Technical Report

A Monitoring Plan of *Crax globulosa* and its habitat, for the implementation and consolidation of a Protected Area in the community of San Marcos' Community: Beni, Bolivia

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Contenidos

Estudios Científicos

INTRODUCCIÓN Y ANTECEDENTES DEL PROYECTO

Históricamente en Bolivia, entre la década de los treinta hasta los sesentas el Mamaco (*Crax globulosa*) era considerada una especie común sobre el río Beni. Pero producto de la actividad de la cacería para el comercio de pieles y posteriormente la explotación de madera sus poblaciones se concentraron en áreas especificas. A nivel global muy poco es sabido de la ecología y dinámica poblacional de esta ave, y también se desconoce que efecto tendrá el aislamiento de esta fascinante especie en el futuro. La única población actual en Bolivia que se encuentra en las orillas del Rio Negro que fue redescubierta después de más de treinta años producto de las exploraciones desarrolladas por Bennett Hennessey en 1998. Población remanente que está todavía en peligro debido a presencia de cazadores furtivos y a la expansión de los interés económicos externos para la explotación de la madera.

En este sentido el año 2003 con el apoyo de Weeden Foundation se desarrollo una exploración de un mes para determinar el estado de conservación y el 2004 con el apoyo del proyecto Áreas Claves para la Biodiversidad se desarrollo las primeras listas de especies. Posteriormente con el apoyo de Rufford Small Grants en 2005 se empieza a tomar datos de la fauna silvestre de forma sistemática para la implementación de un plan de monitoreo de *Crax globulosa* y su ecosistema. Tarea que también fue apoyada en dos gestiones por la Universidad de Glasgow y su programa de voluntarios gracias a las gestiones desarrolladas por el Dr. Ross MacLeod. Así también, en esta iniciativa de conservación el gobierno Holandes (Site Support Group) en el año 2005 nos empezó a colaborar en el desarrollo de la implementación de un programa de Ecoturismo Comunitario con el objetivo de mejorar la calidad de vida de los miembros de la Comunidad de San Marcos y hacia un manejo mas amigable de su medio ambiente.

RESUMEN DE ACTIVIDADES DEL PROGRAMA MAMACO

En el campo de la investigación (Fig. 1), podemos indicar que nuestra base de datos en fauna y flora esta cada vez mas amplia. Lo que nos permite pensar que a mediano plazo podremos plantear más acciones que permitan ayudar de forma más “efectiva” la conservación del Mamaco y su ecosistema.

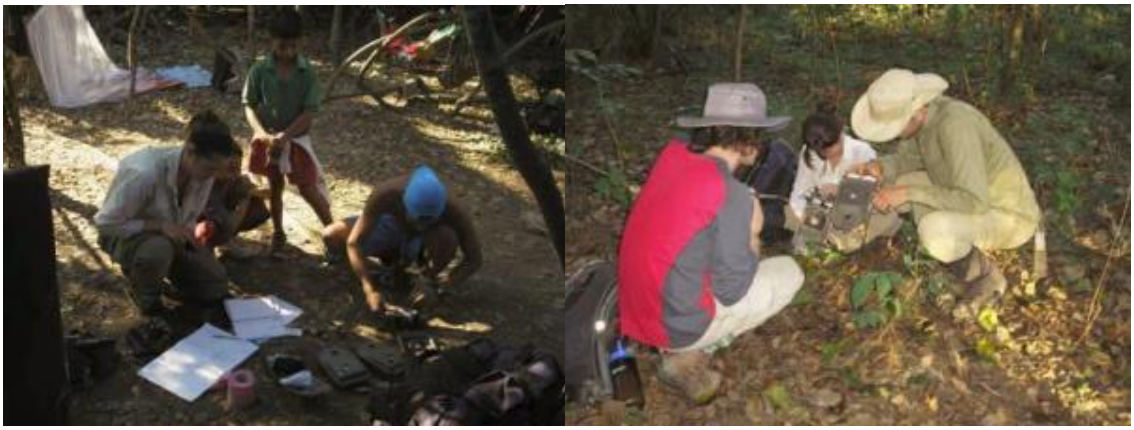

Figura 1. Toma de datos de monitoreo en Rio Negro.

Dentro los resultados preliminares, se puede indicar que actualmente la población de nuestra especie bandera (*Crax globulosa*) presenta menos de 183 individuos (Fig. 2). Lo que indica el estado critico de su conservación, y mas aun considerando que es la única población confirmada para Bolivia. En este sentido una de las acciones mas efectivas desde hace tres años, fue la de llegar a un acuerdo con la Comunidad Indígena de San Marcos de crear un Zona de Protección (zona de núcleo), que incluye la distribución del Mamaco y otra vida silvestre donde las actividades de cacería y extracción de recursos naturales esta prohibida; exceptuando las acciones venta de servicios ecológicos (e.g. turismo ecológico) e investigación.

Figura 2. Fauna en estado critico de conservación *Crax globulosa* (izquierda)y *Callicebus modestus* (derecha).

Dentro la otra fauna estudiada en el grupo de los mamíferos esta el primate endémico Lucachi (*Callicebus modestus*) (Fig. 2). Así también, otros especies de importancia para la conservación (Fig. 3) como el tapir, jaguar, chanchos, entre otros. En relación, a la herpetofauna de las 44 especies registradas el año 2006 se llevo a cabo una investigación preliminar del tamaño poblacional del caimán negro (*Melanosuchus niger*) y lagarto (*Caiman yacare*) con el objetivo de conocer su estado de conservación.

Figura 3. Registro de fauna mediante trampas cámara en Rió Negro.

En el componente de desarrollo y educación ambiental se continúa con los talleres de capacitación a los pobladores de San Marcos en los temas de monitoreo de la vida silvestre, artesanía, contabilidad, administración, guiaje, gastronomía y fortalecimiento institucional. Actividades que tienen relación con la gestión de la cabaña turística en San Marcos y la temática de conservación y manejo sostenible de los recursos naturales (Fig. 4).

Figura 4. Talleres de capacitación en la comunidad de San Marcos.

Asi también, podemos indicar que la construcción de la cabaña turística esta en las etapas sm esperando culminar esta infraestructura a mediados de este año (Fig. 5).

Figura 5. Construcción de la cabaña de turismo en San Marcos.

EQUIPO TÉCNICO Y DE APOYO

Aves

- Davina Lousille - Universidad Glasgow 2006
- Dr. Ross MacLeod - Universidad Glasgow 2005/2006
- Luis Alberto Lurici Beyuma – Comunidad San Marcos
- Pardeep Chand – Universidad Glasgow 2005
- Robert Deward – Universidad Glasgow 2005/ 2006
- William Purnell- Universidad Glasgow 2006

Anfibios y reptiles

- Arturo Muñoz – Bolivia 2005
- Dirk Ercken – Bolivia 2005
- Eddy Perez – Bolivia 2006
- Laura Chapman - Universidad Glasgow 2005
- Limbert Lurici – Comunidad San Marcos 2005
- Samuel Paisley - Universidad Glasgow 2006
- William Paterson- Universidad Glasgow 2006

Mamiferos

- Gemma Strickland – Universidad Glasgow 2005
- Graham Stirling - Universidad Glasgow 2005
- Helen Simmons - Universidad Glasgow 2005
- Jaime Lurici Macuapa - Comunidad San Marcos
- Jorge Luis Ortiz - Comunidad San Marcos
- Kelly Harrison - Universidad Glasgow 2005/ 2006
- Lizette Siles – Bolivia 2005
- Marco Cabinas Cajera – Comunidad San Marco
- Rebecca Dye - Universidad Glasgow 2005
- Rubert Lurici Macuapa – Comunidad San Marcos

FINANCIAL REPORT

Asociación Civil Armonía/BirdLife International
MAMACO PROJECT
RUFFORD SMALL GRANT
From August 28th of 2005 to July - 18 of 2007
In Pounds

DETALLE DE DESEMBOLSOS	FECHA	POUNDS
First Deposit	12/01/2005	4,920.00
	TOTAL	**4,920.00**

CODE	ITEM	BUDGET (POUNDS)	EXPENSES (POUNDS)	TOTAL AVAILABLE (POUNDS)
1	**PROGRAM PERSONNAL**			
1.10	6 months for biologist	**805.63**	**805.63**	**0.00**
1.20	Wages for porters	197.02	387.07	-190.06
1.30	wages for two local guides	1,379.13	1,453.42	-74.29
2.00	**TRAVEL EXPENSES**			
2.10	6 flights La Paz - Rurrenabaque	361.20	105.77	255.43
3.00	**SUBSISTANCE/TRANSPORT**			
3.10	Food and supplies for field work	1,641.82	1,680.51	-38.69
3.20	Hire of boat to transport	295.49	236.35	59.13
4.00	**SERVICES**			
4.10	Armonia Conservation center support	239.71	239.71	0.00
5.00	**Others**			
5.10	Taxes	0.00	11.52	-11.52
TOTAL ACCORDING TO BUDGET		4,920.00	4,920.00	**0.00**
TOTAL ACCORDING TO DEPOSITS		4,920.00	4,920.00	**0.00**

A CONSERVATION ASSESSMENT OF THE POPULATION SIZE, DISTRIBUTION AND BEHAVIOUR OF THE GLOBALLY THREATENED WATTLED CURASSOW *CRAX GLOBULOSA*, IN BOLIVIA

Pardeep Chand, Hugo Aranibar-Rojas, Robert Dewar, Graham Stirling and Ross MacLeod

Abstract

The Wattled Curassow *Crax globulosa* is a globally threatened species listed as vulnerable to extinction by the IUCN. The aim of our study was to obtain the first baseline data on the Wattled Curassow along the Rio Negro, Beni Department, which is the last known location of this species in Bolivia. The study investigated absolute abundance, distribution, habitat use and behaviour and compared these with the sympatric Razor-billed Curassow, *Mitu tuberosa*. Using distance sampling, Wattled Curassow was estimated to have a density of 4.6 $\pm$ 2.0 individuals/km^2 from a total survey effort 222 km. This is the highest density yet found for this species and the population along the Rio Negro, which was estimated to be bout 138 individuals, may be the largest known to remain in South America. It was found at there was a clear difference in distributional patterns between the two species, with Wattled Curassow observed significantly closer to the only river in the area compared to Razor-billed Curassow. This dependence on river edge habitat and the absence of the species from much other habitat that initially seemed suitable suggests that the species actual distribution in varzea forest may be much more restricted that previously known. No other difference in habitat use was found between species but Wattled Curassow were detected significantly closer to human observers compared to Razor-billed Curassow which seemed to suggest that Wattled Curassow is easier to hunt than Razor-billed Curassow. This baseline density, distribution, habitat use and behavioral data of Wattled Curassow along the Rio Negro can have important implications regarding conservation management of this threatened species in the region.

INTRODUCTION

The Wattled Curassow, *Crax globulosa*, is a globally threatened species currently listed as vulnerable (IUCN 2006). Although the Wattled Curassow is believed never to have been very common, the species has in the last century suffered from large declines in its range and population as a result primarily of hunting but also habitat destruction (Del Hoyo et al. 1994). Its total population is believed to be small and consist of a number of fragmented sub-populations found in the upper Amazonian regions of Brazil, Peru, Colombia and Bolivia (Birdlife International 2000, IUCN 2006). The species is restricted to humid *varzea* forests in the tropical lowlands (Del Hoyo *et al.* 1994) below altitudes of 300 m (Birdlife International 2000) and is strongly association with flooded and riparian forest. The global population has been estimated to be between 2500 and 10,000 and decreasing (Birdlife International 2000, IUCN 2006).

Due to its small population size, patchy distribution and the fact that it is found in fairly inaccessible regions of the neotropics there is little information regarding the natural history of Wattled Curassow, especially in Bolivia, and only a few recent population studies have been conducted anywhere in South America (Aranibar-Rojas et al. 2005, Bennett 2000). The best information regarding its abundance and aspects of its behaviour has been gained through studies conducted in Isla Mocagua in Colombia and the Mamiraua Sustainable Development Reserve in Brazil where populations of Wattled Curassow occur. Information from locals states that groups of Wattled Curassow containing between 10-20 individuals gather near lake edges (Santos 1998). The current estimated population in Columbia is less than 100 individuals with the main group on the Isla Mocagua where there are an estimated 61 individuals for an area of 2000 ha (Bennett 2003). It has been found that the Wattled Curassow population in Columbia is highly arboreal, most often observed in the high canopy (Bennett 2003) and is often difficult to see because after extensive hunting it is wary of humans.

Historically in Bolivia the population of Wattled Curassow ranged from Rurrenabaque, down the Rio Beni and past the mouth of the Rio Negro and was considered common (Hennessey 1999). Since then in Bolivia, Wattled Curassow has suffered from a rapid decline in its population size in the latter half of the 20th century, mainly due to being hunted for food by hunters involved in the animal skin trade and by loggers (Hennessey 1999).

A law was passed in 1971 to stop large scale trading in animal skins, but the population still declined due to logging activities and associated hunting continuing to occur in this area. Local knowledge and field surveys conducted by Armonia (Bolivian BirdLife partner) in 1999 and 2001 rediscovered a population of Wattled Curassow on a small tributary of the Rio Beni at a location 15 km east of the main river (Hennessey 2004). Currently this is the only known remaining population of the Wattled Curassow in Bolivia and it is located around the Rio Negro, near the village of San Marcos, Beni Department, Bolivia. The last known specimen in Bolivia was caught here in 1937 (Hennessey 1999). The local community of San Marcos reported that the population was very low in this area about 15 years ago and that they decided to stop hunting Wattled Curassow in the areas surrounding their village. They have reported that the species has begun to repopulate in certain areas surrounding San Marcos in the last ten years (Hennessey 1999).

In 2003, a preliminary study of approximately 15% of the potential habitat was carried out to find the relative abundance of Wattled Curassow along part of the Rio Negro and the species was encountered at a rate of 0.36 individuals per hr (Aranibar-Rojas et al. 2005). It was estimated that suitable Wattled Curassow habitat in the region might amount to very approximately 180 km^2 (Aranibar-Rojas et al. 2005).

The aims of this new study were to measure absolute abundance for the first time, to estimate distribution and habitat use within the region of potential occupancy and to record the behaviour of the globally threatened Wattled Curassow, in comparison with the widespread Razor-billed Curassow, *Mitu tuberosa*, which is sympatric along the Rio Negro.

STUDY AREA

The study was carried out along the Rio Negro (13^o 45'8.1" S, 67^o16'57.5" W at an altitude of 169m) located in the Beni Department, north-western Bolivia. The study site is situated in the Southern Amazonia zoogeographic region and the Madeira-Tapajos sub-region (Stotz *et al.* 1996). The area within and surrounding the study site is *varzea* forest, an ecosystem that is characterized by prolonged seasonal flooding, with the wet season occurring in Bolivia from November/December to March and flood waters not receding until May/June.

The community of San Marcos 25 km away situated 100 km downstream from the town of Rurrenabaque is the nearest human settlement; it is a small village consisting of approximately 15 families. The study site and the surrounding area suffered from human disturbance through a large-scale animal skin market that occurred in this region of Bolivia during the 1960's but now has very much reduced human disturbance (Hennessey 1999). The community of San Marcos hunting zones are concentrated within a 5 to10km radius of the village and so do not encompass the study site (Aranibar-Rojas et al. 2005).

METHODS

Fieldwork was carried out from 25 June untill 29 July 2005 during a University of Glasgow Expedition to Bolivia in 2005. Surveys were conducted daily by two teams using a set of 11 transects of 19.2km total length, which were cut prior to the expedition's arrival at the study site. Transects were surveyed from approximately 0730 H to 1030 H, each day to coincided with the main activity period of the cracids in the area (Del Hoyo et al. 1994). Total survey effort was 222 km distance walked.

When Wattled Curassow or Razor-billed Curassow were encountered during a transect, the following were recorded; time, date, species, individuals per sighting, heard or observed, distance from observer, perpendicular distance from transect, height, stratum of forest (ground, bush or tree) and location on transect where observation occurred. Height, observer distance and perpendicular distance were estimated visually.

The data was analyzed using the distance sampling line transect methodology (Buckland et al. 2001, Bibby et al. 2000) and the DISTANCE 4.1 programme (Thomas et al. 2003) was used to estimate the abundance of both curassow species. As the number of observations of curassows was limited it was assumed for the purposes of calculating the detection curves necessary to calculate density that the two species of curassow are similarly easy to detect. Since both Wattled Curassow and Razor-billed Curassow are similar in size and behaviour this seemed a reasonable assumption and allowed the detection curves to be estimated using data for both species together and separate density calculations to be made for each species.

Differences in distribution between Wattled Curassow and Razor-billed Curassow were investigated by recording the distance of each sighting from the only river in the area, the Rio Negro. Differences in habitat use between Wattled Curassow and Razor-billed Curassow were investigated by recording forest stratum level used and height at each observation of these two species. Finally, a component of the behaviour of Wattled Curassow and Razor-billed Curassow was investigated by comparing the distance from the observer at which the two species were first detected. It was hypothesized that this would give a measure of how wary the curassows are of humans and therefore any difference in vulnerability to hunting between the two species. This hypothesis was based on the observation that the cracids were usually first detected when they moved in response to the approach of the human observer. Such movements normally involved moving higher in trees or turning to walk away if on the ground so it did not generally change the perpendicular distance of the birds from the transect but rather signaled when the birds had detected the humans. All results are expressed as mean $\pm$ standard error.

RESULTS

A total of 40 curassows were observed during the study; 13 Wattled Curassow and 27 Razor-billed Curassow (Table 1). DISTANCE 4.1 identified the half normal key with 2 cosine adjustments as the model best fit for the curassow detection data and Fig. 1 shows this was a close fit to the actual distances from the transect at which the curassows were detected. Using this detection curve the density estimates for Wattled Curassow was 4.6 $\pm$ 2.0 individuals per km^2 and for Razor-billed Curassow 12.3 $\pm$ 3.2 individuals per km^2.

Table 1.

Density and numbers of each curassows observed

Species	No. of observations	Density (D) (individuals/km2)	Standard error	% coefficient of variation	95% confidence interval
Wattled Curassow	13[a]	4.59	2.02	44.07	1.99 - 10.58
Razor-billed Curassow	27	12.28	3.18	25.92	7.41 - 20.36

[a] 2 observations occurred where the perpendicular distances were not properly recorded so these observations were excluded from the density analysis.

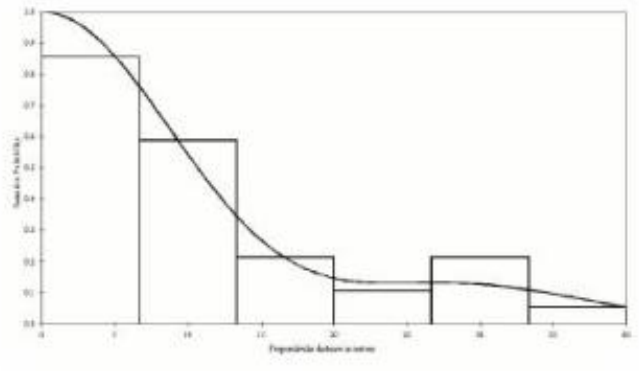

Figure 1.

Curassow detection curve from Distance 4.1. Showing how probability of detecting curassows declines rapidly with perpendicular distance from the transect line. The bars show the actual data and the curved line shows that the calculated detection curve closely models this data.

Distribution

All Wattled Curassow observations and 18 of 27 Razor-billed Curassow observations occurred on transects parallel and close to the Rio Negro with nine Razor-billed Curassow observations occurring on transects up to 2 km away from the Rio Negro, which was the maximum distance from the river surveyed.

A Mann-Whitney U-test confirmed that the two species had significantly different distributions with respect to how far from the river they were found ($z = 3.42$, $P < 0.01$).

Habitat Use

For Wattled Curassow, four observations occurred on the ground, with three at bush level and five at tree level. For Razor-billed Curassow, seven observations occurred at ground level, 11 at bush level and six a tree level (Table 2). A chi square test showed that there was no significant difference in level of habitat used between Wattled Curassow and Razor- billed Curassow, ($\chi^2 = 1.7$, $P = 0.44$, $df = 2$).

Table 2.

Forest layer use of Wattled Curassow and Razor-billed Curassow observations

Species	**Stratum Layer**		
Wattled Curassow	**4**	**3**	**5**
Razor-billed Curassow	**7**	**11**	**6**

On average Wattled Curassow was detected at a mean height of 10.6 ± 3.7 m and Razor-billed Curassow was detected at 9.55± 2.1 m above ground. A two sample t-test showed that there was not a significant difference in the height above the ground of our sightings of the two species (t = 0.24, P = 0.624, df = 11).

Behaviour

A two sample t-test showed Wattled Curassow and Razor-billed Curassow were on average found to have a significantly different detection distance from the observer, (estimated difference = 6.77 m, t = 2.24, P = 0.034, df = 27). On average, Wattled Curassow was detected at 14.92 ± 2.4 m and Razor-billed Curassow was detected at 21.7 ± 1.9 m from the observer.

As there was a significant difference in observer detection distances between Wattled Curassow and Razor-billed Curassow, a t-test was carried out to investigate whether there was a difference in perpendicular distances from the transect between the two species which might have invalidated our assumption that the two species were equally detectable. The mean perpendicular distance of observations from transects for Wattled Curassow was 7.38 ± 2.2 m and 11.8 ± 1.8 m for Razor-billed Curassow. A t-test showed there was no significant difference in perpendicular distances between the two species. (t = 1.52, P = 0.139, df = 28).

DISCUSSION

The Wattled Curassow is estimated to occur at a density of 4.6 individuls/km^2 at our study site along the Rio Negro, the highest density yet known for this species. However it remains almost three times less common than the Razor-billed Curassow within the study area and is restricted to a narrow strip of habitat close to the river.

The only previous survey of Wattled Curassow and Razor-billed Curassow along the Rio Negro found that Razor-billed Curassow had a only slightly higher relative abundance of 0.38 individuals/h compared to 0.36 individuals/h for Wattled Curassow (Aranibar-Rojas *et al.* 2005). The difference between the two results is probably due to the previous survey being conducted only along the river edge where our study found Wattled Curassow to be most frequent. Our new results are therefore probably a more accurate estimate of the relative abundance of the two species over the entire habitat in the Rio Negro area. Our study estimated a density of 12.3 ± 3.2 individuals/km2 for Razor-billed Curassow along the Rio Negro. This compares very favorably with the highest known density estimates of this species in Bolivia (12 individuasl/km^2 at a number of protected sites in Noel Kempff Mercado National Park (Delacour and Amadon

2004)). As Razor-billed Curassow is usually one of the most common targets of hunting for food by local communities in Bolivia (Pers. Obs.) the high population level suggests that hunting of curassows is currently minimal in the area.

This supports the belief of Hennessey (1999) that the population of Wattled Curassow has increased in recent years since the reduction of commercial hunting in the area and the oluntary ban on hunting the species introduced by the local San Marcos community. The only other density estimate that has been obtained for Wattled Curassow is from Isla Mocagua, Colombia (Bennett 2003). With an estimated population size from this site of 61 individuals for an area of 2000ha (Bennett 2003), this is equivalent to 3.05 individuals/km^2. From our density estimate for Wattled Curassow along the Rio Negro, it is probable that Wattled Curassow is more abundant at this site compared to the population in Isla Mocagua.

During fieldwork it was obvious that there was a difference in distribution patterns between the two species as all observations of Wattled Curassow occurred along transects parallel to and within 100m of the river. While occurring on transects leading away from the river and up to 2km from it. This highlights a significant ecological difference between the two species and suports findings from Mamiraua Reserve, Brazil, where Santos (1998) found that Wattled Curassow preferred forest strips along water bodies whereas as Razor-billed Curassow was distributed throughout varzea forest (Santos 1998). The total area of varzea habitat that might potentially be suitable for Wattled Curassow around the Rio Negro had been estimated to be 180 km^2 (Aranibar-Rojas et al. 2005). However our study suggests that in reality, as it is closely tied to the river, the Wattled Curassow population is concentrated in a small fraction of this potential habitat during the dry season. Using the density estimates obtained from this study (4.6individuals/km^2) we estimate that if the species is restricted to habitat 500m either side of the river then there will be an adult population of approximately 138 $\pm$ 60 birds along the 30km of the Rio Negro where suitable habitat remains. Further studies along other parts of the Rio Negro may find higher densities of the species and it may be found in small numbers around other water bodies in the area. Both of these will hopefully increase this number by some degree but for now we estimate the known Bolivia population to be less than 140 birds. Since the only other site with sufficient data for a population estimate is the Isla Mocagua in Colombia (where there are an estimated 61 individuals) the Rio Negro represents the largest known surviving population of Wattled Curassow in the world. Further studies are therefore urgently required in Mamiraua Reserve, Brazil to estimate the size of the approximately 67% of Razor-billed Curassow bservations occurred on transects close to the Rio Negro with the rest of the observations

population there. However, even though this site is thought to encompass the largest area of varzea forest left in Brazil, the evidence from our study suggest that because Wattled Curassow is restricted in the dry season to habitat in close proximity to water bodies the population there will not be large. There is also an urgent need to revisit historical and potential new sights for Wattled Curassow in Peru to see if the species remains extant in that country. Given large scale declines this species has experienced in the past due to hunting and the small size and fragmented nature of the remaining known populations it is surprising that the species is only currently classed as Vulnerable, based on existing knowledge Endangered would seem more appropriate.

From our observations Wattled Curassow did not seem to be as wary of human presence as Razor-billed Curassow and this supports accounts that Wattled Curassow was easier to hunt compared to Razor-billed Curassow in the Beni area when the species suffered rapid declines during the 1960s and 70s due to hunting from animal skin hunters and loggers (Hennessey 1999). From investigating stratum use of Wattled Curassow and Razor-billed Curassow, it was found that both species were observed at an average height of approximately 10m and may have moved to higher strata to avoid humans. However the significant difference in observer detection distance may suggest that either Wattled Curassow moved away from humans later than Razor-billed Curassow because it *was* more tolerant to human approach or simply that that Razor-billed Curassow were better at detecting human approach than Wattled Curassow. Either or both the explanations would make Wattled Curassow population more vulnerable to hunting should it recommence in the area. Thus the most important conservation priority for Wattled Curassow in Bolivia is to continue working with the local San Marcos community whose voluntary ban on hunting the species in the last few years probably saved the species from extinction in the country. Extending this voluntary hunting ban into the future and in return helping the local community benefit from the ecotourism potential of this unique and potentially easily observed species seem the two most important conservation activities for the near future.

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ANALISIS PRELIMINAR DE LA DISTRIBUCIÓN DE *Crax globulosa* PRODUCTO DE LOS CAMBIOS CLIMÁTICOS

Hugo Araníbar-Rojas

INTRODUCCIÓN

La planificación sistemática y la implementación de diferentes herramientas de análisis, son importantes para la identificación de prioridades y la toma de decisiones en conservación. En este sentido la utilización de la información geográfica actualmente presenta un rol importante, como por ejemplo, la predicción de la distribución de las especies (Lousille *et al* 2003).

En las últimas décadas producto de las actividades humanas el incremento de los gases invernadero esta produciendo cambios climáticos que afectan a los ecosistemas. Estos efectos a nivel de especie se pueden expresar en cambios de la dinámica poblacional, éxito reproductive, abundancia y distribución (Ruegg *et al*. 2006) lo que puede determinar que algunas especie que presentan un requerimientos específicos de distribución tiendan a extinguirse producto de los cambios en su ecosistema o potencialmente colonizar otras áreas (Peterson *et al.* 2006). Por lo tanto en el presente trabajo evaluamos de forma preliminar las posibles consecuencias de los cambios climáticos sobre la distribución de *Crax globulosa*.

METODOS

Se trabajo con la base de datos de puntos georeferenciados durante las gestiones 2005 y 2006 obtenidas en Río Negro. También estos datos se complementaron con la base de datos de la Asociación Armonia BirdLife.

Para el análisis de datos se trabajo con el programa Maxent 2.0 (Phillips *et al.* 2006). Para las proyecciones de cambios climáticos se utilizo los anales desarrollados por Fernadez *et al.* (2006). Se comparo el escenario actual con una proyección a 100 años con una tasa de cambio en la temperatura de 1ºC y 4.5 ºC.

RESULTADOS

Se observa que al contrastar la distribución actual de la especie (Fig. 1) en relación al aumento de la temperatura de 1 ºC la especie amplia su rango en la región. Así también, se puede observar

que este desplazamiento se dirige hacia el Noreste de la distribución actual. En relación, a la tasa de aumento de 4.5 ºC la especie presenta un patrón inverso llegándose a desplazar en mayor proporción hacia el Noroeste de Bolivia.

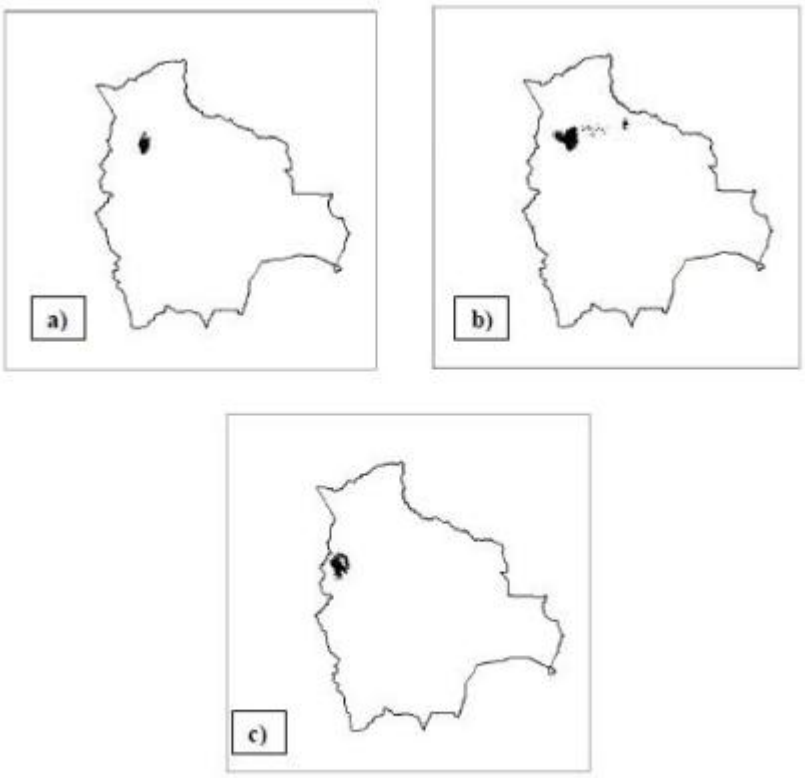

Fig1.

Proyecciones de *Crax globulosa*, bajo efectos del cambio climático a 100 años. a) Distribución actual, b) Distribución aumentando 1 ºC, c) Distribución aumentando 4.5 ºC

CONCLUSIONES

El presente análisis con *Crax globulosa*, sobre el posible efecto de los cambios climáticos nos muestra cual podría ser la potencial dinámica de distribución de la especie en la región asumiendo que exista un proceso de dispersión. En un escenario de variación de 4.5ºC el panorama para la especie es critico debido a que se daría el caso de una extinción local en Bolivia. Debido a que el desplazamiento producido es hacia habitats que no presentan requerimientos mínimos para la especie que son zonas donde empiezan las estribaciones de la cordillera oriental que se caracteriza por hábitat de montaña (bosque montano y pie de monte). Así también, estas regiones presentan los centros de mayor densidad humana y que tiene

proyecciones para las siguientes décadas de convertirse en uno de los principales centros agrícolas.

En contraste la proyección realizada a 1ºC se muestra como alentadora, ya que el desplazamiento se dirigiría zonas donde históricamente estaba presente la especie. Por lo tanto estas regiones presentarían algunos requerimientos específicos para la especie. Aunque cabe indicar que estas regiones presentan una alta actividad ganadera.

Este análisis ilustra los potenciales riesgos para la especie así como las probables regiones donde se deberían generar acciones para futuras estrategias de conservación. Si bien, en el modelo estadístico no se pondero implícitamente las consecuencias de barreras geográficas, interacción de especies, uso futuro de la tierra y efectos de auto correlación (Pearson y Dawson 2003, Araujo 2005, Peterson *et al.* 2006). Hay que tomar en cuenta que este proceso puede ocurrir ya que *Crax globulosa* es una especie de distribución restringida, al igual de otras especies que están dentro los bosques de varzea como el primate *Callicebus modestus* lo que muestra la fragilidad e importancia que tiene este ecosistema para la conservación de esta fauna y otra presente en la region.

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ORNITOLOGICAL INVENTORY REPORT

Pardeep Chand, Robert Dewar, Graham Stirling & Ross Macleod

INTRODUCTION

Bolivia holds the richest avifauna of any landlocked country and with 1358 species (Armonia, 1995) it protects 14% of the world's bird species. This makes it one of the most species rich countries in the world (Wedge & Long, 1995). The specialist nature of many of these species means that they are restricted to very small areas in global terms and their populations are, therefore, extremely vulnerable to disturbance and habitat destruction (Ridgley & Tudor, 1989). There are 68 known bird species in Bolivia regarded as, 'restricted range species'. These are species endemic to an area, with breeding ranges of less than 50.000 km^2. These species are of particular concern to conservationists as habitat destruction can have a particularly devastating affect on the population of these species. The protection of habitat in Bolivia is therefore essential towards protecting the worlds avian diversity.

This section reports back on the ornithological inventory conducted along the Rio Negro, during expedition in the summer of 2005. This region is already an important area for bird conservation as it supports the last Bolivian population of the globally threatened Wattled curassow (*Crax globulosa*). Two previous ornithological inventories have been conducted along different sites of the Rio Negro in November 2004 as part of the Key Biodiversity Areas of Bolivia project. The study identified 98 species at site 1 which was characteristic of varzea habitat and 115 species at a second site classed as terra firme habitat. The November study was conducted during the beginning of the wet season when the area begins to become partially flooded. The study conducted during this expedition was conducted at the start of the dry season so as an offshoot of the original aims of the study; the team was able to compare the level of diversity at these 2 very different times of the year.

STUDY AREA

The study was carried out along the Rio Negro, which is located in the Beni Department, north-western Bolivia. The study site was situated in Amazonia South and based on neotropical zoogeographic regions. The sample area is categorized as the sub-region Madeira-Tapajos (Stotz *et al.* 1996). This system of categorization is based on avian endemism with boundaries being based upon vegetation structures and physiographic features (Stotz *et al.*1996).

The area within and surrounding the study site is characterized by varzea forest. This ecosystem is characterised by seasonal flooding, with the wet season occurring from November/December to March. A number of different habitat types exist around and within the study area. It includes areas of open gallery forest, dense forest and palm forest. The location of the base camp were South 13o 45'8'', West 67o 16'57''.

METHODS

Fieldwork was carried out from 25th of June till the 29th of July. Line transect methodology was used to conduct inventories (Bibby et al. 2000). Surveys were conducted daily along transects (Fig. 1) during the study period by two teams. The number of observers varied, two or three people in each team sampling one of the main transects either side of the main camp each day (1 or 2 or 4 or 5). One observer from Glasgow University was an experienced birdwatcher that had worked in this region before. Observers from Glasgow University worked alongside Bolivian scientists and locals from San Marcos who where highly skilled at detecting birds in the area. The inexperienced observers were quickly able to accurately detect and identify the more commonly encountered birds, however, there was a degree of difficulty in identifying the smaller, rarer bird species that inhabited dense forest or bush.

Inventory work began before first light (approximately 0600 hours) with sound recordings of the dawn chorus conducted at a similar time. Species were identified using plates and textbooks with the more elusive species identified later using sound recordings. Surveys were conducted till approx 1100 hours with dusk sound recording also conducted at sunset. Species encountered outside the period when transect surveys were conducted were also identified and recorded.

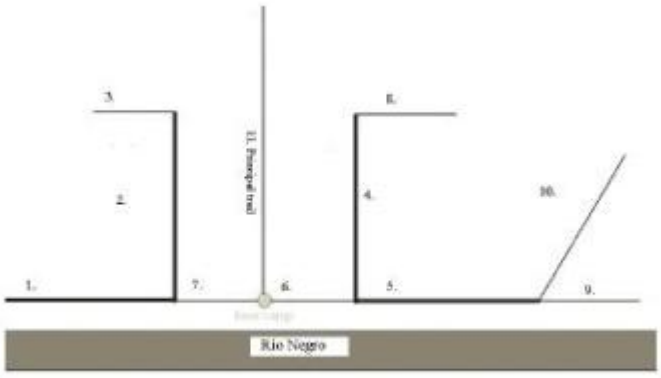

Fig. 1

Simplified layout of transects along Rio Negro

Birds were identified visually using identification plates as well as sound recording equipment. Visual identifications were made using binoculars and supported by field notes, sketches and photographic evidence. Audio identification was based on extensive use of sound recording and play back techniques and vocal identification was achieved by using 'Bird Sounds of Bolivia' (Mayer S.2000).

RESULTS

A total of 85 species were recorded (see Appendix 1) during the survey primarily through visual identification. Of the 85 bird species recorded, 37 were previously unrecorded along the Rio Negro. Using our species inventory list and the data from the KBA surveys conducted in November 2004, in total, 164 species have been recorded along the Rio Negro.

Two species recorded during this survey were of conservation concern. The wattled curassow, *Crax globulosa* which is listed as vulnerable (BirdLife International 2000) and the solitary eagle, *Harpyhaliaetus solitarius* listed as near threatened (BirdLife International 2000).

The wattled curassow is restricted to humid *varzea* forests in the tropical lowlands (Del Hoyo *et al*. 1994) below altitudes of 300m (Birdlife International 2000) and is strongly associated with flooded and riparian forest. The global population is estimated to be between 2500 and 10000 and decreasing (Birdlife International 2000, IUCN). The last population of the wattled curassow in Bolivia is found along the Rio Negro.

The Solitary eagle has a wide distribution, and is found throughout the neotropics from western Mexico and the northwest of Argentina. It is a species of humid, dense wooded foothills and other tropical and subtropical premontane and humid montane forest, and has an altitudinal range of between 600 and 2,200 m. Despite its wide distribution, it is generally rare and localized. There are a number of serious threats such as deforestation, disturbance and hunting (Birdlife International 2000).

DISCUSSION

The bird diversity recorded during this survey was lower than previous inventories recorded along the Rio Negro. The previous inventories recorded 98 species and 115 species at two different sites along the Rio Negro at the beginning of the wet season. Our finding of 85 species is not considerably lower. The lower number of species recorded during this survey could be

explained by the fact that our survey was conducted during the dry season, as river levels receded, some species may have moved to different areas. Another explanation for the lower number of birds recorded was the difficulty in identifying the smaller species which inhabited dense undergrowth. However, it is recommended that a more thorough bird inventory be carried out in order to prepare a full and comprehensive bird list for the area.

Bird diversity in this region of Bolivia tends to be lower than typical Amazonian rainforest as the Rio Negro is situated in varzea forest habitat. During the wet season, the area floods and during the dry season, the river recedes. This leads to the seasonality affecting food availability and so some species may respond to this by migrating to different areas. This aspect of the habitat suggests that the Rio Negro is of particular importance for the breeding success of many bird species since they rely on this type of habitat at particular times of the year. On a downside though, a consequence of this type of behaviour from these bird species is that destruction of other surrounding areas also critical to the lifestyle of these species, could cause major population declines. It is slightly worrying, therefore, to imagine that protection of the Rio Negro does not necessarily mean protection of its species. This indicates that a much greater level of protection must be established in a much wider area in order that the future of these species is secured. Future studies of these types of habitat and the consequences it has for conservation must be carried out so that sensible management plans based on good scientific work can be implemented.

Conducting biological inventories such as this is an important step in conservation as it enables efficient and effective use of resources in conserving biological diversity.
Biological inventories provide essential baseline data. Firstly, they facilitate the instigation of conservation priorities and the establishment of well-designed protected area networks.
Secondly, they act as a snapshot of environmental conditions against which to measure future change. The science that is provided here and in other similar studies must therefore be taken to the next level and used effectively to protect and sustain global biodiversity before it is lost forever.

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Appendix 1 – **Bird species list of the Rio Negro**

Nombre cientifico	**Nombre en ingles**	**Frecuencia**
Xiphorhynchus guttatus	Buff-throated Woodcreepe	
Thryothorus guarayanus	Fawn-breasted Wren	
Monasa nigrifron	Black-fronted Nunb	
Piaya cayana	Squirrel Cuckoo	
Trogon melanurus	Black-tailed Trogon	
Crypturellus undulatus	Undulated Tinamou	
Pipile cumanensis	Blue-throated Piping-Guan	
Mitu tuberosa	Razor-billed Curassow	
Trogon curucui	Blue-crowned	
Momotus momota	Blue-crowned Motmo	
Myrmeciza atrotho	Black-throated Antbird	
Tolmomyias sulphures	Yellow-olive Flycatcher	
Cacicus cela	Yellow-rumped Cacique	
Crax globulosa	Wattled Curassow	
Columba speciosa	Scaled Pigeon	
Sittasomus griseica	Olivaceous Woodcreeper	
Myiarchus tube	Dusky-capped Flycatcher	
Eucometis penicillata	Gray-headed Tanager	
Psarocolius decumanus	Crested Oropendola	
Penelope jacqua	Spix's Guan	
Leucopternis schistacea	Slate-colored Hawk	
Leptotila rufaxilla	Gray-fronted Dove	
Opisthocomus hoazin	Hoatzin	
Piculus leucolaemus	White-throated Wood	
Celeus torquatus	Ringed Woodpecker	
Dryocopus lineatus	Lineated Woodpecker	
Taraba major	Great Antshrike	
Myrmotherula multo	Amazonian Streaked-Antwren	
Phlegopsis nigromaculata	Black-spotted Bare-eye	
Attila bolivianus	Dull-capped Attila	
Neopelma sulphureiventer	Sulphur-bellied Tyrant-M	
Tachyphonus luctuosus	White-shouldered Tanag	

Aramides cajanea		
