Bird Conservation International (2000) 10:255–275. © BirdLife International 2000

The status and conservation of the Blue-Throated Macaw *Ara glaucogularis*

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Summary

The conservation status of the Blue-throated Macaw *Ara glaucogularis*, a Bolivian endemic, is assessed using the most recent information available. The known range of the species is patchily distributed within an 8,600 km^2 area of lowland savanna–forest habitat in the Beni department, under private ownership for cattle ranching, which is the main form of land use in the region. Population surveys of the Blue-throated Macaw revealed this species to exist in very low numbers. The immediate threat to the species is illegal trapping for the live bird trade. Effects of cattle grazing and savanna burning may modify habitat characteristics, but there is no direct evidence suggesting that these factors negatively influence the ecological requirements of *Ara glaucogularis*. The species is highly associated with the *Attalea phalerata* palm, which it uses for feeding and nesting. Current conservation efforts include: population and distribution surveys and assessment of habitat requirements; environmental awareness targeted at landowners and ranch personnel; collaboration with subnational and central government bodies; and development of strategies to curtail parrot trafficking activities. Recommendations for the long-term conservation of the species include increasing the involvement of landowners to strengthen protection for wild macaws; working with the Bolivian government on strategies to curb macaw trafficking; increasing environmental education activities with local inhabitants; basic research on breeding requirements and limitations of wild Blue-throated Macaws; and investigating the application of private reserves to the Blue-throated Macaw range.

Introduction

The Blue-throated Macaw *Ara glaucogularis* (Figures 1 and 2) is a globally threatened Bolivian endemic, listed on Appendix I of CITES as endangered (Collar *et al.* 1992, 1994). The remaining wild population of *A. glaucogularis* has been the subject of an ongoing project since 1993, conducted by Asociación Armonía, Bolivian Partner of BirdLife International. Immediately following the recent scientific redocumentation of a small subpopulation of *A. glaucogularis* in the wild in 1992 (Jordan and Munn 1993), Asociación Armonía began an intensive population and distribution survey of the species. This has developed into a complex conservation programme (Duffield and Hesse 1997), comprising not only routine population surveys and searches for additional Blue-throated

Figure 1. *Ara glaucogularis* in wild, Beni Department, Bolivia (1995, Rob Childs).

Macaw sites, but also components of environmental education, habitat investigation, and outreach with local and subnational bodies. The existing *A. glaucogularis* programme focuses on direct conservation action aiming at providing long-term solutions. This paper sets out to review the status of *A. glaucogularis* and describe the current and potential strategies of Asociación Armonía's *in situ* conservation plan for this species.

Figure 2. *Ara glaucogularis* in captivity, Santa Cruz zoo, Bolivia (Luiz Claudio Marigo, 1997). Over 200 individuals are maintained in captivity, primarily in Europe and the U.S.A.

The Blue-throated Macaw in context: distribution, population and habitat

Early descriptions of the Blue-throated Macaw's distribution including localities in southern Bolivia (Lanning 1982, unpublished report for BirdLife International, U.K., and Wildlife Conservation Society, U.S.A.), Paraguay and Argentina are

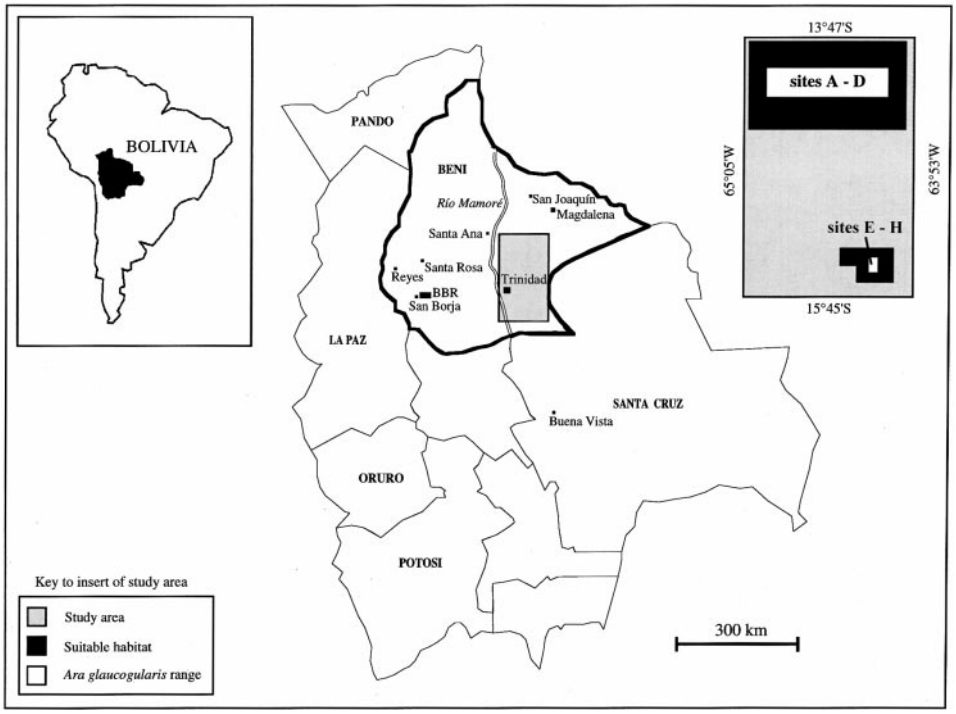

Figure 3. Map of Bolivia showing the distribution of *Ara glaucogularis* in the eastern Beni department (shaded area). The locations of major towns of significance are given. BBR, Beni Biosphere Reserve. Insert gives schematic details of the study area, including general positions of the north and south areas of suitable habitat, and the *Ara glaucogularis* range that includes sites A–H.

believed to originate from confused identifications with the Blue and Yellow Macaw *Ara ararauna*, due to morphological similarities (Forshaw, 1989) and the confusing synonymous nomenclature of *Ara caninde* used for both *A. ararauna* and *A. glaucogularis* (Ingels *et al.* 1981, Collar *et al.* 1992, Yamashita and Machado de Barros 1997).

A 10 week survey in 1992 of the Beni Biosphere Reserve (*El Porvenir* field station 14°50′S 66°17′W), situated 180 km west of the established *A. glaucogularis* range (Figure 3), provided no evidence of this species' occurrence (White, Duffield, Hesse *et al.* 1993, unpubl. report for BirdLife International and Fauna and Flora International, U.K., Brace *et al.* 1997), despite favourable habitat (G.E.D. and A.J.H. pers. obs., Miranda *et al.* 1991). Two specimens were collected in the 1920s from the north-western region of Santa Cruz department, around the town of Buena Vista (17°28′S 63°37′W, Figure 3, Ingels *et al.* 1981), but these may have been incorrectly placed. The birds may have been escapees or some confusion of their true origin may have arisen given that the locality was an important staging post for the bird trade (Yamashita and Machado de Barros 1997). This is confirmed by the different habitat type of this location to that associated with *A. glaucogularis* in its present range (Gemuseus and Sagot 1996). The available literature suggests that historically *A. glaucogularis* was restricted to the Bolivian

departments of Beni and maybe north-western Santa Cruz (Ingels *et al.* 1981, Collar *et al.* 1992, Yamashita and Machado de Barros 1997).

Early reports on the population size of *A. glaucogularis* based on information from local people in 1981 and 1982 yielded estimations ranging from 500 to 1,000 individuals (Lanning 1982 unpubl. report). Since its rediscovery in the wild in 1992, independent surveys have revealed consistently low numbers of observed birds. Based upon field surveys in 1993 and 1994, accounting for observed numbers of *A. glaucogularis* and measurements of suitable habitat area, Yamashita and Machado de Barros (1997) obtained an estimated population size of 200 macaws.

The Blue-throated Macaw inhabits elevated forest fragments surrounded by savannas (200–300 m above sea level). Large areas of the Beni savanna are subjected to several months of flooding (primarily October to May), limiting human settlement and land use. The main commercial activity of the Beni department is large-scale cattle ranching, introduced in 1682 (Palau and Saiz 1992, Hanagarth 1993), replacing pre-Colombian agricultural systems of raising land into artificial mounds (Denevan 1980, Erickson 1995, Mann, 2000).

Methods

Distribution and population studies were conducted from 1993 to the present, with a total survey effort of 229 field days (April to December). Over-flights in a small Cessna plane enabled prior reconnaissance of habitat type, and Global Positioning System (G.P.S.) fixes from the aircraft navigation system were used in conjunction with maps to record broad habitat transitions, and to plot each location visited. Terrain was explored on foot, horseback or with a 4-wheel drive vehicle using linear transects from known, reported, or suspected Blue-throated Macaw sites. Due to the open terrain with which *A. glaucogularis* is associated and because of its distinctive call, linear transects provided a range of visual and acoustic observation of 500 m on either side. Information was collected from ranch people and personally verified whenever possible, and in coordination with the landowners, local people were employed as guides. All sites visited were systematically recorded regardless of whether the macaw was known or found. Information recorded included: name of the investigator(s), date, site name and coordinates, means of access, and data pertaining to the Blue-throated Macaw (observed or reported presence/absence, numbers observed, notes on activity). For inhabited sites the name and town address of the landowner and ranch foreman, and radio frequency of the settlement were recorded. Locations not visited were initially recorded with details from local people, and later visited to confirm the information given. Visual observations were made using binoculars and a telescope (× 20 power). Position data was recorded using a Trimble G.P.S. and military maps (scale 1:100,000). Communication in the field was assisted using ''walkie talkie'' portable radios (range limit: 5 km).

The extreme dispersion and rarity of *A. glaucogularis* precludes the use of any standard sampling techniques to effect population counts. It was decided not to attempt any form of mark–recapture methods for estimating population size on account of the extreme fragility of the *A. glaucogularis* population. An

alternative method, to count individual macaws as precisely as possible, was used that also minimized observer impact. Macaw counts at any given location were, whenever possible, conducted simultaneously by two or more observers using portable radios. Site maps drawn from aerial photographs were used to record graphically individual macaws' movements (times and directions) at each location, on a daily basis for the duration of each survey effort. Proportional differences in tail feather size and in shape often provided a natural means of distinguishing individuals and pairs within a given location during the course of a given survey effort. All effort was made to distinguish individual birds as much as possible, using natural characteristics, so as to ensure accurate population counts.

Broad habitat features were routinely documented during fieldwork at all sites. In addition, a botanical survey was carried out at site A (Figure 3) that characterized the main features of the forest island and savanna habitat. Data were collected on forest island composition and structure, and species abundance for trees most associated with *A. glaucogularis* was evaluated. In habitat judged to be favourable for *A. glaucogularis* particular attention was paid to the relative abundance of the three main palm species (*Attalea phalerata*, *Acrocomia aculeata*, *Copernicia alba*), the composition of forest islands in terms of dominant vegetation and canopy-emergent trees, the fruiting trees present, the availability of potential nesting sites, and the type of savanna (i.e. degree of flooding).

Observations of *A. glaucogularis* behaviour were collected non-systematically as an addition to the fieldwork focusing on population and distributions (recorded in Hesse and Jammes 1993, Hesse 1996, 1998, unpublished reports for Asociación Armonía, BirdLife International, U.K., and Loro Parque Fundación, Tenerife).

Information pertaining to local trafficking activities was sought during periods of fieldwork, and in the cities of Trinidad (Beni department capital) and Santa Cruz (Santa Cruz department capital and major lowland Bolivian city).

Environmental awareness with landowners and local residents was undertaken in the *A. glaucogularis* range, but was incorporated as part of the other aspects of fieldwork, rather than as a distinct activity. Thus all contact with landowners, representing the sector of society with power to take direct and immediate action in favour of *A. glaucogularis*, is considered a form of environmental awareness. ''Educational outreach'' included informal contact with local residents at cattle outposts or ranches that live closest to the Blue-throated Macaw. This outreach was carefully conducted in a gradual discretionary way so as to minimize outsiders' impact on local lifestyle.

Study sites

Ara glaucogularis sites are defined as discrete locations where Blue-throated Macaws are routinely observed, and are classified as sites A–H. Site coordinates, names and detailed descriptions are withheld for the protection of these populations. Sites E–H are grouped because they are close together (maximum distance between sites is 10 km), and macaws seen there are likely to be from the same subpopulation.

Table 1. *Ara glaucogularis (A.g.)* range information (1993–1999)

	Area explored by air and by land (km^2)	Estimated suitable habitat (km^2)	Suitable habitat surveyed by land (km^2)	No. of *A.g.* sites	*A.g.* range (km^2)
North	36,689	7,831	371	4	2,128
South	11,289	826	90	4	380
Total	47,978	8,657	461	8	2,508

Results and Discussion

Distribution and range

Jordan and Munn (1993) discovered a small number of *A. glaucogularis* at a locality in central Beni which provided the starting point for expanding the species range (location B in current study). Between 1993 and 1999 a total area of 47,978 km^2, east of the Mamoré River and between the southern limits of the Beni department and the northern border with Brazil, was explored with over-flights and by land in search of additional Blue-throated Macaw sites (Figure 3). Terrestrial surveys using linear transects totalled 1,315 km^2. A total of 273 G.P.S. points were taken from aerial and ground observations, documenting all sites visited as well as points of interest in terms of forest islands and habitat type. Aerial observations revealed that the extent of suitable habitat for *A. glaucogularis* to the east of the Mamoré River is distributed in two areas in the north and south of the survey zone (latitude 13°47′ to 15°45′ south, and longitude 63°53′ to 65°05′ west, Figure 3). These coordinates comprise an area of approximately 29,000 km^2. Within the total area explored terrestrially, 461 km^2 were intensively surveyed in these two broad areas of suitable habitat, focusing on locations known, reported, or suspected to harbour Blue-throated Macaws. The latitude:longitude coordinates of sites A, B, and D, and sites E, F and H, define the limits of the northern and southern ranges of *A. glaucogularis*, respectively (Table 1, Figure 3). Sites A–D were discovered with the help of a an ex-macaw trapper already familiar with these locations, whereas sites E–H in the southern range area were the result of systematic surveying guided by information from local ranch residents.

The *A. glaucogularis* range is defined as the total area within which the species occurs. (Table 1) as in 'species occurs (Table 1)'. Range area was calculated from the G.P.S. coordinates of the sites representing the geographical limits of Blue-throated Macaw encounters. Suitable habitat refers to areas presenting the savanna–forest fragment formation associated with *A. glaucogularis*. Non-suitable habitat was defined as continuous and gallery forest, marshland, areas close to large human settlements (villages and towns), and open savanna without forest islands.

Information gathered from local people and landowners throughout the study period was consistent in negating the current presence of the species to the west of the Mamoré River. Aerial habitat observations do not support the suggestion made by Lanning (1982, unpubl. report) that *A. glaucogularis* was to be found south of the Beni border in the extreme north-west of the neighbouring Santa Cruz department, on account of the presence of a broad fringe of continuous gallery forest, a habitat not associated with this species.

Although the limited distribution of *A. glaucogularis* may be a typical character-

istic of medium-sized macaws (Yamashita and Machado de Barros 1997), interviews with ex-bird trappers (A.J.H. pers. obs.) suggest that the species's range was historically much broader and that its present restriction would at least in part be due to extraction for the bird trade: whilst no Blue-throated Macaws are presently located in the south-western region of the Beni Department around Santa Rosa, they were present prior to the intense bird trafficking activity of the late 1970s and early 1980s. This finding is supported by early reports from bird traders and trappers (Lanning 1982 unpubl. report, Riviere *et al.* 1986). The fact that this locality is situated some 225 km to the west of the current known western range limit of *A. glaucogularis* (Figure 3) further suggests that the *A. glaucogularis* range is a fragmented remnant of an originally larger area.

Population

Table 2 summarizes census results for *A. glaucogularis* between 1993 and 1999, and clearly indicates an extremely low population. The total *A. glaucogularis* population has previously been estimated by extrapolating the number of birds observed within a given survey area to the total area of suitable habitat (Yamashita and Machado de Barros 1997). Using this approach, extrapolation of the most recent total count of 36 individuals observed in the species range to the total area of suitable habitat gives a total population estimate of 120 Blue-throated Macaws. There may, however, be limitations in using suitable habitat area as a parameter to estimate total population size, given that the species is not uniformly distributed, perhaps partly as a result of the unnatural reduction in population density induced by selective bird trapping. Caution must also be exercised in using the results presented in Table 2 to make comparisons across years and between different sites, given that counts at each site were carried out as independent surveys and reflect seasonal variations in numbers of macaws present, or variation in surveying effort. As such, the data may serve as an indication of the consistently low numbers of *A. glaucogularis*, but cannot be used to draw definite conclusions on spatial or temporal variation in the abundance of this species. In the particular case of Location A, however, interviews with local people suggest that the apparent decline in macaw numbers at this site, situated on a main road leading to the Brazilian border to the north, may be a direct indication of trafficking activity.

Despite the current limitations in census data, there is nevertheless sufficient evidence from the present study and that of Yamashita and Machado de Barros (1997) to show the critically low density of *A. glaucogularis*, thus confirming the Endangered status of this species (Collar *et al.* 1994).

Working with local people and authorities

Landowners The eight *A. glaucogularis* sites are situated on lands belonging to eight different owners, of which two are institutions (a cattle ranching company and the Bolivian military). Contact has been established at all sites. Initial contacts were reinforced at every opportunity with informal conversations explaining the progress of the conservation project and teaching materials pro-

Table 2. Highest Blue-throated Macaw counts (months April–December)

Sites	1993	1995	1996	1997–98
A	—	23	13	11
B	11	6	6	5
C	—	4	2	3
D	5	2	—	—
E–H	6	—	—	17
Total	24	35	21	36

— not surveyed or non-representative survey.

duced by Asociación Armonía (information bulletins, a conservation magazine and posters depicting various macaw species) were given to landowners along with full contact details. Despite initial suspicions owners and/or their staff at all sites changed their attitude to one of collaboration, thus granting access and assistance to researchers.

Following initial contact made in 1996 with the Federación de Ganaderos del Beni y Pando (FEGABENI, the Federation of Cattle Ranchers of the Beni), a series of meetings and correspondence led to the synthesis of a formal agreement document between this authority and Asociación Armonía. This was distributed with project posters to 100 landowners during a cattle ranching congress in October 1997. The formal partnership between the conservation project and FEGABENI has enhanced landowners' awareness of the Blue-throated Macaw and its status, and heightened the local profile of the project. Undoubtedly, the landowner agreement is a fundamental starting point for a long-term, self-sustaining conservation strategy for *A. glaucogularis*.

Environmental awareness and local contact In the surveyed area, verbal communication about the Blue-throated Macaw and the conservation project was established with the inhabitants of 43 different locations, the majority of which were cattle ranching outposts, occupied by one or more employee families. Photocopies of black and white drawings of *A. glaucogularis* with it's local name were distributed to children along with boxes of colour pencils to complement talks focusing on the macaw. Copies of the Asociación Armonía magazine that focuses on birds and conservation and included material on the Blue-throated Macaw were also given to children and adults in rural areas. Observations of *A. glaucogularis* and other birds were often made accompanied by local children. Information was exchanged with adults and children at every available opportunity, and researchers explained the objectives of the conservation project and local people often responded with their knowledge on local wildlife.

An informal approach to environmental education has proved more applicable in rural Beni where the population is small. However, the presence of 20 families and a school teacher at site A justified a pilot education programme in 1996. Activities developed with school children included bird watching, demonstration of mist-netting and in-the-hand identification techniques, and creative expression (Figure 4). Basic classroom materials and ecology encyclopaedias were donated to the school as part of the outreach programme.

Figure 4. Environmental education with rural school children, Beni department, Bolivia (1996, A.J.H.).

Meetings with the newly appointed wildlife authority of the Beni (Unidad Deptal. de Recursos Naturales y Medio Ambiente, Prefectura y Comandancia del Beni) were initiated in 1998. This body was informed of the status of the Blue-throated Macaw and the conservation objectives of the Asociación Armonía project. Awareness of the Blue-throated Macaw as a distinct species from the more common sympatric Blue and Yellow Macaw, and vigilance of local wildlife authorities along main roads and on the border post with Santa Cruz department, is an important complement to working with landowners for the local protection of *A. glaucogularis*.

Macaw trafficking: awareness and information During fieldwork conversations with local people gathered information on the advent or extent of local trapping of Blue-throated Macaws. This information suggested that *A. glaucogularis* is most exposed to trapping in two areas that are close to a main road. Identified trappers were reported to the Beni wildlife authorities, FEGABENI and the respective owners of the areas. Four of these landowners said that they would take active steps to limit the trapping pressure on their lands, but there has been no evaluation of this potential action.

A major outlet for Blue-throated Macaws and other CITES-listed Psittacines from Bolivia continues to be via the laundering of wild-caught birds through certain recreational and tourist institutions. Discussions have been held with the Bolivian government (since March 1998) proposing a nationwide scheme aiming to register, mark and monitor CITES Appendix I psittacines held as exhibits in

Bolivian public institutions. This strategy is still being developed at the time of writing this paper.

The internal demand for Blue-throated Macaws is very difficult to quantify. Conversations with people in ranches, villages and towns show that consumers within the Beni department are few and always local to the locations inhabited by the macaw itself. In such cases *A. glaucogularis* is taken as a pet rather than as a commercial resource. Five such cases were found concerning a total of six macaws where individuals, usually juvenile, have been taken from the wild.

Habitat and ecology

Results obtained at Location A (E. Guttierez 1997, unpubl. report for Asociación Armonía) showed that the general habitat structure ranged from permanently inundated swamp to permanently dry elevated forest islands, a formation consistent with previous habitat analysis carried out in the *A. glaucogularis* range. (Yamashita and Machado de Barros 1997).

Observations at all the *A. glaucogularis* study sites confirm previous findings that the Blue-throated Macaw is highly associated with the *A. phalerata* palm, which offers both nutrition and nest sites (Jordon and Munn 1993, Brace *et al*. 1995, Boussekey et al. 1997, Yamashita and Machado de Barros 1997). *A. phalerata* is a dominant species in most savanna forest fragments, and indeed is known to colonize islands highly impacted by cattle due to its superior resistance over other, less robust plants (Killeen et al. 1993). In general it is known to be continuously fruit-productive, although there is some geographical variation (Killeen *et al*. 1993, Yamashita and Machado de Barros 1997). Non-palm species which tended to dominate the highest central part of forest islands and on which *A. glaucogularis* was seen to perch frequently were *Ficus trigona* (Moraceae) and, at site A where the Amazonian influence is strongest, *Calycophyllum spruceanum* (Rubiaceae). Forest islands contained different proportions of common pioneer species such as *Triplaris americana* (Polygonaceae) and *Genipa americana* (Rubiaceae), an indication of different levels of intervention caused by cattle (E. Gutierrez 1997 unpubl. report).

The association between the Blue-throated Macaw and the *A. phalerata* palm supports the hypothesis that the single outstanding ecological requirement of *A. glaucogularis* is the presence of forest islands or fragments containing a healthy population of these palms. Field observations confirm that the Blue-throated Macaw's main food is the mesocarp of the *A. phalerata* palm, which is high in content of lipids and certain minerals (Hiane *et al.* 1992a,b). This suggests that *A. glaucogularis* is a mesocarp-eater rather than a specialist nut-cracker (Yamashita and Machado de Barros 1997). *A. glaucogularis* has also been observed feeding on the fruit of the *A. aculeata* palm (Yamashita and Machado de Barros 1997, A.J.H. pers. obs., B. Whitney verbally 1997). The Blue-throated Macaw is also known to make use of the *A. aculeata* palm for nesting purposes (Jordan and Munn 1993, Boussekey *et al.* 1997) but there is no evidence that *A. glaucogularis* is consistently associated with this palm species in the way that it is with *A. phalerata*.

Despite the important association between *A. glaucogularis* and *A. phalerata*, the fact that the latter is widely distributed whereas the macaw occupies only a small

fraction of the total suitable habitat precludes this palm species being a reliable indicator of Blue-throated Macaw presence. Detailed discussions of forest island structure and its significance to *A. glaucogularis* can be found in Yamashita and Machado de Barros (1997).

Preliminary observations of the availability of potential nest sites for *A. glaucogularis* indicate variations between different areas. Competition for nesting resources from sympatric macaw species could be an important component regulating the population of *A. glaucogularis*. Such competition (intra- and interspecific) has been reported between *A. ararauna, Ara chloroptera* and *Ara macao* macaws in Manu and Tambopata national parks in Peru (Munn, 1992, Nycander *et al*. 1995). In the *A. glaucogularis* range both *A. ararauna* and, to a lesser extent, *A. chloroptera*, outnumber *A. glaucogularis* in their shared habitat (Jordan and Munn 1993), and since the former are both larger species than the Blue-throated Macaw (approximately 1,000–1,300 g compared with 600–800 g, Low 1990, Schubot *et al.* 1992), it is likely that they would win in contests for access to limited resources. Systematic data collection in this direction is considered a priority for future scientific research.

Conservation issues

Habitat alteration

Forest island habitat is altered by the presence of cattle that affects the growth of tree seedlings through trampling and grazing, and by the associated practice of annually burning savanna to improve pasture (Furley *et al.* 1992, Hanagarth 1993, Hemming 1994, Johnson *et al.* 1997, Comiskey 1999).

Despite these habitat alterations, the presence of cattle is unlikely to have any immediate impact on the current Blue-throated Macaw population. The abundance of *A. phalerata* palms as a major source of nutrition for the Blue-throated Macaw indicates that food is unlikely to be a limiting factor (Yamashita and Machado de Barros 1997, A.J.H. and G.E.D. pers. obs.). The abundance of *A. phalerata* and *A. aculeata* palms would in theory also ensure an adequate supply of potential nesting sites for *A. glaucogularis*, although the mere presence of these palms may not guarantee optimal breeding conditions. In addition, the annual burning of grasslands may preferentially increase the proportion of *A. aculeata* and *A. phalerata* palms within forest islands because of their fire-resistant qualities (Comiskey 1999, G.E.D. and A.J.H. pers. obs.) and thus benefit the Blue-throated Macaw population by increasing food and nesting sites.

Long-term trampling and grazing by cattle may affect the recruitment and growth of young palms, leading to a reduced overall palm productivity for a given forest island (Yamashita and Machado de Barros 1997, Johnson *et al.* 1997). However, the poor suitability of land in the Beni department for intensive cultivation effectively affords protection for savanna habitats and native fauna. The fact that cattle ranching has been the major economic activity in the savannas of Beni for centuries means that the habitat and its fauna have not been subjected to radical and immediate alteration, conditions in which bird communities are able to persist in the face of long-term human induced changes through progressive adaptation (Stotz *et al.* 1996).

Wild bird trade

The potential of the wild-bird trade to quickly destroy the last remaining wild population of *A. glaucogularis* is a serious issue warranting immediate attention. Trafficking is a threat to many parrot species (Collar and Juniper 1992), which are particularly vulnerable to over-harvesting due to their low reproductive rates (Bucher 1992, Munn 1992).

The highest estimated figure for international trade in *A. glaucogularis* between 1981 and 1992 is 390 birds, the majority of which were exported between 1981 and 1984 (Lanning 1982 unpubl. report, Nilsson 1985, Riviere *et al.* 1986, Thomsen *et al.* 1992). Prior to 1980 few *A. glaucogularis* were available on the international market (Low 1994, Schubot *et al.* 1992). However, these exportation figures are likely to be an underestimate: Yamashita and Machado de Barros (1997) suggest that a figure of 1200 may be more accurate, based on discrepancies between CITES permits and quarantine data for the U.S.A. and the probability of undocumented exportations to other parts of the world.

The intensity of trade in Blue-throated Macaws during the late 1970s and early 1980s is likely to be the main factor responsible for the current low population numbers. International trade in *A. glaucogularis* was prohibited in 1983 (WTMU 1988), and exportation of live animals from Bolivia was banned in 1984 (supported by Supreme Decree in 1986, thereby extending the ban indefinitely). However, despite the ban and the fact that Bolivia is a signatory to major international treaties such as CITES and the 1992 Biodiversity Convention (Marconi 1992), small-scale trafficking of psittacines continues. In addition, a limitation in international control mechanisms is that neighbouring countries with fewer export bans serve to filter out birds from the wild populations (Collar and Juniper 1992). This appears to be currently true for *A. glaucogularis*, with birds being exported through Argentina and Brazil (Jordan and Munn 1993, Yamashita and Machado de Barros 1997, M. Galetti *in litt.* 1999). This was reflected in trade figures of parrots exported from Argentina that peaked just after Bolivia's 1984 export ban (Thomsen and Mulliken 1992).

Much of the confusion in assessing levels of illegal exploitation stems from the fact that international trade in wild parrots is often stimulated by undocumented internal markets, which do not appear in official trade statistics (Snyder *et al.* 1992). In most cases the internal demand for parrots in a country like Bolivia is restricted to relatively common, native species (e.g. *Amazona* spp., small *Ara* spp.), and is closely linked to cultural tradition (Beissinger 1994).

Despite active field studies promoting local protection of *A. glaucogularis*, wild specimens of this species still occasionally filter through to internal and presumably also international trafficking circles. Where most advancement is required in a situation as serious as that of *A. glaucogularis* is in ensuring its protection in the wild, whilst preventing wild-caught birds appearing on internal and international markets for the pet trade.

Potential Conservation Strategies

The serious situation faced by *A. glaucogularis* in Bolivia is echoed for many species throughout tropical America. For the variety of psittacines threatened

either by habitat destruction, illegal trade or both, different solutions have been implemented (Beissinger and Snyder 1992). Below we briefly discuss the feasibility of recognized conservation approaches for application to the *A. glaucogularis* scenario.

Ecotourism

Carefully designed ecological tourism where local people have an active input and an equitable share in economic returns can be an appropriate strategy for the conservation of large macaws (Munn 1998). This approach seems to be successful in places such as Manu and Tambopata national parks in Peru, largely because of important economic returns from tourists who are able to admire macaws from healthy populations flocked in large concentrations, for example, at clay licks (Munn 1992, Nycander *et al.* 1995).

In contrast, the particular case of *A. glaucogularis* shows certain conditions that preclude introducing ecotourism on a grand scale or in an intensive manner. The main concern is that *A. glaucogularis* exists only in unprotected areas, and its reduced and fragmented population is extremely sensitive to the disturbance caused by focused human presence. This is especially the case during the breeding season when even a single observer can be a source of disturbance (A.J.H. pers. obs.).

The argument that tourism can provide an alternative source of livelihood for local people is in this case unfounded. *A. glaucogularis* exists entirely on private lands and the local people who are most in contact with the Blue-throated Macaw are ranch employees who have no land tenure and who in many cases are a transient workforce. These conditions mean that only the landowners would profit from ecotourism on private lands and not the employees or other communities from nearby towns and villages. It is these communities that are the most likely to create pressure on wild Blue-throated Macaws by trapping. Therefore, ecotourism designed to provide extra income to landowners without taking into account the other relevant communities does not address the correct target group for it to qualify as an economic alternative to the extractive exploitation of *A. glaucogularis*.

Furthermore, tourism cannot be justified as an opportunity–cost activity compensating lost cattle ranching benefits since there is no need to interfere with this form of land use for the conservation plan of *A. glaucogularis*. Together with the fact that some landowners resent the disruption of normal cattle ranching activities caused by the presence of strangers, especially when ranch hands are tempted with extra cash and recruited by visitors as ad hoc guides (A.J.H. pers. obs.), this means that the economic incentive associated with tourism is of relatively little consequence when applied to the case of *A. glaucogularis*.

Ecotourism applied to the Blue-throated Macaw can only be of conservation value if the primary goal is to instill greater awareness and pride in landowners as the guardians of the last remaining wild *A. glaucogularis*. In this context tourism should be restricted to areas controlled by conservation-sensitive landowners in collaboration with a conservation group. Ecotourism imposed by organizations from outside the Beni department with little or no involvement of local bodies and catering only for foreigners, has little value. Given that tourism high-

lighting this species is increasingly attracting the attention of foreign tour operators and entrepreneurs and travel agents from Bolivian cities, the authors recommend that a study be implemented within the immediate future to determine the extent to which *A. glaucogularis* is being used as an attraction, and under what conditions.

Use of nest boxes to increase reproductive productivity

The use of artificial nests to encourage breeding is a management technique employed with varying degrees of success with parrots and other birds (Beissinger and Bucher 1992, Nycander *et al.* 1995). This strategy could be used to increase the reproduction rates of *A. glaucogularis*, which in some locations may be affected by inter-specific competition for nest sites (Brace *et al.* 1995, Boussekey *et al.* 1997, Duffield and Hesse 1997). Reproductive success of macaws is based on the quality of the sites as well as their availability (Beissinger and Bucher 1992, Guedes and Harper 1995, Nycander *et al.* 1995). A variable but significant proportion of egg and chick mortality in the natural nests of various species of large macaw is associated with predator and ectoparasite activity (Guedes and Harper 1995, Nycander *et al.* 1995), and application of carefully designed and maintained nest boxes has potential in reducing such losses (Beissinger and Bucher 1992, Nycander *et al.* 1995).

Consideration has been given to starting an artificial nest-box programme to stimulate the reproduction of *A. glaucogularis*, at locations where there are few available nest sites. Artificial nest boxes for *A. glaucogularis* should use either wooden or PVC pipe constructions (Nycander *et al.* 1995), or trunk segments of the locally abundant *A. aculeata* palm. Nest management experiments should be carried out on lands that are suitably isolated from human disturbance, and in collaboration with the landowner and local ranch employees.

Given that habitat appears not to be a limiting factor for this species, however, it cannot be assumed without further investigation that the low number of wild *A. glaucogularis* is caused only by a lack of nest sites. With the shortage of information on the natural history of *A. glaucogularis*, the priority is to identify the natural breeding requirements of the species in the wild and how these may be met with minimal manipulation.

Private reserves

The Blue-throated Macaw exists exclusively on private lands outside Bolivia's protected areas network and this reality suggests the potential application of private reserves as a conservation strategy for this species. This approach has been used in Paraguay, where much of the land is within private ownership (A. Madroño *in litt.* 1999, Fundación Moisés Bertoni *http://www.mbertoni.org.py*). Private reserves in the low Chaco of Paraguay, supporting natural grasslands and forest islands, and where cattle ranching is a prominent activity, may serve as a model for the *A. glaucogularis* scenario.

Private reserves highlighting the Blue-throated Macaw as a flagship species would also ensure the protection of key habitats within the forest island, savanna, and wetland ecosystems, which support over 200 species of birds (Hilty

1994, J.M. Guerrero and A.J.H. pers. obs.), more than 20 species of large and medium-sized mammals (A.J.H. pers. obs.), and other important taxa such as the endangered Black Caiman (Ergueta and de Morales 1996).

Local pride

Practical conservation achieved through encouraging personal concern for the environment in local people is exemplified by the work conducted by Paul Butler and the RARE Centre for Tropical Bird Conservation in the islands of the eastern Caribbean (Butler 1992).

Despite obvious limitations in applying experiences from Butler's work in small island states to the department of Beni, the authors maintain that pride can be used in the situation of *A. glaucogularis*, albeit on a different scale and with important modifications. The Blue-throated Macaw is so little known even in the Beni that the potential audience is limited to those people who own the lands upon which the species actually exists. At this level, the main factor evoking pride for the macaw is the fact that it is unique to the Beni department. Most landowners, native either to the Beni or to the neighbouring Santa Cruz department, are potentially receptive to personally identifying with the Blue-throated Macaw.

Captive breeding and reintroduction

There is general agreement among aviculturalists that *A. glaucogularis* reproduces effectively in captivity (Low 1990, 1994, Kment 1995, R. Wirth *in litt.* 1999) and indeed the captive population five years ago was estimated at more than 200 birds (The Parrot Action Plan, Low 1994). *A. glaucogularis* is being bred in important breeding centres in various different countries (e.g. Riviere *et al.* 1986, Schubot *et al.* 1992, Kment 1995, Sweeney 1995, Mueller and Neumann 1998). Although there is currently no established captive breeding scheme for the Blue-throated Macaw in Bolivia, the authors have upon a number of occasions been challenged to consider the application of this approach for *A. glaucogularis* within this country.

Whilst the important role of captive breeding as a conservation tool for endangered species is not questioned in this paper, it is evident from the available literature that the implementation of this approach requires a complex set of conditions warranting case-specific analysis (Snyder *et al.* 1994, Abramson 1995, Sanz and Grajal 1997).

Before considering the potential benefits of introducing captive bred *A. glaucogularis* to boost the wild population, a procedure identified by many authors as an extreme measure (Derrickson and Snyder 1992, Wiley *et al.* 1992), it is important to recognize that limited information is available on the biology of this species in the wild. Another problem with captive breeding *A. glaucogularis* in Bolivia is that little would be gained if macaw trafficking is left unchecked and there continues to be no infrastructure enabling the official control of captive-bred birds. Yet another limitation is the considerable and long-term economic costs of captive breeding facilities (Derrickson and Snyder 1992, D. Waugh *in litt.* 1998).

Given that successful captive breeding of *A. glaucogularis* currently exists in

important collections mainly in Europe and the U.S.A., which have also permitted the compilation of genetic databanks (e.g. Sweeney 1995), and have actively promoted their conservation projects, there is little justification in seeking to duplicate similar breeding efforts in the country of origin, until the appropriate control, supportive and financial conditions are met.

Recuperation centre

Whilst the conditions described above preclude captive breeding in Bolivia as a management technique for *A. glaucogularis*, there is an urgent need for a facility designed to accommodate macaws of this and other species which have been confiscated from internal trafficking routes. In Bolivia, for want of a better solution, all confiscated macaws are currently housed in zoos, which is becoming an unacceptable course of action due to inadequate infrastructure, lack of legislation controlling the origin, identity and housing/health conditions of exhibits, and concerns of trafficking from private institutions. A macaw recuperation centre could provide more adequate conditions to start a national registration system monitoring confiscated and captive Blue-throated Macaws in Bolivia.

Recommendations

Conservation action

- Given the serious and immediate threat posed by the illegal cage bird trade, the most pressing requirement for the survival of wild *A. glaucogularis* is to ensure local protection through the direct recruitment of landowners.
- It is believed that trafficking pressure on *A. glaucogularis* will not be alleviated until there exist legal norms in Bolivia providing a basic means of control over captive macaws. It is therefore imperative to continue working with the Bolivian government towards a more efficient control of the internal movements of parrot trafficking in Bolivia, by means of a scheme for marking, registering, and monitoring captive CITES-listed macaws in this country.
- Environmental education is fundamental to the future conservation of the Blue-throated Macaw and this should be systematically developed to reach children and teachers attending the few rural schools located within the project's area of influence.

Research

- Surveillance of areas of suitable habitat for additional *A. glaucogularis* sites and monitoring of bird populations at identified locations is an ongoing process.
- Comparative investigations need to be conducted between sites and seasons to evaluate differences in the availability of key requirements such as nest sites, and the extent to which these may be limited by competition.
- Although the effect of cattle ranching on *A. glaucogularis* habitat is not considered a cause for immediate concern, further research is required to evalu-

ate the long-term effects of cattle and fire upon the *A. glaucogularis* population to define lasting conservation practices.

- Eggs and nestlings of wild macaws can be lost to ectoparasites and predators (Guedes and Harper 1995, Nycander *et al.* 1995), and thus further study of *A. glaucogularis* should include an assessment of these sources of pressure.

Conclusion

It is hoped that by the implementation of some or all of the discussed conservation strategies, repetition of events experienced by other globally threatened species of macaw can be averted. The most extreme cases are those of the Glaucous Macaw *Anodorhynchus glaucus*, now presumed extinct both in the wild and captivity, and Spix's Macaw *Cyanopsitta spixii*, where only one individual bird remains in the wild (Collar *et al.* 1992). Although the status of *A. glaucogularis* has not reached such a serious situation as that of *A. glaucus* or *C. spixii*, lessons must be learnt from such similar cases and urgent efforts made to prevent further decline of the remaining wild population. Implementing the strategies identified by the conservation programme to immediately provide protection for wild Blue-throated Macaws is the most pressing priority for the survival of this species, and has far reaching implications for the conservation of all Bolivian wildlife.

Acknowledgments

This paper is dedicated to the memory of Paolo Bettella, for his spirit and dedication in facing the daily challenges of nature conservation in Bolivia. Our sincere thanks go to the following individuals for their support at different stages of the project. Mike Parr and David Wege for invaluable help in fund-raising; Laurie Hunter, Yves de Soye, David Waugh and Roland Wirth for their ongoing guidance; Simon Allen, Jesús Guerrero, Bennett Hennessey, Lois Jammes, Peter Kischnick, Gonzalo Navarro, Jonas Nilsson, and Eugenio Stierling for their participation; Rob Childs, David Chivers, Nigel Collar, Erika Cuéllar, James Gilardi, Luiz Claudio Marigo, Dick Meijer, Olivier Morvan, Bret Whitney and Carlos Yamashita for their contribution, advice and guidance; the people of rural Beni for their cooperation and friendship, in particular Don Antonio, Mario Avila, Don Raul and Carlos Veharano; and Lic. Arteaga, Ing. Jaime Cuéllar and Lic Gonzalo Ruíz of FEGABENI for their support. We would like to thank Jim Comiskey, Jonathan Best and Christian Heintzen for their valuable comments on the manuscript, and Tom Stuart for his help in securing bibliography.

The programme of work conducted by Asociación Armonía was supported financially by the following: Loro Parque Fundación, U.S. Fish and WildLife Service, WildLife Conservation Society, American Bird Conservancy, Keith Ewart Charitable Trust, Zoolische Gesellschaft für Arten und Populationsschutz, Ark Foundation, Birds International, British Airways Assisting Conservation, Klinair Environmental Technologies, Cambridge Philosophical Society and Sidney Sussex College, Cambridge. Permission to conduct fieldwork was provided by *Ministerio de Desarrollo Sostenible y Planificación*, La Paz, Bolivia.

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