last two populations only arrived in Cardiff with KY in July 2005. In addition ongoing problems with the laboratory work has meant that this work was only completed in March 2006. Also in view of the emerging requirement to include data from mitochondrial and nuclear genes in population papers it has been decided to combine the results of the mtDNA and microsatellite analysis into a single paper which will be submitted to *Conservation Genetics*. The population census data is being compiled and a manuscript will be submitted to *Orxy* by the end of the project.

Additional outputs are as follows.

(3) Nineteen Peruvian students were enrolled on the course rather than the anticipated number of ten.

(4a, b) An undergraduate veterinary student SGI obtained funding to conduct a placement on the project with CONOPA. SGI was trained for eight weeks in laboratory skills by CD and JR. She travelled to the field to sample and examine alpacas to learn more about camelid medicine. She also attended the conservation biology course although did not sit the assessments.

(6b) KY received training in the laboratory in Cardiff for eight rather than six months.

(7) A DVD of all the course materials was produced and handed to the students at the end of the course.

(15a, b) A press release was issued to advertise the public sessions in local newspapers. Information about the course was disseminated by post, with letters of invitation, posters and a leaflet to the relevant authorities at all Peruvian universities with biology and other relevant programmes, other institutions involved in conservation, and government offices. Information about the course was sent to internet lists of professionals (biology and veterinary science, among others). A number of articles were published in national and international journals which discussed the objectives of the project.

(17a, b) A contact network was established by the students on the course to continue work and exchange ideas in conservation biology. This also enhances the contact network created by the students on the first course.

Outcomes

An important outcome of the course has been the establishment of a web user-group by the students, speakers and professors through which they keep in touch and have begun working together in many different areas of conservation which has resulted in the preparation and submission of a number of research proposals to different agencies.

Dissemination and target audiences

Many of these issues are discussed in other parts of section 9. However in general, it is envisaged that the project goals and findings will be disseminated to as broad an audience as possible. The course specifically targeted young professionals working in conservation biology, but the public lectures were freely available to anyone who wished to attend. Information is also disseminated to the local communities on whose land the guanaco live and where sampling takes place, since without their support, the goals of the project will not be fulfilled. HC's presentation in Arequipa in March disseminated important information about the project at an international conference.

Representatives from all of the communities where guanaco samples were collected will be attending the PHVA in May and several attended the dissemination conference on 6th April. The President of Huallhua has visited CONOPA in Lima on more than one occasion to coordinate work and CONOPA will be helping him to find funding for special guanaco conservation modules.

Table 1. Project Outputs (According to Standard Output Measures)

Code No.	Quantity	Description
3	16 +3	16 Peruvian scientists receive diplomas from conservation biology course (+3 = certificate of attendance)
4a	1	Cornell University veterinary placement student SGI received 8 weeks of training in camelids including – conservation biology, laboratory work, fieldwork and veterinary medicine. She was trained by CD, JR and other CONOPA staff
4b	8wk	
5	2	KY was trained in the laboratories in Cardiff and Lima by CD and JR was trained in Lima.
6a	10wk	KY took MWBs undergraduate conservation biology module
6b	2x6wk	JR and KY received training in laboratory techniques in Lima
7	1x8months 1	KY received training in Cardiff for 8 months A DVD of training materials from the course (core lectures and guest lectures and references and other useful information) was disseminated to all course participants and course speakers.
8	2 wk	CD providing training in laboratory to CONOPA staff (June-July) and preparation for and teaching on course
	4wk	CD teaching on course
	2wk	MWB to Lima for 2 weeks teaching on course
10	1	Research report containing protocols from Cardiff work

		handed over to CONOPA
12a	1	Genetic results database established, completed and handed over to CONOPA in Lima
12b	1	
13b	1	Samples are archived in the collection at CONOPA in Lima
14b	1	International conference on south American camelids in Arequipa on 30 th -31 st March 2006 -
15a	4	Articles in national/international publications (details in table 2)
15b	1	Press release to advertise the course
17a	1	Students from the course set up a contact web
17b	1	This enhanced the web set up by the previous course

Table 2: Publications

Type *	Detail	Publishers	Available from	Cost £
(e.g. journals, manual, CDs)	(title, author, year)	(name, city)	(e.g. contact address, website)	
Journal	Camelid Research in Peru. Jane C. Wheeler June 2005	<i>International Camelid Quarterly</i>	www.llamas-alpacas.com	
Journal	Guanaco 1 – Working to Save Peru's Endangered Guanacos. Jane C. Wheeler March 2006	<i>International Camelid Quarterly</i>	www.llamas-alpacas.com	
Journal	Guanaco: El Camelido Injustamente Olvidado. Domingo Hoces R. May 2005.	AgroNoticias		

10. Project Expenditure

- Please expand and complete Table 3.

Table 3: Project expenditure during the reporting period (Defra Financial Year 01 April to 31 March)

Item	Budget (please indicate which document you refer to if other than your project schedule)	Expenditure	Balance
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- Highlight any recently agreed changes to the budget and explain any variation in expenditure where this is +/- 10% of the budget.

There has been an overspend on laboratory work since the samples have proven much more difficult to work with than anticipated. Therefore extra work had to be conducted to complete the genetic data.

11. Monitoring, Evaluation and Lessons

Throughout this period, the project has been monitored on a regular and ongoing basis both in Lima and in Cardiff. Project members have maintained regular email contact so that any issues that may need to be discussed or require action are rapidly addressed. Regular weekly lab meetings have continued in Cardiff and Lima with the UK and Peruvian project leaders. In Cardiff a regular journal club and seminar series takes place and provide an environment in which any issues can be discussed with the project leader and also with other members of the lab, drawing on their areas of expertise. This has proved a valuable resource when problems have been encountered with DNA extractions and amplifications and KY has benefited from this. Day-to-day monitoring of the trainees performance in the laboratory is conducted by CD. Typically, KY was assigned a particular task and once completed results and any problems that may need to be addressed were discussed with CD. Troubleshooting is ongoing throughout the process as required. In this way the trainee gains the maximum amount of experience and proficiency for the techniques which he/she is learning. KY also gave a 15 min presentation in English to the lab group in which she discussed the project and summarised problems with the laboratory work. This has provided her with invaluable experience of scientific presentations in her second language.

12. OPTIONAL: Outstanding achievements of your project during the reporting period (300-400 words maximum)

Although not an output of this project it is perhaps worth mentioning that the DI have carried out a 'Closed Projects Review' of projects based in Peru which have now ended. This included our previous collaborative camelid project, N251 (06/126) *Vicuna and Guanaco Conservation and Genetic Resource Management in Peru*, which was evaluated by Anna Karp of LTS International Ltd and which included a visit to CONOPA during the reporting period, 24 - 26 October 2005. Our project was extremely positively evaluated and partly as a result of this, MWB was invited to present an evaluation of the lessons learned from this project in the context of how DI project results can influence CBD-related activities and legislation in-country at the recent Darwin Initiative workshop in London, 22nd February 2006.

■ I agree for ECTF and the Darwin Secretariat to publish the content of this section

In this section you have the chance to let us know about outstanding achievements of your project over the year that you consider worth highlighting to ECTF and the Darwin Secretariat. This could relate to achievements already mentioned in this report, on which you would like to expand further, or achievements that were in addition to the ones planned and deserve particular attention e.g. in terms of best practice. The idea is to use this section for various promotion and dissemination purposes, including e.g. publication in the Defra Annual Report, Darwin promotion material, or on the Darwin website. As we will not be able to ask projects on an individual basis for their consent to publish the content of this section, please note the above agreement clause.

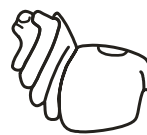
Project summary	Measurable Indicators	Progress and Achievements April 2005-Mar 2006	Actions required/planned for next period
<p>Goal: To draw on expertise relevant to biodiversity from within the United Kingdom to work with local partners in countries rich in biodiversity but poor in resources to achieve</p> <ul style="list-style-type: none"> • The conservation of biological diversity, • The sustainable use of its components, and • The fair and equitable sharing of the benefits arising out of the utilisation of genetic resources 			
<p>Purpose</p> <p>To enable conservation management for the Peruvian population of the Andean guanaco.</p> <p>To build capacity in conservation genetics in Peru.</p> <p>To train a cohort of Peruvian scientists in conservation biology and population viability analysis.</p>	<p>The production of the management plan (at latest by the end of Year 3).</p> <p>The successful training two Peruvian scientists in conservation biology.</p> <p>The courses having been successfully held and the trainees having earned their diplomas.</p>	<p>D-loop sequences and microsatellite DNA has been completed for the six Peruvian populations as well as additional material from Bolivia, Argentina and Chile obtained through collaboration with JCM.</p> <p>The population viability modelling has been completed also.</p> <p>JR completed MWB's final year module in 2003. KY completed MWB's final year module in 2005.</p> <p>Both JR and KY have received intensive training in the laboratory.</p> <p>Both have acquired sufficient knowledge to operate as independent scientists.</p> <p>KY, JR and 13 Peruvian scientists completed the conservation biology course in 2004 and 19 Peruvian scientists in 2005.</p>	<p>Completed laboratory work. PVA modelling complete.</p> <p>A one day conference to present the results of the genetics and modelling is scheduled for 6th April 2006.</p> <p>PHVA workshop will be run on 16th -17th May 2006.</p> <p>No further action is required although troubleshooting for statistical analysis will continue via email as necessary until the end of the project.</p> <p>The conservation biology courses have been completed. No further action is required. CONOPA have all the relevant material that will</p>

<p>To carry out a Population Viability Assessment.</p>	<p>The production of a risk assessment for the guanaco. To have held the workshop</p>	<p>The Vortex PVA modelling was completed in April 2006.</p>	<p>enable them to run future courses.</p> <p>Preparation for the risk assessment is being conducted at the moment by CONACS and CONOPA, ready for the workshop in May.</p>
<p>Outputs</p>			
<p>The production of a management plan INRENA can use to guide guanaco conservation.</p> <p>Two scientists who can produce genetic data, analyse it and write scientific papers and management plans.</p> <p>Two training courses in conservation biology.</p> <p>A full population viability assessment.</p>	<p>The plans themselves should be easily translated into specific action.</p> <p>The scientists' increased knowledge and hands-on capability at conservation genetics should be verified.</p> <p>The students should be able to pass an exam at the end of their course or demonstrate increased knowledge.</p> <p>The PVA can run successfully and provide useful indicators of specific threats and solutions for</p>	<p>To be completed in May and June, before the end of the project.</p> <p>JR and KY have been trained in automated sequencing and mitochondrial data analysis.</p> <p>Both have been and are involved in the writing of new grant proposals to continue their research.</p> <p>Courses were held in June-July 2004 and 2005. All students were examined and 29 received diplomas and 3 a certificate of attendance.</p> <p>To be held in year 4.</p> <p>Genetic lab work and analysis and</p>	<p>The genetic and population data produced in this project provides sufficient resolution to determine the level of gene flow between populations and to answer questions of phylogeography.</p> <p>KY and JR are applying their knowledge in the laboratory in Peru. Both have the necessary laboratory skills to apply to other areas.</p> <p>A network of trainees developed following each course and contact maintained with CONOPA.</p> <p>One student (SN) organised a spin-off course in Trujillo on conservation biology from 10-12th March 2006.</p> <p>Run the workshop 16-17th May 2006.</p>

	populations.	PVA modelling has been completed. All relevant data has been gathered for PHVA.	
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Note: Please do NOT expand rows to include activities since their completion and outcomes should be reported under the column on progress and achievements at output and purpose levels.

Annex 2: Programme for the dissemination Conference on 6th April 2006



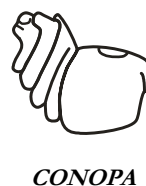
Ministerio de Agricultura

**Conferencia Internacional
PRIMERA EVALUACIÓN CIENTÍFICA SOBRE LA SITUACIÓN CRÍTICA DEL
GUANACO EN EL PERÚ (RESULTADOS DEL PROYECTO GUANACO 1)
Lima – Perú, 06 de Abril del 2006**

PROGRAMA

- Sede:** Auditorio del Instituto Cultural Peruano Británico
Bajada Balta, Miraflores
- 3:00 pm** Palabras de Bienvenida
Sr. Robert Webb – Jefe de la Misión, Embajada del Reino Unido
- 3:10 pm** Inauguración
Eco. Juan Carlos Zevallos Ugarte - Vice Ministro de Agricultura
- 3:40 pm** Presentación del Proyecto Guanaco 1, a cargo de:
-Dra. Jane Wheeler - CONOPA
-Dra. Katherine Yaya - CONOPA
-Dra. Ciara Casey - Cardiff University, Reino Unido
- 4:10 pm** Conferencia Internacional: Primera Evaluación Científica sobre la Situación Crítica del Guanaco en el Perú (Resultados del Proyecto Guanaco 1), a cargo de:
Dr. Michael Bruford - Cardiff University, Reino Unido
- 5:50 pm** Panelistas (Invitados especiales)
INRENA: Ing. Antonio Morisaki 10'
CONACS: Ing. Wilder Trejo 10'
CND: Sr. Augusto Urrutia 10'
CONCYTEC: Blgo. Guillermo Alvarez 10'
- 5:30 pm** Lanzamiento del Taller "Situación actual de Guanaco en el Perú y Propuesta para un Plan de Conservación", a cargo de:
Ing. Daniel Rivera - Jefe del Programa de Camélidos Silvestres, CONACS.
- 6:10 pm** Rueda de Preguntas
Conducción: CONACS
- 6:45 pm** Clausura
Ing. Wilder Trejo – Presidente, CONACS
- 7:00 pm** Pisco de Honor

Annex3: Programme for the PHVA Stakeholders Workshop on 16th-17th May 2006



**Taller Internacional
SITUACIÓN ACTUAL DE GUANACO EN EL PERÚ Y PROPUESTA PARA UN
PLAN DECONSERVACIÓN
Lima - Perú, 16 y 17 de Mayo del 2006
Lugar: Auditorio CONCYTEC
(Calle del Comercio 197 - San Borja, Lima)**

PROGRAMA

Día 1: Martes 16 de Mayo

08:30 am	Registro de participantes	
09:00 am	Inauguración Ing. Manuel Manrique Ugarte - Ministro de Agricultura	
09:30 am	Historia Natural del Guanaco Ponente: Dra. Jane Wheeler, CONOPA - Perú	
10:00 am	Situación del Guanaco en Argentina Ponente: Dra. Julieta Von-Thüngen, INTA Bariloche - Argentina	
10:30 am	Café	
11:00 am	Situación del Guanaco en Chile Ponente: Ing. Benito Gonzáles, Pontificia Universidad Católica - Chile	
11:30 am	Situación actual e importancia del Guanaco en el Perú Ponente: Blgo. Domingo Hocés, Especialista GECS-IUCN - Perú	
12:00 pm	Rueda de Preguntas	
12:30 pm	Video: Experiencias de conservación del guanaco en Los Pelambres - Chile	
12:45 pm	Almuerzo	
01:45 pm	<u>Tema Grupal 1:</u> "Convenios Internacionales y Estrategias Nacionales para la Conservación" Ponente: Dra. María Luisa del Río, CONAM - Perú Ponente: Blga. Rosario Acero, INRENA - Perú Ponente: Ing. Daniel Rivera, CONACS - Perú	15' 15' 15'
02:30 pm	<u>Panelistas Grupo 1:</u> Dra. Julieta von-Thüngen, INTA Bariloche - Argentina Ing. Carlos Ponce del Prado, Conservación Internacional - Perú Blga. Silvia Sánchez, Comité Peruano UICN - Perú	10' 10' 10'
03:00 pm	Rueda de Preguntas	
03:15 pm	<u>Tema Grupal 2:</u> "Experiencias, amenazas y potencialidades en la conservación del Guanaco" Ponente: Sr. Luis Guerra, Representante Comunidades Campesinas Ponente: Blgo. Víctor Injante, CONACS - Perú Ponente: Heinz Plengue, Reserva Ecologica Chapari- Perú	15' 15' 15'
04:00 pm	<u>Panelistas Grupo 2:</u> Dr. Antonio Brack, PNUD - Perú	10'

	Lic. Luis Alfaro, INRENA - Perú	10'
	Dr. Alejandro Camino, Consultor - Perú	10'
04:30 pm	Rueda de preguntas	
04:45 pm	Café	
05:00 pm	<u>Tema Grupal 3:</u> "Necesidades de Investigación para la Conservación del Guanaco"	
	Ponente: Dr. Juan Tarazona, CONCYTEC - Perú	15'
	Ponente: Dra. Jane Wheeler, CONOPA - Perú	15'
	Ponente: Dr. Raúl Rosadio - Consorcio Universitario Post Grado - Perú	15'
05:45 pm	<u>Panelistas Grupo 3:</u> Ing. Benito Gonzáles, PUC - Chile	10'
	Blgo. Edgard Sánchez, UNALM - Perú	10'
	Ing. Pedro Vásquez, UNALM - Perú	10'
06:15 pm	Rueda de preguntas	
06:30 pm	Cierre del Primer Día	

Día 2: Miércoles 17 de Mayo

9:00 am	<u>Taller de trabajo grupal:</u> "Identificación de la problemática, medidas de acción inmediata y necesidades de implementación de proyectos de Conservación del Guanaco"
	Facilitador: Ing. Daniel Arestegui, CONACS
	<u>Mesas Temáticas:</u>
	Grupo 1: "Caza furtiva y deportiva"
	Responsables: - PNP CAP. Miguel Garay, Policía Nacional - Segundo Morales, Poder Judicial
	Grupo 2: "Marco Legal, Institucional y Político"
	Responsables: - Dr. José Luis Capella, SPDA - Tte. CrI. EP Marco Dill'erva Cevallos, CCFFAA
	Grupo 3: "Conservación y Participación Social para la Supervivencia de la Especie"
	Responsables: - Lic. Luis Alfaro, INRENA - Blgo. Víctor Injante, CONACS
	Grupo 4: "Prioridades de Investigación y acciones de protección del Guanaco"
	Responsables: - Dr. Juan Tarazona - CONCYTEC - Blgo. Domingo Hoces - Especialista GECS IUCN - Perú
11:00 am	Café
11:30 am	Exposición de grupos(15 minutos cada uno) Facilitador: Ing. Daniel Arestegui, CONACS
01:00 pm	Almuerzo
03:00 pm	Preparación del documento de Declaración del Guanaco (Responsables de grupos)
04:00 pm	Plenaria General a cargo del Dr. Antonio Brack Egg, PNUD - Perú (Conservación Internacional)

- 04:30 pm** Acuerdo Final de la Declaración del Guanaco y conformación de la Comisión de Elaboración del Plan de Conservación del Guanaco
- 05:00 pm** Clausura
Ing. Wilder Trejo Cadillo, Presidente del CONACS

Annex 4: Fieldwork Community Survey Questionnaire

FORMATO DE EVALUACION DE POBLACIONES DE GUANACOS

Departamento de Arequipa

A.- UBICACION

ORGANIZACIÓN: _____ Representante _____
PROVINCIA: _____
DISTRITO: _____ : _____
Lugar del Conteo _____
Dato GPS: _____ : _____

B.- DEL SITIO:

Cuerpos de Agua:

Acceso: Desde _____ Rios ___ Lagos ___ Lagunas ___
Via: Carretera ___ C.Herradura ___ Sendero ___
1.- Superficie Estimada _____ Ha. Bofedal ___ Otro _____
2.-Formación Vegetal: Holdridge _____ Udvardy _____ Brack _____ Otro _____
3.- Tipo Suelo: Roca ___ Pedregal ___ Arenal ___ Fangoso ___ Nieve ___ Volcánico ___ Otro ___
4.- Relieve del Terreno: Accidentado ___ Uniforme ___ Llano ___ Otro _____
5.- Exposición: _____
6.- Vientos: ___ Leve ___ Moderado ___ Intenso ___ Dirección _____
7.-Fisiografía: Vertiente ___ Loma ___ Pampa ___ Valle ___ Quebrada ___ Pico ___
8.- Vegetación: Arbórea ___ Arbustivo ___ Maleza ___ Monte ___ Otro ___
9.-Actividad Agrícola (Si) (No) Cultivo _____ Siempre ___ Eventual ___ Secano ___
10.- Actividad Ganadera: Especies _____ Siempre ___ Temporal _____
11.- Otras Actividades: (Si) (No), Minería ___ Tala Árboles ___ Otro _____
12.-Estimado de la Temperatura _____ Estimado de la Humedad _____
13.-Colección de Muestras: Botánicas _____ De Heces _____

C.- DE LA POBLACIÓN DE GUANACOS EN EL LUGAR

1996 97 98 99 **00** 01 02 03
____ _

Conteo: _____

Censadores: _____ Total: _____ Guanacos

D.-GUANACOS HALLADOS MUERTOS: (SI) (NO)

Años: _____

Dspojos: _____

CAUSA _____

OBSERVACIONES _____

E.- OTRAS ESPECIES DE ANIMALES EN EL LUGAR

A.D. : Vacunos _____ Ovinos _____ Caprino _____ Alpacas _____ Llamas _____ Otros _____

A.S. Tarucas _____ Guanacos _____ Venado _____ Pumas _____ Zorros _____ Otros _____

A.Pred: Perros Vagos

F.-ETOLOGÍA DE LOS GUANACOS

Normal _____ Huidizo _____ Tímido _____ Inestable _____ Otro _____

Observaciones: _____

G.-CONDICION SANITARIA:

Sarna _____ Alicuya _____ Ojo Sarco _____ Actinomicosis _____ Polidactilia _____ Otro _____

H.- CAZA FURTIVA:

Siempre _____ A veces _____ Nunca _____ Procedencia _____

Nº Cazadores _____ Observaciones: _____

I.-CONOCIMIENTO TRADICIONAL DEL GUANACO

Siempre presente: _____ Últimamente _____ Solo en el año _____ Muy irregular _____

Algunas Veces _____ Solo Huellas _____ Otro _____

El parecido es con: Vicuña _____ Llama _____ Alpaca _____ Venado _____ Otro _____ Ninguno _____

Guanacos son diferentes en : Forma _____ Color _____ Tamaño _____ Otro _____

Restos arqueológicos con presencia de Guanacos: Presente _____ Nunca _____ Se desconoce _____

Uso del Guanaco: Carne _____ Piel _____ Fibra _____ Bosta _____ Vísceras _____

Motivo: _____ Frecuencia _____

K.- DE LA PASTURA:

Formaciones %PAJONAL CÉSPED TOLAR/CANLLAR BOFEDAL PEDREGAL DESIERTO

Dentro del Sitio _____
Fuera del Sitio _____

Estado de la Pastura: Muy Bueno Bueno Regular Pobre Muy Pobre Pésimo

Dentro de Sitio _____

Fuera o de Sitio _____

Predominancia: Dentro del Sitio _____

Fuera del Sitio _____

Estimado de la Capacidad de Carga: _____

OBSERVACIONES _____ /

COMENTARIOS: _____:

CROQUIS DEL SITIO: _____

Formato para encuesta oral a pobladores:

1.- ¿Conoce al Guanaco?

2.- ¿Desde cuando?

- 3.-¿ Como lo identifica y no lo confunde con otro animal?
- 4.- ¿Sabe que es un animal silvestre o salvaje?
- 5.- ¿Sabe que es pariente de la Llama, la Alpaca y la Vicuña?
- 6.- ¿Sabe para que sirve ó es útil. ¿O cree que no tiene utilidad ó que hasta es perjudicial?.
- 7.- ¿Ha comido alguna vez su carne- A que otro animal se aparece?
- 8.- ¿Es cazado siempre en este lugar. Con que motivo y por quienes?
- 9.- ¿Cree que hay muchos guanacos, pocos o que ya se está extinguiendo?
- 10.- ¿Cree que puede serle igual de útil o mas útil que otro ganado, porque?
- 11.- ¿Cree que el Estado ó las Leyes lo protegen?
- 12.- ¿Ud. Forma parte de algún Comité que protege al guanaco?
- 13.- ¿Estaría dispuesto ó interesado en trabajar con el guanaco?
- 14.- ¿Cree que se le puede aprovechar asi como se encuentra: en estado silvestre, o que tendría que encerrarse en corrales y domesticarse?
- 15.- ¿Tiene algo mas que agregar, pedir ó comentar?