

# SPECIES ACTION PLAN BLACK-BREASTED PUFFLEG *ERIOCNEMIS NIGRIVESTIS*

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# ■ EXECUTIVE SUMMARY

Black-breasted Puffleg *Eriocnemis nigrivestis* is an enigmatic hummingbird (Aves: Trochilidae) endemic to Ecuador and considered to be Critically Endangered with extinction at both global and national levels. It is restricted to the Central Andean Páramo and Inter-Andean Slopes and Valleys endemic centers, where it is found in high Andean montane forest on two isolated volcanoes and one cordillera in northwestern Ecuador. The majority of observations are from the northwestern slope of Volcán Pichincha, though there was a sighting of a possible female in 1983 from the neighboring Volcán Atacazo. In 2006, a small population was rediscovered in the Cordillera de Toisán above the Íntag valley, a historical locality for the species. According to data from museum specimens, the species historically occurred between 2,440 and 4,725 m. In recent years, most records have been between 2,850 and 3,500 m, with dispersing immatures found as low as 1,700 m. The puffleg's confirmed Extent of Occurrence is estimated at 68 km<sup>2</sup>, and its global population at 250-999 individuals. The expansion of the agricultural frontier, and particularly the establishment of cattle pastures and the felling of montane forest for timber and charcoal production, constitutes the main threat to the species' survival. Its small subpopulations are believed to be suffering ongoing declines due to deforestation within a severely fragmented habitat, and increasingly from the impacts of climate change. This combination of factors qualifies the species as Critically Endangered and justifies the urgency of the actions presented here.

This Action Plan was developed in 2007, a year during which considerable progress was made in the implementation of conservation measures to benefit Black-breasted Puffleg:

- A community and stakeholder outreach program was carried out in Pichincha province. This included eight workshops with representatives of communities, private landowners, NGOs, local and regional governments, and ministries.
- A Local Conservation Group (LCG) was formed to support conservation in the Important Bird Area (IBA) "Mindó and western slopes of Volcán Pichincha", one of the last strongholds of the puffleg. Creation of this LCG will help train local people in fundraising, bookkeeping, project administration, and basic bird monitoring techniques.
- Environmental education materials were produced and distributed, including a booklet for the general public and didactic materials for teachers, allowing them to include topics like the Black-breasted Puffleg and the importance of high-Andean forests for biodiversity conservation and water provision in their school curricula.
- The first standardized bird monitoring program in the range of Black-breasted Puffleg was initiated, providing scientist with the data necessary for the estimation of the hummingbird's and other species' absolute population density and population size.
- Two private reserves, Hacienda Verdecocha and Yanacocha Reserve, together protecting more than 2,200 ha of the species' key habitat in Pichincha, continued their conservation efforts and implemented new action, such as reforestation on recently purchased cattle pastures and other degraded lands.
- Finally, project proposals for livelihood alternatives for local people were developed and presented to potential donors, at least one of which is being implemented during 2008.

While all of these activities should be continued, expanded or consolidated, there are also many other urgent conservation actions that need to be implemented as soon as possible:

- Awareness campaigns should be expanded to other areas, particularly the Íntag valley and the Volcán Atacazo area.
- The development of a GIS database of land tenure, current land-use, and other socioeconomic information will greatly facilitate the design and implementation of many site-specific conservation interventions, and especially those linked to the provision of sustainable livelihood alternatives for local people.
- Recently developed management plans should be implemented to improve the protection of the Cotacachi-Cayapas Ecological Reserve and the Protective Forest Mindo-Nambillo.
- Expeditions to poorly studied areas of suitable habitat should be carried out, particularly on the western slope of Volcán Pichincha, Volcán Atacazo, and the main massif of the Cordillera de Toisán.
- Key sites for new community and private reserves should be identified.
- Effective legal mechanisms for formal recognition of community and private reserves are urgently needed.
- Likewise, all governmental, community and private reserves have to be protected from the adverse environmental impacts of mining.
- To make habitat protection economically attractive and viable for local people, an endowment fund strategy for conservation easements has to be developed and implemented.
- Degraded lands should be reforested and biological corridors re-established to guarantee connectivity between remnant forest fragments and continuous habitat.
- The Ecuadorian government, as well as national and international stakeholders should lobby for an effective agreement on the reduction of greenhouse gas emissions, as global warming might push the climate envelope of Black-breasted Puffleg and many other endemic high-Andean animal and plant species above the current timberline.
- In addition, diverse plant communities of native woody vegetation have to be restored in the páramo grasslands of Volcán Pichincha, Volcán Atacazo, and within the Cotacachi-Cayapas Ecological Reserve, to mitigate the adverse effects of global warming.
- The monitoring of habitat status and change in five-year intervals would facilitate the evaluation of the conservation status of Black-breasted Puffleg as well as the success of conservation interventions.
- Studies on feeder-transmitted diseases should be carried out to exclude potential negative impacts of increasing use of hummingbird feeders.

Activities that maintain and restore the species' key habitat (high Andean montane forest) have absolute priority over all other conservation measures. To that end, a comprehensive awareness campaign has to be carried out, addressing a wide spectrum of topics, such as unsustainable land management practices, community-based resource stewardship, alternative livelihoods, water security, and the potential impacts of mining (i.e. in the Íntag valley and Cordillera de Toisán). In some areas, the provision of economic alternatives for local people through well-designed conservation and development projects might be the only way to interrupt the vicious cycle of rural poverty and habitat destruction. To achieve this goal, it will be important to develop broad alliances between communities, farmers, NGOs, development agencies, and governmental institutions.

# ■ RESUMEN EJECUTIVO

El Zamarrito Pechinegro, *Eriocnemis nigrivestis*, es un enigmático colibrí (Aves: Trochilidae), endémico para Ecuador, que se considera Críticamente Amenazado de extinción tanto a nivel global como nacional. La especie se restringe a los centros de endemismo del Páramo de los Andes Centrales y Laderas Inter-Andinas y Valles, donde se ha registrado en los bosques alto andinos montanos de dos volcanes aislados y una cordillera al noroccidente de Ecuador. La mayoría de las observaciones corresponden a la ladera noroccidental del Volcán Pichincha, con la existencia de un avistamiento adicional de una posible hembra en el vecino Volcán Atacazo en 1983. En el 2006, una pequeña población fue redescubierta en la Cordillera de Toisán, sobre el valle de Íntag, una localidad histórica de la especie. De acuerdo a especímenes de museo, la especie ocurría históricamente entre los 2,440 y 4,725 m. En los últimos años, la mayoría de los registros obtenidos se encuentran entre los 2,850 y 3,500 m, existiendo individuos inmaduros itinerantes que se han registrado hasta en los 1,700 m. La Extensión de Presencia de la especie se estima en 68 km<sup>2</sup>, y su población global entre 250 y 999 individuos. La expansión de la frontera agrícola, particularmente el establecimiento de pastizales y la tala del bosque montano para la producción de madera y carbón, han sido identificados como las principales amenazas para la supervivencia de la especie. Se piensa que sus pequeñas subpoblaciones sufren constantes disminuciones debido a la deforestación dentro de su hábitat, mismo que ya está severamente fragmentado, y recientemente también debido a los impactos del cambio climático. Esta combinación de factores califica a la especie como Críticamente Amenazada y justifica la urgencia de las acciones que aquí se presentan. Este Plan de Acción fue desarrollado en el 2007, año durante el cual se realizaron considerables progresos en la implementación de medidas de conservación que benefician al Zamarrito Pechinegro, entre ellas:

- Se realizó un programa de difusión para las comunidades y actores clave en la provincia de Pichincha. El programa incluyó ocho talleres con representantes de las comunidades, propietarios privados, ONGs, gobiernos locales y regionales, así como ministerios relevantes.
- Un Grupo de Apoyo Local (GAL) se conformó con el fin de apoyar la conservación de la IBA Mindo y Estribaciones Occidentales del Volcán Pichincha, uno de los últimos remanentes importantes para la supervivencia del zamarrito. La creación de este GAL apoyó el entrenamiento de gente local en levantamiento de fondos, contabilidad, administración de proyectos y técnicas básica de monitoreo aves.
- Se produjeron y distribuyeron materiales de educación ambiental, incluyendo un folleto para el público en general y materiales didácticos para los maestros de la zona. Estos permitirán la inclusión en el currículo escolar del Zamarrito Pechinegro y la importancia de los bosques altoandinos para la conservación de la biodiversidad y la provisión de agua.
- Se inició el primer programa de monitoreo estandarizado de aves en el rango de distribución del Zamarrito Pechinegro, mismo que proveyó a los científicos los datos necesarios para la estimación de la densidad poblacional absoluta de este colibrí y otras especies de aves, así como su tamaño poblacional.
- Dos reservas privadas, la Hacienda Verdecocha y la Reserva Yanacocha, que juntas protegen más de 2,200 ha de hábitat clave para la especie en Pichincha, continuaron sus esfuerzos de conservación e implementaron nuevas acciones, como reforestación de pastizales recientemente adquiridos y de otras áreas degradadas.
- Finalmente, propuestas de proyectos para brindar alternativas de subsistencia a la gente local fueron desarrolladas y presentadas a donantes potenciales. Al menos una de ellas inició su implementación en el 2008.

Mientras estas actividades deben mantenerse, expandirse o consolidarse, también se requieren varias otras acciones de conservación, que deberían implementarse lo más pronto posible:

- Las campañas de concienciación y difusión deberían expandirse a otras áreas, particularmente al área del valle de Íntag y el Volcán Atacazo.
- El desarrollo de una base de datos SIG sobre tenencia de la tierra, uso actual de la misma y otra información socio económica, facilitará enormemente el diseño e implementación de acciones de conservación específicas para cada sitio y especialmente de aquellas ligadas a la provisión de alternativas de subsistencia sostenibles para la gente local.
- Los planes de manejo recientemente desarrollados deberían implementarse con el fin de mejorar la protección de la Reserva Ecológica Cotacachi-Cayapas y el Bosque Protector Mindo-Nambillo.
- Deberían realizarse expediciones a áreas poco estudiadas con hábitat adecuado para la especie, particularmente en la ladera occidental del Volcán Pichincha, Volcán Atacazo y el macizo principal de la Cordillera de Toisán.
- Deberían identificarse sitios claves para nuevas reservas comunitarias y privadas.
- Se requieren con urgencia mecanismos legales efectivos para el reconocimiento formal de las reservas privadas y comunitarias.
- Del mismo modo, todas las reservas gubernamentales, comunitarias y privadas deben protegerse de los impactos adversos de la minería.
- Con el fin de hacer de la conservación del hábitat una alternativa económicamente viable para la gente local, debe desarrollarse e implementarse un fondo fiduciario para servidumbres ecológicas o pagos por servicios ambientales.
- Las tierras degradadas deberían reforestarse así como restablecerse los corredores biológicos que garanticen la conectividad entre los fragmentos remanentes de bosque y que garanticen un hábitat continuo.
- El gobierno del Ecuador, así como los actores nacionales e internacionales, deberían cabildear un acuerdo efectivo para la reducción de emisiones de gases de efecto invernadero, ya que el calentamiento global añadirá presión sobre el espacio climático del Zamarrito Pechinegro y otras especies de animales y plantas altoandinas sobre el actual límite del bosque.
- Adicionalmente, en los pastizales de los páramos de los Volcanes Pichincha y Atacazo, así como dentro de la Reserva Ecológica Cotacachi-Cayapas, deben restaurarse las diversas comunidades de plantas de vegetación leñosa nativa, para así mitigar los efectos adversos del calentamiento global.
- En intervalos de cinco años debería monitorearse el estado del hábitat y sus cambios, lo que facilitaría la evaluación del estado de conservación del Zamarrito Pechinegro, así como del éxito de las acciones de conservación implementadas.
- Deberían realizarse estudios sobre enfermedades transmitidas a través de los alimentadores, con el fin de excluir cualquier impacto negativo del uso de éstos para los colibríes.

Actividades que mantengan y restauren el hábitat clave para la especie, es decir el bosque montano alto andino, tienen absoluta prioridad sobre todas las medidas de conservación indicadas. Con ese fin, una campaña de concienciación debe ser llevada a cabo, abarcando un amplio espectro de temas, tales como prácticas sostenibles de uso del suelo, manejo de recursos comunitario, alternativas de subsistencia, seguridad del agua e impactos potenciales de la minería (particularmente en el valle de Íntag y Cordillera de Toisán). En algunas áreas la provisión de alternativas económicas para personas locales a través de proyectos de conservación y desarrollo bien diseñados podría ser la única forma de interrumpir el ciclo vicioso de la pobreza rural y la destrucción del hábitat. Para lograr este objetivo será importante fomentar el desarrollo de alianzas entre comunidades, finqueros, ONG's, agencias de desarrollo e instituciones gubernamentales.



# ■ INTRODUCTION

This Black-breasted Puffleg Species Action Plan was developed within the framework of BirdLife International's Preventing Extinctions initiative. Through the development and implementation of this plan, Aves & Conservación aims to engage key Ecuadorian stakeholders (communities, private landowners, NGOs, government agencies, etc.) in a cooperative effort to conserve the species. The plan is intended as a guiding framework for conservation action and it is recommended that it be revised and up-dated at five-yearly intervals.

Proposed conservation actions were evaluated and refined through stakeholder consultation workshops in Quito, Nono, and three communities on the northwest slope of Volcán Pichincha (see Appendix 6 for the list of participants). A similar event in Imbabura had to be cancelled due to a lack of funds. Thus, meetings with stakeholders there and in the area of Volcán Atacazo are an urgent priority action.

The structure of the plan follows Version 1.0 of the Conservation Actions Authority File of the IUCN's Species Survival Commission (Appendix 1a). All sections of the Conservation Actions Authority File have been included, even those currently not considered relevant in the context of Black-breasted Puffleg, with the intention of facilitating comparisons with other plans as well as future revisions of the present one. Sections which are not relevant have usually been annotated with the comment "not applicable," but more detailed comments are sometimes provided.

One chapter was added to those listed in the Conservation Actions Authority File: "Landownership and stakeholder analysis" (Chapter 1.4), as this information was considered to be of key importance for the planning of meaningful conservation measures. Although the costs of each proposed conservation action are required for fundraising, detailed budget estimates are not included here primarily because some activities are in an early phase of planning. However, approximate estimates are presented

for some actions for which information is available (Appendix 4). Any specific projects that are developed should refer to the Species Action Plan to justify the importance of proposed activities and their budgets.

## SPECIES PROFILE – BLACK-BREASTED PUFFLEG *ERIOCNEMIS NIGRIVESTIS*

**Taxonomy** – Members of the genus *Eriocnemis* are medium-sized hummingbirds with conspicuous feathered thighs, the 'puffs,' that almost entirely envelop their legs (Schuchmann *et al.* 2001). Currently 12 species are recognized, making it one of the most widespread and diverse group of Andean hummingbirds. However, at least four species are extremely restricted in range, and therefore are considered globally threatened. One of these is the Black-breasted Puffleg *Eriocnemis nigrivestis* that may form a superspecies with the recently described Gorgeted Puffleg *E. isabellae* from southwestern Colombia and the much more common Glowing Puffleg *E. vestita* from the eastern Andes (Cortés-Diago *et al.* 2007; G. Stiles in litt. 2007).

**Identification** – It is a rather small puffleg (8-9 cm); both sexes have straight black bills, distinct white leg-puffs, violet-blue undertail-coverts, and a forked dark steel-blue tail. The male is distinct within its restricted range, with entirely blackish upperparts, dark blue uppertail-coverts and blackish underparts, with violet-blue throat. The female is shining bronze-green above, becoming bluish-green on rump and uppertail-coverts, underparts golden-green with pale blue throat patch, cream-colored or cinnamon malar stripe, and a whitish postocular spot. Immature males resemble females (Heynen 1999, Ridgely & Greenfield 2001). Similar spp.: Males of the slightly smaller Gorgeted Puffleg *E. isabellae* are very similar to male Black-breasted; however, the sides of the gorget are brilliant flashing green whereas in *nigrivestis* these areas are dull, dark green. The nape and upper back of male Black-breasted also show a distinct



A male Black-breasted Puffleg *Eriocnemis nigrivestis* perched in the undergrowth of its high-Andean montane forest habitat (Yanacocha Reserve, Pichincha, 3,500 m, 20 September 2005; photo: Aldo Sornoza).



bronzy gloss absent in *isabellae*. Female Black-breasted resembles both Glowing *E. vestita* and Gorgeted Puffleg, but is less cinnamon below and its belly has more extensive whitish fringes (BirdLife International 2000, 2006; Cortés-Diago *et al.* 2007; G. Stiles in litt. 2007). Voice: Mostly silent, but sometimes gives a weak tzeet tzeet after taking flight (Jahn 2008).

**Population and Range** – Black-breasted Puffleg is found seasonally on the northern and northwestern ridge-crests of Pichincha volcano (Volcán Pichincha), Pichincha, and in the Toisán mountain range (Cordillera de Toisán) above the Íntag valley, Esmeraldas and Imbabura, northwest Ecuador. On Volcán Pichincha, the area of suitable habitat where the species is known to occur has been dramatically reduced to c.34 km<sup>2</sup>, and supports an estimated 160 individuals (BirdLife International 2000, 2006). However, it may also occur on the unstudied western slope of the volcano where additional habitat remains (Santander *et al.* 2004). In 2006, another population was discovered within the Cotacachi-Cayapas Ecological Reserve (Jahn 2008). On the basis of satellite images of vegetation cover and topography, two separate areas of appropriate habitat appear to exist in the region, one of 24 km<sup>2</sup> (Cayapachupa) and another of 30 km<sup>2</sup> (main massif of the Cordillera de Toisán). The Toisán population is estimated at 48–108 birds, yielding a global population of 208–268 mature individuals. The species may still occur on Volcán Atacazo where, according to recent satellite images, a few hundred hectares of suitable habitat remain. However, the only confirmed evidence concerns three specimens from 1898, with a possible sighting in 1983 (Collar *et al.* 1992). This population is likely small (perhaps 10–50). In consequence, an updated population estimate should probably be in the order of 250–999 individuals. Available records suggest that it is an altitudinal migrant, but its movements remain poorly understood and appear to have changed since it was first collected (Jahn 2008). Seasonal distribution also seems to change from year to year (Santander *et al.* 2004, Jahn 2008). The large number of museum specimens (over 100) suggests the species was formerly more common, but the only confirmed record between 1950 and 1993 was of three individuals in 1980 (Bleiweiss & Olalla 1983, Collar *et al.* 1992). The species has clearly declined and is now rare within a very limited range (BirdLife International 2000, 2006).

**Ecology** – Black-breasted Puffleg inhabits humid and wet cloud forest, and especially high-Andean montane forest, including elfin forest and forest borders, between 1,700 and 3,500 m (Bleiweiss & Olalla 1983, Collar *et al.* 1992, Santander *et al.* 2004, Jahn 2008). It is uncertain whether historical records up to 4,700 m are due to mislabeling of museum specimens or indicate that the species formerly occurred at higher elevations (and that presumably páramo habitat structure and plant species' composition has changed considerably over the last 150 years) (Jahn 2008). The species undertakes seasonal movements, which might be linked to the flowering periods of certain plant species, such as vines, shrubs and ericaceous trees along altitudinal gradients (Bleiweiss & Olalla 1983). It has been recorded using 29 different food-plant species of 11 families, and thus it is not believed to be restricted in range as a result of dietary constraints (Santander *et al.* 2004, Jahn 2008). Historically, Black-breasted Puffleg seems to have been most numerous during April to September between 2,400 and 3,050 m, and from November to February (during the presumed breeding season) above 3,100 m. In recent years, most records have been between 2,850 and 3,500 m, with dispersing immatures occurring as low as 1,700 m (Collar *et al.* 1992, Santander *et al.* 2004, Jahn 2008). It has recently been recorded along bushy forest-edges along road-sides, steep slopes with stunted vegetation, and from taller montane forest interiors and clearings (Santander *et al.* 2004, Jahn 2008).

**Threats** – The main threat is the felling of forest for timber and charcoal, facilitating the introduction of cattle and the eventual expansion of the agricultural frontier for ranching, and to a lesser extent crop production (Collar *et al.* 1992, Santander *et al.* 2004, Jahn 2008). In Canton Cotacachi,

Imbabura province, 45% of households still use firewood and charcoal for cooking and heating (Poats 2006), contributing to the destruction of key habitat. The situation is similar on the west slope of Volcán Pichincha, where some families still produce charcoal for auto-consumption and commercialization in Quito. Suitable habitat on ridge-crests and the saddles of mountain passes is disappearing more rapidly than surrounding vegetation, as these areas provide flat ground for cultivating potatoes and livestock-grazing within otherwise steep terrain (Bleiweiss & Olalla 1983). The Toisán population is threatened by rapid deforestation on the southeast slope of the cordillera, copper mining concessions, and invasions of landless farmers into the Cotacachi-Cayapas Ecological Reserve (Jahn 2008). Some ridges where the species formerly occurred are now almost completely devoid of natural vegetation and, even if it still occurs in these areas, it is unlikely to be numerous.

An estimated 93% of the suitable habitat within its probable historic range has been degraded or destroyed, with 97% lost in Pichincha (Santander *et al.* 2004). Human-induced fires threaten large tracts of forest during the dry season (Santander *et al.* 2004, Jahn 2008). The construction of a pipeline at Cerro Chiquilpe led to habitat destruction through the laying of the pipeline and the construction of an access road and a depressurization station, which went ahead despite the known presence of the species in the area (Santander *et al.* 2004). Volcán Pichincha has erupted sporadically since 1999, and ash-fall has been considerable in the area (BirdLife International 2000, 2006). The impacts of this on the species and its habitat are unknown. Projected global warming may push the climate envelope for the species above the current treeline, which is thought to be lower than it was historically as a result of centuries of anthropogenic stresses, particularly fire and livestock grazing, that has been causing the gradual loss and fragmentation of high altitude forest (Jahn 2008). Global warming may also lead to increased competition with Gorgeted Sunangel *Heliangelus strophianus* if that species expands its altitudinal range upwards, as it occupies a similar ecological niche to the puffleg (Jahn 2008).

**Assessment of IUCN Red List category** – Recent data suggest that the species' population size is probably too large to trigger criterion C of the IUCN Red List (IUCN 2001) at the Critically Endangered level. Even if a precautionary approach is applied, assuming that the population may fall below 250 mature individuals (the threshold for Critically Endangered), sub-criterion '2a(ii)' would no longer apply as fewer than 90% of mature individuals are concentrated in one subpopulation (i.e., Pichincha 60%, Toisán and Cayapachupa 40%). Similarly, criterion C2a(i) is triggered only at the Endangered level (all subpopulations ≤250 mature individuals) (Jahn 2008).

Although the total area of suitable habitat is now estimated at 139 km<sup>2</sup>, Jahn (2008) suggest that the Extent of Occurrence should be taken as the sum of the known range of 44 km<sup>2</sup> at Volcán Pichincha (Santander *et al.* 2004) and an estimated 24 km<sup>2</sup> at Cayapachupa, or a total of 68 km<sup>2</sup>, which is below the 100 km<sup>2</sup> threshold for Critical (criterion B1). The additional areas of c.36 km<sup>2</sup> of unexplored habitat on the west slope of Volcán Pichincha, c.30 km<sup>2</sup> on the flanks of the highest ridges of the Cordillera de Toisán, and c.5 km<sup>2</sup> on the south-west flanks of Volcán Atacazo should be regarded as possible habitat until observations confirm the species' presence in these areas (Jahn 2008). Although now known from two localities, sub-criterion 'a' still applies as the species' habitat is 'severely fragmented'. In combination with sub-criterion 'b' (continuing decline in: (i) Extent of Occurrence; (ii) Area of Occupancy; (iii) area, extent and quality of habitat; and (v) number of mature individuals), this would continue to qualify the species as Critically Endangered under criterion B1a+b(i,ii,iii,v). However, if future field work confirms the species presence on the west slope of Volcán Pichincha or the main Toisán massif, then the species could be downlisted to Endangered (Jahn 2008).

# 1. POLICY-BASED ACTIONS



A few years ago, the inhabitants of Alaspungo decided to cut-down the montane forest above their community. Severe water shortages followed in the subsequent dry seasons. Future projects must resolve this problem, either through reforestation or the provision of piped water (Alaspungo community, Pichincha, 3,080 m, 12 April 2007; photo: Camila Mafla - Aves & Conservación).

## 1.1 MANAGEMENT PLANS

*Current situation.* – Within the range of Black-breasted Puffleg, the only governmental reserve for which an officially approved management plan exists is the ‘Bosque y Vegetación Protectores de las Montañas de Mindo y Cordillera de Nambillo’ (= Bosque Protector Mindo-Nambillo) (Valarezo *et al.* 2006); though its implementation is hindered by a lack of funding within the Ministry of Environment (MAE) (C. González pers. comm.). All other governmental reserves in Pichincha province that might support populations of the hummingbird lack management plans (Tab. 1-1).

The only private reserve with a management plan is Hacienda Verdecocha (Fundación Bosques para la Conservación 2005). No plan exists for the Jocotoco Foundation’s Yanacocha Reserve, nor for several much smaller private reserves below the species’ normal range (e.g., Tandayapa, Sachatamia) and community reserves (Chapter 4.4.2). Moreover, none of the private and community reserves are formally recognized by MAE (Tab. 1-1; Chapter 1.2.1.2), with the exception of the Maquipucuna Reserve, which lies at the periphery of the hummingbird’s known range.

The situation is similar in the Íntag–Cordillera de Toisán area where much of the land is also privately- or community-owned. This includes some reserves (Tab.1-1 and Chapter 1.3.2), few of which have management plans (e.g., Alto Chocó Reserve) or are formally recognized by MAE (e.g., Bosque Protector Los Cedros). No management plans exist for the three government-managed reserves in the Íntag valley: Bosques Protectores El Chontal, Siempre Verde, and Siempre Vida.

## 1.1.1 DEVELOPMENT

*Current situation.* – To our knowledge the only area within the range of Black-breasted Puffleg for which a management plan is currently in development is the Cotacachi-Cayapas Ecological Reserve, which was due for completion/approval in 2007 (Tab. 1-1).

*Action in place.* – The new management plan for the Cotacachi-Cayapas Ecological Reserve was finished in June 2007. However, ratification of the plan will take several months.

*Action needed.* – It is very important to increase knowledge of the reserves within the known and presumed range of Black-breasted Puffleg. This information could be generated as part of the proposed GIS database on landownership (Chapter 1.4.1). A key action is to promote the development and implementation of management plans for those reserves which currently lack them. Furthermore, official recognition should be sought for private and community reserves as a means to guarantee their long-term maintenance (Chapter 1.2.1.2). A significantly greater challenge is the long-term financial sustainability, of these reserves (Chapter 1.3.3). Although habitat protection is effective at the Jocotoco Foundation’s Yanacocha Reserve, a management plan could help to implement other proposed conservation actions (Appendix 3a), and especially the restoration of woody vegetation in the reserve’s grass páramo (Chapter 4.2). As a first step in the development of a management plan, in 2005 Jocotoco developed a fire prevention strategy (F. Sornoza pers. comm.), including a system of water reservoirs and hosepipes covering accessible

Table 1-1. Management plans and legal status of governmental, community, and private reserves (>100 ha) in the known and presumed range of Black-breasted Puffleg. Abbreviations used: n.a.= information not available (Note: due to lack of funding it was not possible to carry out stakeholder workshops in Imbabura).

RESERVE	PROVINCE	OWNERSHIP	SIZE (HA)	ALTITUDINAL RANGE (M)	LEGAL STATUS	MANAGEMENT PLAN (YES/NO) / STATUS
Cotacachi-Cayapas Ecological Reserve	Esmeraldas, Imbabura	Governmental and private	243,638	80 – 4,900	Ministerial Decree No. 1468; 28 August 1968	Yes (2007) / in development
Junín Reserve	Imbabura	n.a.	3,000	n.a.	Not officially recognized	n.a.
Bosque Protector Íntag - El Chontal	Imbabura	Governmental	6,963	n.a.	Ministerial Decree No. 2; 14 January 1994	No / needed
Bosque Protector Los Cedros	Imbabura	Private	6,400	1,200 – 2,700	Ministerial Decree No. 057; 19 October 1994	No / needed
Alto Chocó Reserve	Imbabura	Private	2,500	1,800 – 4,000	Not officially recognized	Yes (date n.a.) / in implementation
Neblina Reserve	Imbabura	Private	187	n.a.	Not officially recognized	n.a.
Bosque Protector Siempre Verde	Imbabura	Governmental	166	n.a.	Ministerial Decree No. 12; 11 March 1989	No / needed
Bosque Protector Siempre Vida	Imbabura	Governmental	289	n.a.	Ministerial Decree No. 17; 5 May 1995	No / needed
Árbol Lindo	Imbabura	Private	n.a.	n.a.	Not officially recognized	n.a.
Bosque Protector Cuenca Alta del Río Guayllabamba	Pichincha	Governmental (and private?)	13,880	1,320 – 3,000	Ministerial Decree No. 226; 7 June 1989	No / needed
Bosque Protector Mindo-Nambillo	Pichincha	Governmental and private	19,537	1,200 – 4,776	Ministerial Decree No. 118; 12 April 1988	Yes (May 2006) / ratified by MAE but not implemented yet due to a lack of funding
Bosque Protector Laderas Occidentales del Volcán Pichincha	Pichincha	Private	8,096	n.a.	Ministerial Decree No. 258; 9 July 1985	No / needed
Community Reserve Alaspungo	Pichincha	Community	900	c.3,200	Not officially recognized	No / needed
Private Reserve Rosendo Albarracín	Pichincha	Private	1,200	c.3,200	Not officially recognized	No / needed
Yanacocha Reserve	Pichincha	Private	c.1,000	c.3,400	Not officially recognized	No / needed
Hacienda Verdecocha	Pichincha	Private	1,269	2,700 – 3,500	Not officially recognized	Yes (Jun 2005) / in implementation

areas of the reserve, and an emergency fund to provide 100–200 local people with food for several days. Similar forest fire contingency plans should be developed for the Hacienda Verdecocha, run by the Nubesierra Foundation. The Municipality of Quito, particularly the Fire Fighting Department, should promote the formation and training of community-based fire fighting brigades.

Of course, it would be ideal to develop detailed management plans for all governmental, community, and private reserves. Realistically, most of them will have to be relatively simple and inexpensive to develop. In Canton Quito, the Environmental Department of the Municipality is willing to finance the development of management plans, and the Museo Ecuatoriano de Ciencias Naturales (MECN), Aves & Conservación, and Maquipucuna Foundation have offered to provide technical assistance (Appendix 2a). However, at this point it is unclear how many plans can be developed during the next five years. Similar conservation planning might be necessary on the slopes of Volcán Atacazo, Cordillera de Toisán, and the upper Íntag valley.

### 1.1.2 IMPLEMENTATION

*Current situation.* – The new management plan for Bosque Protector Mindo-Nambillo (Valarezo *et al.* 2006) was approved by the Ministry of Environment (MAE) but its implementation is hindered by a lack of funding (C. González pers. comm.). The management plans for Hacienda Verdecocha and the Alto Chocó Reserve, the latter managed by Zoobreviven Foundation, are under implementation (Tab. 1-1).

*Action in place.* – According to the new management plan for Bosque Protector Mindo-Nambillo, the conservation zone covers c.87% (16,954 ha), the restoration zone an additional 4% (838 ha), and the special use zone (for agricultural activities, mainly cattle raising) covers 9% (1,746 ha) (Valarezo *et al.* 2006). However, the government owns only 62% (12,065 ha) of the reserve, with the remaining 38% (7,472 ha) being privately-owned, though not all farms within the reserve have legal land titles. Furthermore, most landowners have been expanding their agricultural activities beyond the limits of their properties in order to claim additional land.



The threat of invasions by landless farmers is ever present in several areas of the reserve, such as the southwestern part (Río Cristal and Río Verde) and the Río Nambillo Chico drainage. However, to date there is no evidence that the key habitat of Black-breasted Puffleg has been affected by these invasions. Hacienda Verdecocha has a total area of 1,269 ha, of which 1,140 ha are forested. About 30% of the reserve is located within the limits of Bosque Protector Mindo-Nambillo. Funding for the implementation of the site's management plan is available, including for park rangers, delimitation of the reserve limits, maintenance of the trail system, and an enrichment scheme for 4.5 ha of degraded secondary forest (Fundación Bosques para la Conservación 2005). The management plan for the Alto Chocó Reserve aims to foster economic development of local communities.

*Action needed.* – The successful implementation of the management plan in Bosque Protector Mindo-Nambillo, which is the responsibility of the Los Bancos Technical Office of the Ministry of Environment, will be difficult without funding for an appropriate number of park rangers to discourage land-invasions. As an alternative to government-employed park guards, MAE should strengthen its relationship with other key stakeholders in the area. Several NGOs are willing to collaborate in guarding the reserve limits, at least in the area of their influence, namely Jocotoco Foundation, Nubesierra Foundation, and Corporación Ecoruta. Even some communities and private landowners would be interested in cooperating, as long as MAE provides them with an official mandate, e.g., as 'honorary park rangers' and a minimum assistance for food and equipment. Ornithological fieldwork needs to be undertaken in the Alto Chocó Reserve and other reserves in the upper Íntag valley and Cordillera de Toisán to evaluate their importance for Black-breasted Puffleg and the maintenance of high-Andean montane forest ecosystems in general (Chapters 1.4.2 and 3.9).

## 1.2 LEGISLATION

### 1.2.1 DEVELOPMENT

*Current situation.* – Existing international, national, and sub-national legislation provides a strong legal framework for the conservation of the Black-breasted Puffleg. However, the survival of the species in the medium-term might depend on effective measures to adapt to or eliminate the effects of global warming (Chapter 1.2.1.1). Additionally, mining concessions have the potential to destroy species' key habitat in the main massif of the Cordillera de Toisán, making the development of additional legislation and the implementation of existing laws and decrees an urgent priority (Chapters 1.2.1.2 and 1.2.2.2). Likewise, at the sub-national level, legislation that regulates charcoal production must be developed and implemented (Chapter 1.2.1.3).

#### 1.2.1.1 INTERNATIONAL LEVEL

*Current situation.* – Comparing the 1990s with 2000-2006, the rate of increase of worldwide emissions in CO<sub>2</sub> has more than doubled, from <1.3% per year to >3.3% per year (Canadell *et al.* 2007)<sup>1</sup>. As a consequence of global warming, ecological changes in the phenology and distribution of plants and animals have been reported for all well-studied marine, freshwater, and terrestrial groups on every continent and in every ocean. Among the most affected are range-restricted and mountaintop species (e.g., Parmesan 2006).

*Action in place.* – World leaders are negotiating a successor agreement to the Kyoto Protocol, which expires in 2012 (Lovell 2006), including the Clean Development Mechanism (CDM)<sup>2</sup>. Related mechanism, such as carbon credits, are a key component of national and international emissions-trading schemes. Under such schemes companies sell carbon credits to commercial and individual customers who are interested in lowering their carbon footprint on a voluntary basis.

*Action needed.* – An international agreement guaranteeing a gradual

reduction of greenhouse gas emissions as soon as possible. Ecuadorian stakeholders should actively lobby the national government and collaborate in the development of a national position, which feeds into global discussions on this topic. In this context, monitoring of climate change-related biodiversity loss will be crucial to back future claims for compensation payments from industrialized countries to the Ecuadorian government.

#### 1.2.1.2 NATIONAL LEVEL

*Current situation.* – Ecuadorian legislation permits mining within protected areas and their buffer zones (Arias & Corral 2006). The corresponding laws are:

- Mining Law (Ley de Minería, Ley No. 126, Registro Oficial No. 695, suplemento, 31 May 1991); and,
- Forest and Conservation of Natural Wildlife Areas Law (Ley Forestal y de Conservación de Áreas Naturales de Vida Silvestre, Registro Oficial No. 418, suplemento, 10 September 2004).

However, legislation also exists which is aimed at reducing the impacts of mining within protected areas. The corresponding laws are:

- Environmental Management Law (Ley de Gestión Ambiental, Registro Oficial No. 1, 11 August 1998); and,
- Unified Text of Secondary Environmental Legislation (Texto Unificado de Legislación Ambiental Secundaria, Decreto DE-1761, Registro Oficial No. E2, 31 March 2003).

Most of the remaining Black-breasted Puffleg habitat on the east slope of the main massif of the Cordillera de Toisán lies outside of legally protected areas, and as such is not covered by any legislation prohibiting mining activities. The current Ecuadorian government is discussing the formation of a new government-owned Mining Company in order to more effectively exploit Ecuador's rich mineral resources.

*Action in place.* – Existing legislation is too contradictory to protect the habitat of Black-breasted Puffleg from the impacts of mining.

*Action needed.* – Key stakeholders should lobby for a ministerial or presidential decree that unambiguously prohibits mining within the Cotacachi-Cayapas Ecological Reserve, as well as in private and community reserves on the eastern slope of the Cordillera de Toisán and in the upper Íntag valley. In this context it will be critical to obtain legal recognition of private and community reserves. Currently, the only way to achieve this is through their declaration as 'Protective Forests' (Bosques Protectores). However, the MAE is drafting legislation that will establish alternative mechanisms and simplify the process of recognition. As part of political awareness campaigns, conservation groups should lobby for the development and implementation of new legislation in this regard (Chapter 2.2).

#### 1.2.1.3 SUB-NATIONAL LEVEL

*Current situation.* – Throughout the range of Black-breasted Puffleg the felling of montane forest for timber and charcoal production is an ongoing threat. In Canton Cotacachi, 45.3% of households are still using firewood and charcoal for cooking and heating (Poats 2006), contributing to the destruction of key habitat. The situation is similar on the west slope of Volcán Pichincha, where some families still produce charcoal for auto-consumption and commercialization in Quito. Although some recent literature has stated that charcoal production on Volcán Pichincha has been forbidden by local authorities (e.g., Phillips 1998; Heynen 1999; Rodríguez 2002; BirdLife International 2000, 2004, 2006), we are not aware of the existence of any such legislation (Departamento de Archivos del Municipio de Quito pers. comm.). Furthermore, representatives of the Municipality of Quito have expressed their opposition to any legislation in this sense, unless feasible economic alternatives are available for local people. In fact, the original source (Phillips 1998) referred only to the Yanacocha area, where the Metropolitan Water Company of Quito

<sup>1</sup> 1990 is the reference year for a 5% reduction of CO<sub>2</sub> emissions in 35 industrialized countries that have signed the Kyoto Protocol (Associated Press 2006).

<sup>2</sup> The CDM is an arrangement under the Kyoto Protocol allowing industrialized countries with a greenhouse gas reduction commitment to invest in projects that reduce emissions in developing countries as an alternative to more expensive emission reductions in their own countries.





Volunteers conducting interviews with local people to gather baseline data for the design of future sustainable development and conservation projects (Alaspungo community, Pichincha, 3,080 m, 5 May 2007; photo: Camila Maffla - Aves & Conservación).

(EMAAP-Q) locally controlled access to the forest before the private reserve was established.

*Action in place.* – There is no legislation in place that regulates charcoal production.

*Action needed.* – Municipalities need to regulate charcoal production. Prohibition of this activity would be unrealistic, at least in the short-term, due to the economic consequences for the local communities. As a compromise, technical assistance should be provided, improving the efficiency of charcoal production and agricultural practices. Alternative livelihood sources also need to be identified and developed (Chapter 1.3.3). In the medium-term, management plans for charcoal production should be made obligatory and their implementation enforced, ideally through a certification scheme.

## 1.2.2 IMPLEMENTATION

### 1.2.2.1 INTERNATIONAL LEVEL

*Current situation.* – International trading of Black-breasted Puffleg is regulated by the Convention on International Trade in Endangered Species of wild fauna and flora (CITES).

*Action in place.* – Black-breasted Puffleg is listed in Appendix List II of CITES.

*Action needed.* – Although, there are no recent reports that Black-breasted Puffleg is traded in international bird markets (Chapters 3.6 and 5.3.2), the species should be transferred to Appendix List I of CITES, implying that trading of live or dead individuals must only be authorized in exceptional circumstances.

### 1.2.2.2 NATIONAL LEVEL

*Current situation.* – Conservation efforts for Black-breasted Puffleg benefit directly or indirectly from numerous Ecuadorian laws and decrees, and in particular through: (1) international agreements, (2) ministerial resolutions on the protection of threatened species, (3) legally protected areas that include parts of the species' range and habitat, (4) legislation regulating potential impacts of mining activities within protected areas, (5) obligatory management plans for commercial timber production, and (6) ministerial agreements on the status of Important Bird Areas (IBAs) identified by the Ecuadorian conservation community. However, ambiguous interpretations of existing legislation on mining could result in the destruction of the species' remaining habitat in the Cordillera de Toisán. Furthermore, effective controls of illegal logging have yet to be implemented.

*Action in place.* – (1) The Ecuadorian government has ratified the following international conventions:

- CITES, Registro Oficial No. 746, 20 February 1975; and

- Convention on Biological Diversity (CBD), Registro Oficial No.647, 6 March 1995.

(2) The Black-breasted Puffleg is recognized as Critically Endangered and the persecution and trade of this species and other threatened wildlife is prohibited by ministerial resolution No. 50 (19 August 2002).

(3) The following laws regulate the establishment and management of protected areas:

- Forest and Conservation of Natural Wildlife Areas Law (Ley Forestal y de Conservación de Áreas Naturales de Vida Silvestre, Registro Oficial No. 64, 24 August 1981);
- Forest and Conservation of Natural Wildlife Areas Law (Ley Forestal y de Conservación de Áreas Naturales de Vida Silvestre, Registro Oficial No. 418, suplemento, 10 September 2004).

An important portion of the species' remaining habitat is located within the limits of legally protected areas, such as Bosque Protector Mindo-Nambillo and Cotacachi-Cayapas Ecological Reserve (Tab. 1-1).

(4) Several legal mechanisms regulate mining within the limits of protected areas (Chapter 1.2.1.2). However, mining concessions emitted by the Ministry of Energy cover rectangular areas. That is, they do not follow natural limits in the landscape, such as ridge crests or watersheds. In consequence, many mining concessions in the Íntag valley overlap widely with the Cotacachi-Cayapas Ecological Reserve, especially in the Cordillera de Toisán (districts of Cuellaje, Apuela, and García Moreno). Furthermore, some concessions also include private and community reserves on the eastern slope of the Cordillera de Toisán (which are not legally protected, see Chapter 1.2.1.2). Taking into account that paid jobs are rare in the area, there is an increasing risk that mining activities will affect the reserves in the future.

(5) According to the 'Forest and Conservation of Natural Wildlife Areas law' and accompanying legislation, management plans are obligatory for commercial timber production. Unfortunately, to date, effective controls of illegal logging and timber trade have not been implemented.

(6) Almost the entire known and presumed range of Black-breasted Puffleg is located within several Important Bird Areas (IBAs) that were identified by Aves & Conservación, BirdLife International, Conservation International, and the Ministry of Environment (Chapter 3.5 and 4.4.1). The Ecuadorian Government has officially recognized IBAs as "geographic areas of public interest for the conservation of threatened bird species" through the Registro Oficial No. 550 (23 March 2005).

*Action needed.* – Key stakeholders should lobby for more strict regulations of mining in general, but particularly in legally protected areas, as well as in community and private reserves. Mining activities within the limits of the Cotacachi-Cayapas Ecological Reserve and on the eastern slope of the Cordillera de Toisán, and in the upper Íntag valley should be banned by ministerial or presidential decree (Chapters 1.2.1.2 and 2.2). The implementation of effective controls of illegal logging and timber trade are important not only for the conservation of Black-breasted Puffleg, but also for other forest-inhabiting plant and animal species. Thus, key stakeholders should form broad alliances to push for effective national-level surveillance systems.

### 1.2.2.3 SUB-NATIONAL LEVEL

*Current situation.* – Slash-and-burn agriculture and felling of montane forest for timber and charcoal production are still common practice in Pichincha and Imbabura provinces (Chapter 1.2.1.3). The burning of páramo grasslands has been forbidden in Canton Quito and within the Cotacachi-Cayapas Ecological Reserve. However, infractions are common and law enforcement is rare in the latter area.

*Action in place.* – In 2006, the municipality of Quito passed a decree prohibiting fires, with a maximum penalty of several years in jail.

*Action needed.* – The successful implementation of forest restoration programs will require a regulatory framework for the sustainable production of timber and charcoal (Chapter 4.2). See Chapter 1.2.1.3 regarding the development of legislation on the production of charcoal.

Communities that depend on unsustainable management practices should be included in the awareness campaign (Chapter 2.2) and programs for livelihood alternatives (Chapter 1.3.3). In some cases, e.g., in extremely poor communities, it might be necessary to design and implement comprehensive conservation and development projects (Chapter 1.3.3). In Canton Quito, key stakeholders should build alliances with communities, private landowners, NGOs, and government institutions to promote the successful implementation of the municipal decree on fire prevention (Chapters 4.1).

### 1.3 COMMUNITY MANAGEMENT

#### 1.3.1 GOVERNANCE

*Current situation.* – In Pichincha province, the hummingbird's known or suspected range lies within the administrative districts (parroquias) of Nono, Lloa, and Mindo. The closest communities to known localities for Black-breasted Puffleg are Yanacocha, Alaspungo, Alambi, and La Sierra, along with several individual farms and the town of Nono. In the case of Volcán Atacazo, fieldwork is required to determine the location of any extant populations (Chapter 3.9). Historical records from Atacazo do not provide any specific locality information. The localities of the recently rediscovered northernmost population lie in Esmeraldas province (Jahn 2008), very close to the Esmeraldas–Imbabura inter-provincial border, and the closest human settlements are all in Imbabura province. For this reason the administrative districts (parroquias) of greatest importance for the conservation of the species are those in Imbabura: Imantag, Apuela, Cuellaje, Peñaherrera, and García Moreno. In fact, the area is so inaccessible from Esmeraldas that even the administration of the corresponding part of the Cotacachi-Cayapas Ecological Reserve was delegated to the regional Ministry of Environment of Imbabura. The most important communities in this area are Piñán and Guamanin, which are located within the Cotacachi-Cayapas Ecological Reserve, and El Rosario, Purranqui, Playa Rica, San Joaquín, and 6 de Julio de Cuellaje in the upper Íntag valley.

*Action in place.* – As per the Ecuadorian constitution and related legislation, communities elect a president and community council for a term of one year. The implementation of any conservation action on community lands has to be closely coordinated with these local governance bodies.

*Action needed.* – None to implement governance. However, much has to be done to improve the collaboration between conservation organizations and community councils in order to build local awareness in favor of the conservation of remaining forest habitat and to implement proposed conservation actions (Chapters 1.3.2 and 2.2). In this context, it is very important to carry out a GIS-based analysis of landownership (Chapter 1.4.1).



Workshops in local communities help to improve awareness about conservation issues and are an important tool for assessing the needs and interests of local people. The resulting data are invaluable for planning appropriate conservation actions (Alaspungo community, Pichincha, 3,080 m, 12 April 2007; photo: Cristian Martínez – Aves & Conservación).

#### 1.3.2 RESOURCE STEWARDSHIP

*Current situation.* – In Pichincha, community-based resource stewardship is still in an early stage of development. Various communities maintain forest reserves, e.g., Yanacocha (80 ha) and Alaspungo (900 ha) largely as a result of the Ecoruta project, which aims to increase the number of tourists visiting the area (Chapter 1.3.3). In Mindo, conservationists groups have existed for many years. However, open conflicts and competition between them have hindered their active participation in the management of Bosque Protector Mindo-Nambillo (Valarezo *et al.* 2006). Other noteworthy conservation efforts are restricted to private initiatives (e.g., Hacienda La Merced de Nono), which are often linked to ecotourism facilities (e.g., Hacienda Verdecocha, Las Gralarias, Bellavista Lodge, Sachatamia), and NGOs based in Quito (e.g., Jocotoco's Yanacocha Reserve, Maquipucuna Reserve). In the Cotacachi-Cayapas Ecological Reserve buffer zone, low water levels in the rivers and streams are a growing concern for local communities (Poats 2006, Proaño 2006), especially in the dry season (July–September). The water is needed for irrigation of agricultural lands, cattle raising, drinking, cooking, bathing, and washing. Some headwaters are also holy sites for Kichwa people (Poats 2006).

Several communities and NGOs (e.g., DECOIN) are engaged in the anti-mining movement, which is a serious social conflict in the area, in addition to threatening the habitat of Black-breasted Puffleg in the Cordillera de Toisán and upper Íntag valley (Chapter 3.5).

*Action in place.* – In Pichincha, the ecotourism project Ecoruta is in an early stage of implementation. At this moment it is difficult to assess its benefits for the conservation of Black-breasted Puffleg and local communities.

In the Íntag valley, the agricultural frontier continues to expand in most areas, however, a growing number of communities have been establishing forest reserves to protect the upper watersheds of their rivers and streams. DECOIN (Defensa y Conservación de Íntag) has a lead role in assisting communities in the creation of c.40 small forest reserves, which vary from a few hectares up to 130 ha in size (Carlos Zorilla pers. comm.). Some of these reserves even have management plans. Three of them are located above 2,700 m, and thus include potential habitat for the hummingbird. Two are managed by the Junta Parroquial de Cuellaje and another by the community La Loma, also in the administrative district of Cuellaje. Another watershed reserve that lies in the appropriate altitudinal range for the species is managed by the community of Azaví (Carlos Zorilla pers. comm.). DECOIN has been promoting reforestation in five community reserves, with a total of 20,000 trees planted. A group of local people is also patrolling Rainforest Concern's Neblina Reserve.

*Action needed.* – Community-based resource stewardship, such as the establishment of community forest reserves and the formation of Local Conservation Groups, should be promoted through a comprehensive awareness campaign (Chapter 2.2) and capacity building programs (Chapter 2.3), promoting economic alternatives, the development of business plans, legal recognition of community reserves, and other direct benefits. The organizations involved should capitalize on the growing public consciousness regarding the issue of 'water scarcity' in order to achieve important conservation goals such as the protection of forest remnants and implementation of reforestation programs (Chapters 2.2 and 4.2). Strategies implemented by DECOIN and Rainforest Concern in the Íntag valley should be adapted as models for similar conservation action on the slopes of Pichincha and Atacazo. Likewise, the possibility of establishing other Ecoruta-like tourism projects (Chapter 1.3.3) along the old Quito–Santa Domingo road (Lloa district) and the Íntag valley should be evaluated. In general, for any community-based resource stewardship initiatives to be successful in the long-term, it will be critical to link them with sustainable development projects, aiming to improve the livelihood alternatives for local people (Chapter 1.3.3).

#### 1.3.3 LIVELIHOOD ALTERNATIVES

*Current situation.* – In Pichincha province, no up-to-date socio-economic data are available for the administrative districts of Mindo, Nono, and Lloa. However, there is no doubt that living conditions have improved considerably for many people over the last two decades, mainly due to their proximity to the capital, Quito, a major market for



local products. Another factor is the increasing number of national and international tourists visiting the Mindo-Nono area. However, isolated communities and small farms still live in considerable poverty. In contrast to Canton Quito, the socio-economic situation in Canton Cotacachi is of great concern. In the five relevant administrative districts (Imantag, Apuela, Cuellaje, Peñaherrera, and Garcia Moreno), 85.9-96.0% of the people live in poverty, and 49.2-80.7% in extreme poverty (Poats 2006).

The poverty of local people is an important driver of ongoing deforestation: the collection of firewood and production of charcoal is an important source of energy in the buffer zone of the Cotacachi-Cayapas Ecological Reserve and on the western slope of Volcán Pichincha. In order to avoid the destruction and overexploitation of remaining high-Andean forests, well-designed and well-managed conservation and development programs have to be implemented, especially in Canton Cotacachi. These should be accompanied by awareness campaigns (Chapter 2.2).

*Action in place.* – The Ecoruta tourism project, with a total length of 54 km on the northwestern slope of Volcán Pichincha has the biggest potential to provide livelihood alternatives for communities in the Nono-Tandayapa-San Tadeo area. The Corporación Ecoruta is planning to implement various activities linked to the tourism business, aiming to increase benefits for local people, including a mobile car repair service, camping sites, restaurants, souvenir stores, etc. Workshops on the elaboration of handicrafts, organized by Corporación Ecoruta and CORPEL, will soon be carried out in the town of Nono, as well as in the communities of Tandayapa and San Tadeo. The Maquipucuna Foundation has also produced a booklet on livelihood alternatives for local people.

*Action needed.* – Stakeholders should build alliances with communities and strengthen their relationship with NGOs and development agencies in order to design and implement joint conservation and development projects in Canton Cotacachi and Canton Quito. These projects should be planned and carried out in close cooperation with the corresponding municipalities and ministries. Their main objective should be the provision of livelihood alternatives and basic services for poor communities and farmers in the high-Andean buffer zones of two important nature reserves (Cotacachi-Cayapas Ecological Reserve and Bosque Protector Mindo-Nambillo) with the goal of protecting the remnant forest cover in headwater areas, and particularly within the altitudinal range of the Black-breasted Puffleg. Technical assistance for improved management, including training programs and the development of business plans, will be key to increasing the benefits of new and existing activities, e.g., agro-forestry projects, milk production, trout farms, ecotourism programs, etc. The elaboration of tourism development plans will be particularly important for the following areas: southwestern slope and páramos of Volcán Pichincha, upper Íntag valley, and the community of Piñán within the Cotacachi-Cayapas Ecological Reserve.

Reforestation of watersheds with native tree and shrub species, including in grass páramo, is a key conservation action (Chapter 4.2). In the case of private and community lands of critical importance for the Black-breasted Puffleg but which are not for sale (Chapters 4.4.2 and 4.4.4), the development of conservation easement programs should be considered. The proposed land tenure database (Chapter 1.4.1) would facilitate the implementation of this activity. An endowment fund will be required to ensure the long-term sustainability of any easements that are established. To that end, a transparent endowment fund strategy has to be developed, which must include, among others, an analysis of the legal basis for such a program and a plan to build new or strengthen existing alliances with NGOs based in the US and Europe. The FAN (Fondo Ambiental Nacional) has set up a trust fund for 11 protected areas of Ecuador and is interested in assisting the establishment of a similar fund for payments of conservation easements.

To provide livelihood alternatives for communities, all existing conservation initiatives (e.g., Ecoruta, Yanacocha Reserve, Hacienda Verdecocha) should promote the participation of local people, e.g., as local guides, park rangers, and workers in infrastructure construction projects and reforestation programs.

## 1.4 OTHER: LANDOWNERSHIP AND STAKEHOLDER ANALYSIS

### 1.4.1 LANDOWNERSHIP

*Current situation.* – A detailed knowledge of land tenure is crucial to the conservation of Black-breasted Puffleg's remaining habitat and partial restoration of woody vegetation in deforested areas and extensive grass páramos at the species' upper altitudinal range (Chapter 4.2). With the exception of Bosque Protector Mindo-Nambillo and its vicinity, very little is known about landownership in the presumed range of the species.

*Action in place.* – A recent analysis of landownership was carried out for Bosque Protector Mindo-Nambillo (Valarezo 2006), and identified 34 private properties partially or entirely inside the reserve, accounting for 38.3% (7,472 ha) of its total area. However, only 27 of these properties have legal titles, while the remaining 7 families took possession but do not have any legal land rights. The remainder of the reserve (12,065 ha) is government-owned land managed by the Ministry of Environment. In Pichincha province, the Municipality of Quito, forestry department of the Ministry of Environment, Corporación Ecoruta, Maquipucuna Foundation, and Nubesierra Foundation are willing to share their cartography of the area. However, this information is incomplete and needs to be updated. Mindo Cloudforest Foundation is seeking funding to establish an up-to-date database on landownership for the Ecoruta, which covers part of the range of the Black-breasted Puffleg.

*Action needed.* – An urgent priority is to develop a GIS database on landownership for the known and presumed range of Black-breasted Puffleg, covering the altitudinal range of c. 1,700-4,700 m. Other important socio-economic and political information should be also included, such as limits of administrative districts (parroquias), cantons, reserves, and mining concessions, as well as the location of communities, schools, and tourist facilities. Basic data on current land-use should also be included. This would facilitate the elaboration of a series of thematic maps, invaluable tools in guiding management and conservation efforts. The corresponding GIS database should be updated every five years, ideally as part of the proposed habitat monitoring program (Chapter 3.4).

### 1.4.2 STAKEHOLDER ANALYSIS

#### 1.4.2.1 PRIVATE LANDOWNERS

*Current situation.* – In 2007, Aves & Conservación established formal contact with landowners from the northwestern slope of Volcán Pichincha. No contact exists, however, with private landowners in the Cordillera de Toisán, upper Íntag valley, and Volcán Atacazo. It is not known whether other NGOs have established formal relationships with local landowners in these areas.

*Action in place.* – Some private landowners participated in the workshop in Quito on 22 January 2007 (Appendix 6) and declared their interest



The typical clearly-demarcated borders of high-Andean forest fragments are the result of fires (páramo of Piñán, Cotacachi-Cayapas Ecological Reserve, Imbabura, 3,350 m, 27 September 2007; photo: Olaf Jahn).

in collaborating in conservation actions to benefit the Black-breasted Puffleg. On 20 September 2007, Aves & Conservación conducted a workshop for private landowners of the northwestern slope of Volcán Pichincha in order to explain the goals of the Species Action Plan and to involve them in the implementation of the proposed conservation actions. Preliminary information on the limits, size, and land use of their properties was also gathered.

*Action needed.* – Conservation organizations should establish contact with private landowners in the Cordillera de Toisán, upper Íntag valley, and Volcán Atacazo. The planned GIS database (Chapter 1.4.1) should be used to identify those private landowners who might have direct impacts on habitat within the known and presumed range of Black-breasted Puffleg. The awareness campaign (Chapter 2.2) should aim to integrate as many landowners as possible in conservation measures in favor of the species.

#### 1.4.2.2 COMMUNITIES

*Current situation.* – Aves & Conservación, Jocotoco Foundation, and Maquipucuna Foundation have maintained informal contact with several communities on the northwestern slope of Volcán Pichincha. Meanwhile, DECOIN and Rainforest Concern have established close working relationships with local communities in the Cordillera de Toisán, upper Íntag valley, and Volcán Atacazo.

*Action in place.* – Several communities, namely Alaspungo, Alambi, Yanacochoa, and La Sierra, participated in the Quito workshop on 22 January 2007 (Appendix 6). Most of them are involved in the Ecoruta Project (Chapter 1.3.3) and are very interested in collaborating in conservation actions for Black-breasted Puffleg. Naturally, they are hopeful that in the medium term these initiatives will improve their living conditions. During 2007, Aves & Conservación conducted four workshops on the northwestern slope of Volcán Pichincha as part of its community outreach program.

*Action needed.* – Conservation organizations should establish and strengthen contacts with communities in the Lloa area, Volcán Atacazo, Cordillera de Toisán, and upper Íntag valley. The proposed GIS database (Chapter 1.4.1) should be used to identify those communities that might have direct impacts on habitat within the known and presumed range of Black-breasted Puffleg. The awareness campaign (Chapter 2.2) should aim to integrate as many communities as possible in conservation measures in favor of the species.

#### 1.4.2.3 GOVERNMENTAL ORGANIZATIONS

*Current situation.* – Part of the range of Black-breasted Puffleg is located within two important state-owned reserves (Chapters 1.1). Consequently, the Ministry of Environment (MAE) is an important stakeholder, particularly for achieving the conservation goals: maintenance of the species' remaining habitat (Chapter 4.1), restoration of woody vegetation in deforested areas and grass páramos (Chapter 4.2), and the formal recognition of community and private reserves (Chapter 1.2.1.2). In 2007, the newly-elected government transferred jurisdiction for state-owned forests lying outside of protected areas from the Ministry of Environment to the Ministry of Agriculture, making the latter an additional key stakeholder in conservation efforts. The Ministry of Energy is another important player, due to the numerous

mining concessions in Canton Cotacachi, which cover large portions of the puffleg's presumed habitat in the Cordillera de Toisán (Chapter 1.2.1.2).

*Action in place.* – Various conservation organizations (e.g., Corporación Ecoruta, Maquipucuna, Mindo Cloudforest) maintain contact with several governmental institutions, e.g., the Municipality of Quito, Consejo Provincial de Pichincha, Ministry of Environment, and Ministry of Tourism. In 2007, Aves & Conservación and the Museo Ecuatoriano de Ciencias Naturales (MECN, a governmental institution) implemented a joint monitoring program for Black-breasted Puffleg and other bird species on the northwestern slope of Volcán Pichincha (Chapter 3.9). Nubesierra Foundation also secured funding to join this monitoring program.

*Action needed.* – Conservation organizations should strengthen their relationships with governmental institutions and identify common conservation interests benefiting the Black-breasted Puffleg, especially in Canton Cotacachi and Canton Imbabura. The proposed GIS database (Chapter 1.4.1) should be used to identify those government sponsored development activities that might have direct impacts on habitat within the known and presumed range of Black-breasted Puffleg. Some conservation goals will not be achieved without an efficient coordination with governmental organizations.

For example, conservation organizations should cooperate closely with the environmental police to improve the enforcement of existing legislation; efforts to restore woody vegetation in the grass páramos of Volcán Pichincha should be coordinated with the Metropolitan Water Company of Quito (EMAAP-Q); and finally, comprehensive conservation and development measures cannot be implemented without the collaboration of the municipalities in the project areas.

#### 1.4.2.4 NON-GOVERNMENTAL ORGANIZATIONS (NGOs)

*Current situation.* – Aves & Conservación has been leading research activities on the status of Black-breasted Puffleg and its habitat since 1999, and to that end, collaborating with several other international (e.g., BirdLife International) and national organizations (e.g., Jatun Sacha–CDC, Jocotoco and Nubesierra Foundations, Museo Ecuatoriano de Ciencia Naturales). Nubesierra and Jocotoco own, respectively, 1,269 and c.1,000 ha of the puffleg's key habitat on the northwestern slope of Volcán Pichincha (Chapter 4.1).

*Action in place.* – Aves & Conservación, Jocotoco Foundation, and Nubesierra Foundation are in contact with several other national and international NGOs. Jatun Sacha Foundation and Aves & Conservación are developing joint project proposals in favor of local communities on Volcán Pichincha. In the Íntag valley, DECOIN and Rainforest Concern have been coordinating their conservation efforts in that area. However, if comprehensive conservation and development measures are to be implemented to benefit the Black-breasted Puffleg, a much broader coalition of stakeholders has to be established.

*Action needed.* – A broad coalition of non-governmental organizations has to be built to develop and implement comprehensive conservation and development measures in the range of Black-breasted Puffleg. All conservation organizations should strengthen their existing contacts and form new alliances with other NGOs that are active in the geographic area and field of interest.



# 2. COMMUNICATION AND EDUCATION

## 2.1 FORMAL EDUCATION

*Current situation.* – The Government provides formal education in all of the administrative districts (parroquias) of importance for the conservation of the Black-breasted Puffleg (Tab. 2-1), although it is often poor in quality. In Pichincha province, the rate of analphabetism among the adult and youth population (older than 10) is relatively low at 6.3–17.2%. No up-to-date data are available for Imbabura, but it would seem likely that the proportion of analphabets is higher.

*Action in place.* – The government provides formal education in most rural communities. In 2007, Aves & Conservation, with support of the EcoFondo, produced folders with didactic material for primary school teachers providing information about the Black-breasted Puffleg and the importance of montane forests for the conservation of high-Andean biodiversity. These environmental education materials were distributed in the communities on the northwest slope of Volcán Pichincha, and will be included in the schools' curricula.

*Action needed.* – The scope of the awareness campaign targeting school children and teachers has to be widened geographically and thematically. The program should aim to strengthen local capacity and knowledge about the environment in general, and threatened high-Andean biodiversity in particular (Chapter 2.2).

## 2.2 AWARENESS

*Current situation.* – After an intense lobbying campaign led by CECIA (now Aves & Conservación), Black-breasted Puffleg was declared “the emblematic bird of Quito” by municipal resolution no. 481 (23 June 2005). The Corporación Ecoruta and CORPEI have carried out workshops to raise awareness of the economic potential of biodiversity conservation for future ecotourism activities on the northwest slopes of Volcán Pichincha. In the same area, Aves & Conservación has been implementing an outreach program with the goals of strengthening the relationship with local stakeholders, promoting widespread knowledge of the Black-breasted Puffleg and its uniqueness, and developing attitudes supportive of measures to conserve its habitat and associated biodiversity. Furthermore, the Environmental Fund of Quito's Metropolitan District is supporting a project (proposed by Aves & Conservación) which aims to raise awareness among Quito's school and high-school students of the severe impacts climate change might have on high-Andean biodiversity and the livelihoods and living conditions of the human population (e.g., water shortages). Corporación Ecoruta is planning the construction of three tourist information centers and Jocotoco Foundation wants to build an environmental education center in the Yanacocha Reserve. Some other

organizations (e.g., Jatun Sacha Foundation) are also planning activities focused on enhancing the awareness and technical capacity of local stakeholders, particularly communities. DECOIN has been carrying out awareness campaigns regarding watershed protection, which through the establishment of community reserves and reforestation programs indirectly benefit the Black-breasted Puffleg. The Ministry of Tourism is willing to co-finance the production of additional environmental education materials, and the biologist and artist Juan Manuel Carrión has expressed his interest in collaborating in this process, particularly in the elaboration of booklets, posters, and documentary films.

*Action in place.* – Corporación Ecoruta has published a booklet for local people and tourists, with information about the geology, archaeology, landscapes, and biodiversity of the Ecoruta ‘El Paseo del Quinde’. In 2007, Aves & Conservation, with support of the EcoFondo, produced an educational brochure for the general public about the Black-breasted Puffleg and its habitat, which was distributed among the communities on the northwest slope of Volcán Pichincha. The same organization has been promoting the formation of Local Conservation Groups for the IBA ‘Mindó and Western Slopes of Volcán Pichincha’ (IBA EC043), and other areas, with the goal that these groups become actively involved in the conservation and management of the IBA. They are receiving training in bird-monitoring, administration, and fundraising, with the aim that each group becomes self-sustaining in the medium-term.

*Action needed.* – A comprehensive multilevel awareness program should be designed and implemented in Canton Cotacachi. If the presence of a population of Black-breasted Puffleg is confirmed for Volcán Atacazo, then the awareness campaign should be extended to that area as well. Target groups are the local communities and private landowners and NGOs, in addition to the municipalities and government institutions. The program and topics will have to be adapted for each target group. In Canton Quito, NGOs and others should capitalize on the declaration of the Black-breasted Puffleg as “the emblematic bird of Quito” to promote additional conservation action, and in particular to access novel sources of funding for conservation and development projects for local communities (e.g., Yanacocha, Alaspungo, Alambi, and La Sierra).

The design of an awareness program for Black-breasted Puffleg must take into consideration that the conservation of an unobtrusive hummingbird species will not be a topic of importance for the majority of rural people, especially for those who live in poverty. Thus, the campaign should focus on more tangible environmental problems, e.g. water scarcity and potential economic alternatives if forest cover is maintained or restored (e.g., ecotourism, payments for environmental services). Educational

Table 2-1. Number of schools and levels of analphabetism in the administrative districts (parroquias) of importance for the conservation of Black-breasted Puffleg. Based on Valarezo (2006) and Poats (2006).

ADMINISTRATIVE DISTRICT	CANTON	PROVINCE	NUMBER OF SCHOOLS	ANALPHABETISM: AGE >10 YEARS (%)
Mindo	Los Bancos	Pichincha	7	6.3
Lloa	Quito	Pichincha	7	10.6
Nono	Quito	Pichincha	5	17.2
Imantag	Cotacachi	Imbabura	9	?
Apuela	Cotacachi	Imbabura	9	?
6 de Julio Cuellaje	Cotacachi	Imbabura	9	?
Peñaherrera	Cotacachi	Imbabura	13	?
García Moreno	Cotacachi	Imbabura	39	?

materials focused on the puffleg should provide information about the severe effects of global warming on the long-term survival of high-Andean ecosystems and their biodiversity. Other threatened animal species that are more charismatic and might function as an umbrella or flagship for intact high-Andean forest ecosystems, such as Spectacled Bear (*Tremarctos ornatus*), should be also used to promote the importance of conserving native vegetation cover. Environmental impacts of charcoal production, deforestation, forest fires, and burning of páramo grasslands should be core topics. Awareness workshops and training events should also focus on related topics such as the prevention and fighting of forest fires, livelihood alternatives, and the improvement of land-use practices.

Environmental education talks should be held in as many schools as possible in each of the two relevant cantons. Several awareness events per year should be also carried out in each local community and private landowners invited to attend. Ideally, park rangers and other representatives of the Ministry of Environment (MAE) should also participate to explain relevant legislation regarding land tenure, habitat conversion, charcoal production, and fire prevention. Regular meetings should be held with all key stakeholders (NGOs, government institutions, community representatives, etc.) to provide updates regarding the implementation of the action plan. Once the environmental education center in Jocotoco's Yanacocha Reserve is available, environmental education events and excursions should be conducted on a regular basis, especially for schoolchildren, as no classroom talk can equal the experience of observing the colorful diversity of hummingbirds at a feeder. With luck the children could even see a Black-breasted Puffleg. Finally, local communities should be informed about the scope and implementation of the existing contingency plan for accidents along the OCP pipeline. The pipeline crosses the Black-breasted Puffleg's range on the northwestern slope of Volcán Pichincha.

### 2.3 CAPACITY-BUILDING/TRAINING

*Current situation.* – The survival of the Black-breasted Puffleg primarily depends on the maintenance of its remaining forest habitat and restoration of woody vegetation in deforested areas and extensive grass páramos within the species' upper altitudinal range (Chapter 4.2). To reduce

human pressure on forests it is necessary to improve productivity of existing agricultural lands (e.g. milk production) and to provide true livelihood alternatives (e.g. ecotourism, trout farms, etc.). The implementation of any of these activities will not be possible without comprehensive training programs for local people. Such training programs should be included within integrated conservation and development projects (Chapter 1.3.3). As a first step, Aves & Conservación plans to train members of the Alaspungo community in providing services to national visitors, primarily school and high-school students from Quito, who will visit the area as part of an awareness campaign on the adverse effects of climate change on high-Andean ecosystems.

The Ministry of the Environment and Ministry of Tourism are willing to provide training for paid park rangers, and for private landowners and community members who are willing to collaborate as volunteers in the surveillance of Bosque Protector Mindo–Nambillo. Finally, monitoring of the Black-breasted Puffleg population cannot be implemented without a capacity-building and training program for students, biologists, and birdwatchers (Chapter 3.9, Appendix 5).

*Action in place.* – DECOIN has been providing training for local people in the management of tree nurseries and reforestation techniques. Rainforest Concern, Maquipucuna, Jocotoco, Nubesierra, Mindo Cloudforest Foundation and others have been training numerous park rangers from local communities for their private reserves. In 2007, as part of the bird monitoring program on the northwest slopes of Volcán Pichincha (Chapter 3.9, Appendix 5) Aves & Conservación trained two young biologists in the Transect Mapping methodology. Additionally, local people have learned basic bird monitoring, administration and fundraising techniques within Aves & Conservación's IBA Local Conservation Groups project.

*Action needed.* – Capacity building must be designed and implemented as an integral part of conservation and development projects (Chapter 1.3.3), focusing on livelihood alternatives and the improvement of existing management techniques.

# 3. RESEARCH ACTIONS

## 3.1 TAXONOMY

*Current situation.* – No action required. The status of *Eriocnemis nigrivestis* as a valid species has apparently not been questioned since its scientific description as *Trochilus nigrivestis* by Bourcier & Mulsant (1852) (Remsen *et al.* 2006). It is closely related to *E. vestita* and *E. derbyi* (Heynen 1999), and almost identical in coloration and overall appearance to the recently described *E. isabellae* (Cortés-Diago *et al.* 2007). *E. nigrivestis*, *E. isabellae*, and *E. vestita* probably represent a superspecies (Cortés-Diago *et al.* 2007).

## 3.2 POPULATION NUMBERS AND RANGE

*Current situation.* – More than 100 museum specimens are known (covering an altitudinal range of 2,440-4,725 m), though most have little information on their labels (Collar *et al.* 1992). Only a few records have been published for the period 1950 to 2000 (Bleiweiss & Olalla 1983, Krabbe *et al.* 1994, Ridgely & Greenfield 2001). With the exception of one record, all of these were from the northwestern ridge-crests of Volcán Pichincha: Alaspungo, Cerro Pugsi, Loma Frutillas, Loma Gramalote, and above Yanacocha (see Tab. 3-1 for geographic coordinates and altitudes). The one exception refers to a sighting in 1983 of a possible female from the neighboring Volcán Atacazo. The species is only known from this site from three males collected in 1898 (Collar *et al.* 1992).

Since October 2000, a specific monitoring program for Black-breasted Puffleg has been carried out by Aves & Conservación (e.g., Santander *et al.* 2004), supplemented by opportunistic observations of the species by Yanacocha Reserve personnel (F. Sornoza M. pers. comm.). These efforts have produced yearly records on the northwestern slopes of Volcán Pichincha, with several individuals seen or mist-netted at various

sites between 2,700 and 3,500 m. In 2006, a new site for the species was discovered at Hacienda La Merced de Nono, on the northernmost slope of the volcano (P. Mena V. pers. comm.). Presumed dispersing individuals, particularly immature birds, are occasionally found at considerably lower altitudes, e.g., Reserva Las Galarías at 2,070 m (Lyons & Santander 2006) and Sachatamia Lodge at 1,700 m (*vide* F. Sornoza). However, the observer of the latter record is not known, the circumstances of the observation have not been reported, and there appears to be no verifiable documentation (e.g., photographs).

Within the species' known range of 44 km<sup>2</sup> on the north-western flanks of Volcán Pichincha, only 33.8 km<sup>2</sup> of suitable habitat remains (Santander *et al.* 2004). However, Black-breasted Puffleg is likely also to be present on the volcano's west slope, which is covered by primary forest but remains unstudied due to its inaccessibility (Santander *et al.* 2004, Jahn 2008). Consequently, BirdLife International (2006) estimated the species' Extent of Occurrence (IUCN 2001) to be 80 km<sup>2</sup> and based a population estimate of 160 individuals on the following reasoning: 20% of the Extent of Occurrence occupied, population density of 10.0 individuals/km<sup>2</sup> (the lowest of six population density estimates for five species of similar-sized, high altitude hummingbirds). This estimate was then placed in the range of 50-249 individuals. In 2006, Black-breasted Puffleg was rediscovered in the Cayapachupa area, Cordillera de Toisán, above the Íntag valley, a historical locality for the species (Jahn 2008). Suitable habitat for this population is believed to occur in two areas: c.24 km<sup>2</sup> of known and projected habitat in the Cayapachupa area, and c.30 km<sup>2</sup> projected to occur on the flanks of the highest ridges of the Cordillera de Toisán (determined through remote sensing). The former is restricted to Esmeraldas province, while the latter also includes forest remnants on

Table 3-1. Known collecting localities for the Black-breasted Puffleg *Eriocnemis nigrivestis*, with coordinates, altitude, and year of last record. See Figure 3-1 for the geographic position of each site. Brackets at the site number and geographic coordinates imply that the exact locality is unknown (historic records). Table adapted from Santander *et al.* (2004: Table 1), Lyons & Santander 2006, Jahn (2008); E. Guevara, R. Maldonado, P. Mena V., F. Sornoza M., and J. C. Valarezo pers. comm. Some specimens, e.g., 'Tumbaco', 'Napo' and 'Sarayacu' are considered to be mislabeled (Collar *et al.* 1992), and thus have been omitted (though see Schuchmann *et al.* 2001).

LOCALITY	SITE NO. FIG. 3-1	MOUNTAIN MASSIF / SUBPOPULATION	PROVINCE	COORDINATES	ALTITUDE (m)	YEAR OF LAST RECORD
Cerro Atacazo	(20,21)	Volcán Atacazo	Pichincha	(0°22'S, 78°38'W)	3,000 - 4,450	1898 (1983?)
Loma Gramalote	16	Volcán Pichincha	Pichincha	0°07'S, 78°36'W	3,250	1993
Cerro Pugsi	(14),15	Volcán Pichincha	Pichincha	0°06'S, 78°36'W	3,000	2007
Yanacocha	18,(17,19)	Volcán Pichincha	Pichincha	0°06'S, 78°35'W	3,200 - 3,500	2007
Verdecocha	(11),12,13	Volcán Pichincha	Pichincha	0°05'S, 78°36'W	2,800 - 3,400	2007
Loma Frutillas	(10)	Volcán Pichincha	Pichincha	(0°05'S, 78°34'W)	3,150	Unknown (historic site)
Sachatamia	4	Volcán Pichincha	Pichincha	0°02'S, 78°46'W	1,700	2006
Loma La Bola	9	Volcán Pichincha	Pichincha	0°02'S, 78°38'W	2,700	2006
Loma Chiquilpe	8	Volcán Pichincha	Pichincha	0°02'S, 78°36'W	3,250	2002
La Merced de Nono	7	Volcán Pichincha	Pichincha	0°02'S, 78°32'W	3,000 - 3,200	2006
Reserva las Galarías	6	Volcán Pichincha	Pichincha	0°01'S, 78°44'W	2,070	2005
Alaspungo	(5)	Volcán Pichincha	Pichincha	(0°00'S, 78°36'W)	3,200	Unknown (historic site); rediscovered in 2007
'Íntag'	(3)	Cordillera de Toisán	Imbabura	(0°24'N,78°36'W)	unknown	Unknown (historic site)
Cayapachupa	1,2	Cordillera de Toisán	Esmeraldas, Imbabura	0°33'N,78°29'W	3,200 - 3,300	2007



the eastern slope of the cordillera located in Imbabura province. These two areas are separated by a section of *c.* 10 km where the cordillera does not exceed 2,800 m, approximately the lowest altitude of recent records on Volcán Pichincha (Santander *et al.* 2004), though presumed seasonal migrants or dispersing birds have been recorded somewhat lower. Using BirdLife International’s precautionary calculation (see above), the Toisán population can be estimated at 48-108 birds, yielding a global population of 208-268 mature individuals. A small population (perhaps 10-50 individuals) might also survive on the south-western flanks of Volcán Atacazo, where a few hundred hectares of appropriate habitat remain. As a result, the revised total population estimate should probably be placed in the range of 250-999 individuals (Jahn 2008). Consequently, the species’ global population might be slightly larger than previous estimates have suggested. However, unless fieldwork confirms its presence on the west slope of Volcán Pichincha and/or the main Toisán massif, or its continued presence on the southwest flanks of Volcán Atacazo, the puffleg’s threat status (Critically Endangered) should not be changed.

*Action in place.* – Since October 2000, Aves & Conservación has been monitoring the presence/absence of Black-breasted Puffleg (and other birds) at 1-4 key sites on the northwestern slope of Volcán Pichincha. A population monitoring program was initiated in early 2007 in cooperation with the Museo Ecuatoriano de Ciencias Naturales (MECN) (Chapter 3.9). Aves & Conservación is working on a model of the current potential range of the species, taking into consideration all recent records, as well as a set of climatic and ecological variables.

*Action needed.* – Two types of studies are needed: (a) fieldwork in poorly studied areas of appropriate habitat, particularly on the Volcán Atacazo, the western slopes of Volcán Pichincha and the main Toisán massif, and (b) a long-term monitoring study (Chapter 3.9).

### 3.3 BIOLOGY AND ECOLOGY

*Current situation.* – Black-breasted Puffleg tends to be rare and local even within its preferred altitudinal range and habitat. Recent observations on Volcán Pichincha have revealed that the species does not strictly depend on a particular type of ridge-crest elfin forest, as was suggested by Bleiweiss & Olalla (1983). In fact, most recent records of the species come from scrubby forest edges at road sides, on steep slopes with stunted vegetation, and from the interior of montane forest with a canopy height >15 m and light gaps (Santander *et al.* 2004; Jahn 2008).

In 2006, two males were even recorded in a 75 ha forest fragment at Hacienda La Merced de Nono, on the northernmost slope of Volcán Pichincha (P. Mena V. pers. comm.). Black-breasted Puffleg has been recorded feeding on the nectar of 29 plant species in 11 families, including 8 species of Ericaceae (Tab. 3-3). Thus, it seems unlikely that its rarity is the result of a specialized diet. However, local and seasonal occurrence patterns might be linked to the staggered flowering periods of certain plant species along altitudinal gradients (e.g., Bleiweiss & Olalla 1983). Historical museum specimens and sight records suggest that formerly the species was most numerous between 2,440-3,050 m during April



Ecuadorian biologist taking measurements of a captured hummingbird (Campanario, Pichincha, 2,500 m, 7 May 2003; photo: Fabián Cupuerán – Aves & Conservación).

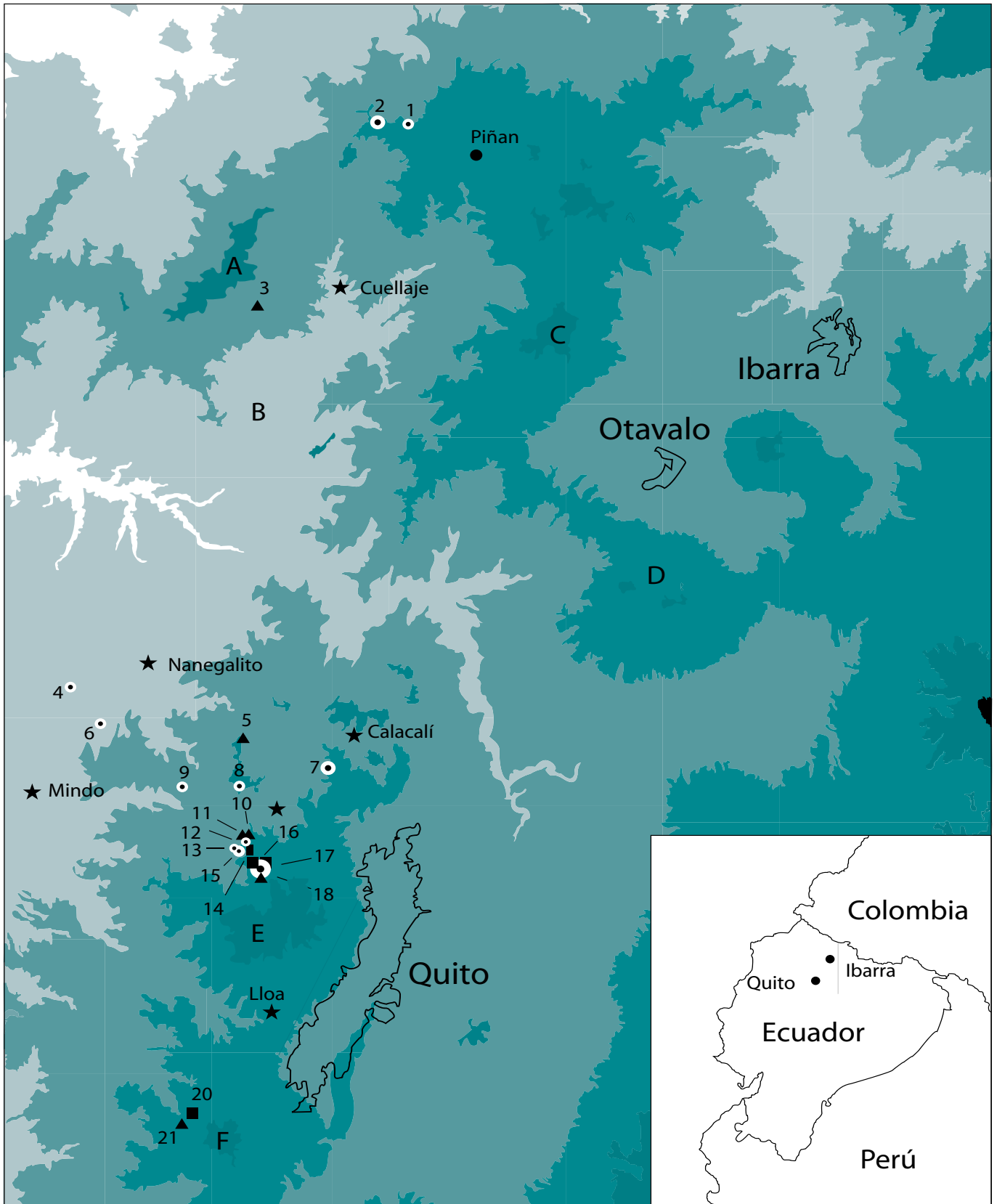
to September, and between 3,100-4,725 m from November to February (Bleiweiss & Olalla 1983, Collar *et al.* 1992, Heynen 1999). However, new data from Volcán Pichincha and the Cordillera de Toisán suggest that either seasonal movements are more complex than previously thought or that the patterns have changed in recent years. Recent records come from Reserva Las Gralarias (2,070 m) in December and January, the lower parts of Hacienda Verdecocha including Cerro Pugsí (2,800-3,100 m) in March, July, September, and November, Cayapachupa (3,100-3,400 m) in August and September (Jahn 2008), and Yanacocha (3,200-3,400 m) in almost all months of the year (Santander *et al.* 2004, Santander unpubl. data, F. Sornoza M. pers. comm.). Only those observations from Loma Chiquilpe (3,250 m) in September to April appear to match the historical pattern (Tab. 3-4).

The Black-breasted Puffleg’s breeding season most likely coincides with the rainy season, which occurs from October to March (Heynen 1999).

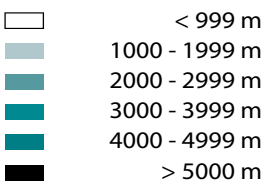
Table 3-2. Estimated Extent of Occurrence and population size for the three presumed extant populations of Black-breasted Puffleg *Eriocnemis nigrivestis*. Population estimates are based on the following reasoning (*sensu* BirdLife International 2006): (a) 20% of the Extent of Occurrence occupied, (b) estimated population density of 10.0 individuals/km<sup>2</sup>. References: (a) Volcán Pichincha (and Volcán Atacazo?) = BirdLife International (2006); (b) Cordillera de Toisán = Jahn (2008).

SUBPOPULATION	EXTENT OF OCCURRENCE (KM <sup>2</sup> )	POPULATION ESTIMATE		
		MATURE INDIVIDUALS	RANGE	DATA QUALITY
Volcán Pichincha	80	160	50 – 249	medium
Volcán Atacazo	5	10 – 50	0 – 50	low
Cordillera de Toisán	24 - 54	48 –108	50 – 249	medium
Total	109 – 139	218 – 318	250 – 999	medium

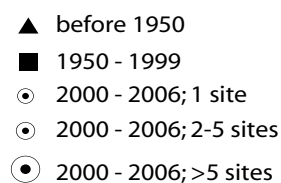




**Altitudinal Ranges**



**Records**



**Other symbols**

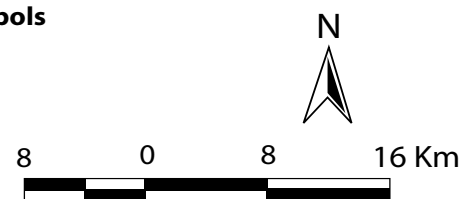


Figure 3-1. Recent and historical records of Black-breasted Puffleg. See Tab. 3-1 for the names, geographic coordinates and altitude of the localities, and dates of last record. Note that the precise localities are unknown for several historical records. Abbreviations: A= Cordillera de Toisán, B= Íntag Valley, C= Volcán Cotacachi, D= Mojanda Mountains, E= Volcán Pichincha, F= Volcán Atacazo.

Table 3-3. Known food plants of the Black-breasted Puffleg on the northwestern slopes of Volcán Pichincha (following Santander *et al.* 2004; modified by Germán Toasa).

SPECIES	COLOR OF FLOWER	SOURCE
<b>Ericaceae</b>		
<i>Macleania cf. rupestris</i>	Pink	Krabbe <i>et al.</i> 1994, Santander unpubl. data
<i>Macleania macrantha</i>	Orange	Bleiweiss & Olalla 1983
<i>Thibaudia floribunda</i>	Red and white	Bleiweiss & Olalla 1983
<i>Disterigma cf. acuminatum</i>	White	Bleiweiss & Olalla 1983
<i>Disterigma acuminatum</i>	Pink	Bleiweiss & Olalla 1983
<i>Disterigma empetrifolium</i>	Pink	Santander unpubl. data
<i>Pernettya prostrata</i>	Green	Santander unpubl. data
<i>Themistoclesia dependens</i>	White	Germán Toasa & Tatiana Santander unpubl. data
<b>Rubiaceae</b>		
<i>Manettia recurva</i>	White	Bleiweiss & Olalla 1983
<i>Palicourea amethystina</i>	Blue	Bleiweiss & Olalla 1983, Krabbe <i>et al.</i> 1994
<i>Psychotria uliginosa</i>	White	Bleiweiss & Olalla 1983, Krabbe <i>et al.</i> 1994
<b>Gesneriaceae</b>		
<i>Heppiella repens</i>	Red	Germán Toasa & Tatiana Santander unpubl. data
<i>Heppiella ulmifolia</i>	Red	Bleiweiss & Olalla 1983
<b>Melastomataceae</b>		
<i>Miconia corymbiformis</i>	Pale yellow	Bleiweiss & Olalla 1983
<i>Miconia hymenanthera</i>	Yellow	Bleiweiss & Olalla 1983
<i>Miconia</i> sp.	Yellow	Santander 2001
<i>Brachyotum gleasonii</i>	Yellow	Mazariegos pers. com.; Germán Toasa & Tatiana Santander unpubl. data
<b>Lobeliaceae</b>		
<i>Centropogon erianthus</i>	Orange	Germán Toasa & Tatiana Santander unpubl. data
<i>Siphocampylus</i> sp.	Yellow	Navarrete pers. com.
<i>Burmeistera</i> sp.	Green	Bleiweiss & Olalla 1983
<b>Onagraceae</b>		
<i>Fuschia cf. silvatica</i>	Red	Bleiweiss & Olalla 1983
<i>Fuschia dependens</i>	Red	Aldás & Rodríguez pers. com.
<b>Tropaeolaceae</b>		
<i>Tropaeolum pubescens</i>	Pink	Bleiweiss & Olalla 1983
<i>Tropaeolum smithii</i>	Red	Germán Toasa & Tatiana Santander unpubl. data
<b>Rosaceae</b>		
<i>Rubus</i> sp.	Pink	Bleiweiss & Olalla 1983, Aldás & Rodríguez pers. com.
<b>Gentianaceae</b>		
<i>Gentianella jamensonii</i>	Red	Santander unpubl. data
<b>Asteraceae</b>		
<i>Barnadesia arborea</i>	Pink	Aldás y Rodríguez pers. com.
<i>Verbesina</i> sp.	White	Santander unpubl. data
<b>Elaeocarpaceae</b>		
<i>Vallea stipularis</i>	Pink	Krabbe <i>et al.</i> 1994

This is when the species might be expected to be most common at the upper end of its altitudinal range (see above). The only recent breeding data is a mist-netted female with a well-developed brood patch, caught in early March at Cerro Pugsí (3,000 m), within the Hacienda Verdecocha (Santander *et al.* 2004). The number of individuals present at any particular site appears to fluctuate considerably. For example, at Cayapachupa the species was rare in 2006 but uncommon to fairly common in 2007 (Jahn 2008). At Yanacocha, 13 individuals were present in 2001 but only a few in the same months of the following year (Santander *et al.* 2004), and only one individual was recorded during the entirety of 2006. Jocotoco's park rangers, who pay considerable attention to hummingbirds and keep records of all observations of Black-breasted Puffleg, patrol the reserve on most days of the year (F. Sornoza pers. comm.). Thus, it is likely that such fluctuations in numbers are genuine, at least along the trails frequented by the guards.

*Action in place.* – Data on the occurrence, habitat preferences, and food plants of Black-breasted Puffleg have been collected as part of the monitoring project conducted by Aves & Conservación on the northwestern slope of Volcán Pichincha (Chapter 3.9). In 2007, Jocotoco Foundation initiated a project on the reproductive biology of the species. One aim is to clarify the habitat requirements for nest sites.

*Action needed.* – Additional data on the ecology of Black-breasted Puffleg should be collected as part of the proposed long-term monitoring study of all extant subpopulations (Chapter 3.9). The Ministry of the Environment would be willing to co-finance accompanying thesis work on the ecology of the species.

### 3.4 HABITAT STATUS

*Current situation.* – The only study of habitat status and change within the range of the Black-breasted Puffleg is that of Santander *et al.* 2004, who





Black-breasted Puffleg is more of a generalist feeder than previously thought. Currently, at least 29 food plants of 11 families are known (upper left: *Thibaudia floribunda* Kunth (Ericaceae), Alaspungo, Pichincha, 2,900 m, 12 October 2006; photo: G. Toasa; upper right: *Palicourea amethystina* (Rubiaceae), Alaspungo, Pichincha, 2,900 m, 12 October 2006; photo: G. Toasa; lower left: *Heppiella repens* (Gesneriaceae), Yanacocha, Pichincha, 3600 m, 13 October 2006; photo: G. Toasa; lower right: *Gentianella jamensonii* (Gentianaceae), Yanacocha, Pichincha, 3,500 m, date; photo: Tatiana Santander – Aves & Conservación).



compared aerial photographs of the northern and western slopes of Volcán Pichincha from the period 1982-2001 (Tab. 3-5 and Tab. 3-6). The study revealed an ongoing decrease and degradation of suitable habitat (mature forest, structurally intermediate forest, and young secondary vegetation) within the species' known altitudinal range. Mature forest declined by 6.2%, structurally intermediate forest by 18.0%, and secondary vegetation by 10.0%. These losses were accompanied by an increase in agricultural lands (of 24.7%). The rate of loss of primary habitat was significantly higher during 1996-2001 than during 1982-1996. By the end of 2001, only 5,684 ha of primary forest and 1,472 ha of appropriate secondary habitats remained within the puffleg's altitudinal range. However, this area includes a large portion of inaccessible primary habitat on the western slopes of Volcán Pichincha where the species has not been recorded (as presumably no fieldwork has ever been undertaken in that area). Locally, the loss of habitat has been much more severe, such as the Alaspungo-Chiquilpe area where 23% of the primary forest was cleared during the study period.

Within the documented range of Black-breasted Puffleg (that is, excluding the western flanks of Volcán Pichincha), Santander *et al.* (2004) estimated the remaining primary forest in 2001 to cover 2,582 ha, and secondary and disturbed vegetation to cover 1,460 ha. Santander *et al.* (*op. cit.*) considered that within the likely historical range of Black-breasted Puffleg suitable habitat has declined by 96.8% (1,046 km<sup>2</sup> to 33.8 km<sup>2</sup>). However, these figures do not include Volcán Atacazo, where the species might still be extant, or the 'Intag' area, where the species was recently rediscovered in the Cordillera de Toisán (Jahn 2008). Furthermore, grass páramos were not considered as lost habitat (Chapter 3.5). Jahn (2008) pointed out that recent authors have not adequately addressed one important aspect of the species' natural history and habitat requirements: Historical collecting data indicate that during the early rainy season (November to February) Black-breasted Puffleg occurred from 3,100 m to 4,725 m. This corresponds to the breeding season of the species (October to March). Collar *et al.* (1992, p. 517) considered that "records from above 4,000 m seem somewhat dubious as this is well above the treeline", citing the fact that data from historical specimens are often erroneous. Consequently, a number of recent authors have not taken into consideration historical records from above 3,500 m (e.g., Ridgely & Greenfield 2001). However, the absence of recent records of Black-breasted Puffleg above that altitude might be the key to understanding the species' decline.

Páramos have been altered by human activities over the course of many centuries and in particular through burning. In the Ecuadorian Andes, forest fragments currently occur up to 4,100-4,350 m. Typically, their borders are sharply delineated, evidence that they are conditioned by fire. Lægaard (1992) suggested that these fragments are remnants of previously more extensive high altitude forest cover. That is, that the original tree-line was likely 650-900 m higher than today. Although, most contemporary páramos probably existed already 150 years ago, when the species was first described, there is little doubt that their extension, general vegetation

cover, and floral composition has continually changed since then. It seems possible that Black-breasted Puffleg seasonally used high Andean montane forest and scrubland up to these altitudes, as suggested by the historical collecting data. Today, extensive grass páramos represent an uninhabitable vegetation type and insurmountable obstacle for seasonal migrations between the current timberline and remaining forest fragments at higher altitudes.

Thus, human activity might have destroyed a critical habitat in the species' annual life cycle, causing a bottleneck during the rainy (= breeding) season. If this assessment is correct, the species' conservation status might be even more complex and critical than previously thought. In particular, global warming might be an important factor in the survival of Black-breasted Puffleg in coming decades.

*Action in place.* – The Environmental Division of the Municipality of Quito is in the process of generating geo-referenced data on the current state of the environment in Canton Quito.

*Action needed.* – The hypothesis that Black-breasted Puffleg may have occurred well above 3,500 m in historical times should be tested above Yanacocha, where a mosaic of trees, shrubs, and perennial herbs still partially covers the steep western slopes of Volcán Pichincha up to about 4,200 m. Satellite images could be used to identify other potential study sites where corridors between the current timberline and fragments of forest or scrubland at higher altitudes persist. The monitoring of habitat change in the known and presumed range of Black-breasted Puffleg will be important for estimating its population size and trends (Chapter 3.9). Furthermore, this information will allow for the planning of habitat restoration programs (Chapters 4.2 and 4.3). We recommend that GIS-based studies on habitat status and changes in vegetation cover be carried out at five-year intervals. Shorter study intervals would increase costs, whereas longer intervals would prevent a fast response in the case of a rapid increase in the rate of habitat destruction, making immediate action necessary. A five-year period also coincides with the timeframes used in the IUCN Red List criteria. The habitat should be monitored in the range of all three subpopulations (Atacazo, Pichincha, Toisán). The study should also cover the entire known altitudinal range of the species (c.1,700-4,700 m) in order to gather information on the potential impacts of global warming. Furthermore, technical reports should take into consideration the different levels of political organization and land tenure, to allow a fine-tuning of conservation action (e.g., parroquias, community lands, private properties, governmental reserves, etc.).

### 3.5 THREATS

*Current situation.* – Habitat loss and degradation continue in the species' known range on the northwest slope of Volcán Pichincha, the main cause being the expansion of the agricultural frontier, particularly the establishment of cattle pastures (Santander *et al.* 2004). The felling of montane forest for timber and charcoal production is an ongoing threat in

Table 3-4. Months with confirmed records of the Black-breasted Puffleg at seven sites. These preliminary data have to be interpreted with caution, as the observer effort is variable and unknown for most sites, particularly for months with no records (light cells). More regular records at Yanacocha in comparison to other sites in the same altitudinal range may just reflect the much higher observer effort at this locality. Adapted from Santander *et al.* (2004: Table 2), Lyons & Santander 2006, F. Sornoza M. (pers. comm.), P. Mena V. (pers. comm.), and Jahn (2008).

LOCALITY	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
Reserva Las Gralarias (2,070 m)												
Loma La Bola (2,700 m)												
Verdecocha-Pugsi (2,800-3,000 m)												
La Merced de Nono (3,000-3,200 m)												
Loma Chiquilpe (3,250 m)												
Yanacocha (3,200-3,500 m)												
Cayapachupa (3,200-3,300 m)												





The puffleg’s local and seasonal occurrence patterns might be linked to staggered flowering phenologies of certain plant species along altitudinal gradients (Yanacocha, Pichincha, 3,500 m, 5 July 2001; photo: Francisco Enriquez).

many farms and communities (Chapter 1.2.2.3). Jocotoco Foundation’s Yanacocha Reserve protects about *c.* 1,000 ha of the hummingbirds’ key habitat. However, human-caused fires threaten large tracks of forest during the dry season, such as in August 2004 when several hectares of forest were destroyed. Nubesierra Foundation’s Hacienda Verdecocha Reserve of 1,269 ha, which shares borders with Yanacocha Reserve, also protects important habitat for the Black-breasted Puffleg. Furthermore, a large portion of the unexplored primary forests on the volcano’s west slope is within the limits of the Bosque Protector Mindo-Nambillo (19,200 ha). All three reserves form part of the Important Bird Area (IBA) ‘Mindo and western slopes of Volcán Pichincha’ (EC043; Freile & Santander 2005b). Illegal hunting and logging activities, as well as invasions by landless farmers, locally threaten the integrity of the IBA. However, it is unclear how much of Black-breasted Puffleg’s key habitat has been affected by this situation.

No recent fieldwork has been carried out at Volcán Atacazo, where some forest cover remains on steep slopes on the western and southern flanks

(IBA EC054; Freile & Santander 2005d). Thus, it is unknown whether a population of Black-breasted Puffleg survives there. Habitat degradation is continuing and likely threatens the integrity of the forest remnants, and as is the case with the Pichincha and Íntag populations, grass páramos have replaced the natural woody vegetation above the current tree-line at *c.* 3,500 m. The western slopes of the Cordillera de Toisán lay within the Cotacachi-Cayapas Ecological Reserve (IBA EC037; Freile & Santander 2005c). Forest cover is largely intact and pristine, but is locally threatened by the burning of páramo grasslands. Furthermore, local people from the village of Piñán openly admit that they are planning to establish cattle pastures on the pass southwest of Cayapachupa, where Black-breasted Puffleg was rediscovered in 2006 (Jahn 2008). Forest cover on the southern and eastern slopes of Cordillera de Toisán is severely fragmented. At least 10,000 ha are protected in various governmental and private reserves (IBA EC038: Íntag-Toisán; Freile & Santander 2005a), a small fraction of which might be located in the appropriate altitudinal range of Black-breasted Puffleg (Tab. 1-1). However, this area suffers from the continued encroachment of the agricultural frontier, timber harvesting, charcoal production, and pressure from various mining companies. Forest fires were frequent in August and September 2006, some of them immediately below the boundaries of the Cotacachi-Cayapas Ecological Reserve (Jahn 2008).

Given that Black-breasted Puffleg is likely vulnerable to the impacts of global climate change, it is particularly worrying that recent studies have demonstrated that greenhouse warming causes temperatures to rise faster in highland areas than in the lowlands (Bradley 2006). The average annual temperature in the tropical Andes increased by about 0.11°C per decade during 1939 to 1998, compared with the global average of 0.06°C per decade (Vuille *et al.* 2003). Furthermore, the rate of warming has doubled in the last 40 years, and tripled during the last 25 years of the twentieth century (Vuille & Bradley 2000). If current trends in greenhouse gas emissions continue, mean annual temperatures within the range (latitude and altitude) of Black-breasted Puffleg are expected to have increased by 3.5-4.5°C by the end of the twenty-first century (Bradley 2006). Mean annual precipitation in the same geographic area could increase by 6-20% by the 2080s (Hulme & Sheard 1999). Not surprisingly, the Tropical Andes are one of the biodiversity hotspots that are most sensitive to global warming, and 540-9,400 endemic plant species and 42-737 endemic vertebrate species have been predicted to be in risk of extinction within the next 100 years through changes resulting from global climate change (Malcolm *et al.* 2006). Black-breasted Puffleg could be one of these species, as predicted changes might push the habitable climate zone (the species’ “climate envelope”) above the current tree-line within decades. Some recent data indicate that this process might have already started, as suggested by the species’ presence above 3,100 m from April–September on Volcán Pichincha (Santander *et al.* 2004) and Cordillera de Toisán (Jahn 2008). Furthermore, Gorgeted Sunangel *Helianthus strophianus*, a potential competitor with Black-

Table 3-5. Extent of seven vegetation types within the altitudinal range of Black-breasted Puffleg on the northwestern slopes of Volcán Pichincha. Adapted from Santander *et al.* (2004). Note: Structurally intermediate forest is medium-age and selectively-logged forest.

VEGETATION TYPE	YEAR					
	1982		1996		2001	
	HECTARES	%	HECTARES	%	HECTARES	%
Mature Forest	6059.57	61.36	6021.27	60.98	5683.75	57.56
Structurally intermediate forest	707.80	7.17	678.04	6.87	580.10	5.87
Secondary vegetation	991.24	10.04	734.91	7.44	892.27	9.04
<b>Total appropriate habitat</b>	<b>7758.61</b>	<b>78.57</b>	<b>7434.22</b>	<b>75.29</b>	<b>7156.12</b>	<b>72.47</b>
Páramo	161.48	1.64	169.63	1.72	283.35	2.87
Agricultural lands	1931.83	19.56	2248.07	22.77	2409.40	24.40
Bare soil	10.42	0.11	10.43	0.11	10.43	0.11
Urban area	12.58	0.13	12.58	0.13	15.62	0.16
<b>Total inappropriate habitat</b>	<b>2116.31</b>	<b>21.44</b>	<b>2440.71</b>	<b>24.73</b>	<b>2718.8</b>	<b>27.54</b>

Table 3-6. Percentage change in habitat cover within the altitudinal range of Black-breasted Puffleg on the northwestern slopes of Volcán Pichincha. A negative number indicates habitat loss. Adapted from Santander *et al.* (2004).

VEGETATION TYPE	PERIOD					
	1982 – 1996		1996 – 2001		1982 – 2001	
	HECTARES	%	HECTARES	%	HECTARES	%
Mature forest	-38.30	-0.63	-337.52	-5.61	-375.82	-6.20
Structurally intermediate forest	-29.76	-4.20	-97.93	-14.44	-127.70	-18.04
Secondary vegetation	-256.33	-25.86	157.35	21.41	-98.97	-9.98
<b>Total appropriate habitat</b>	<b>-324.39</b>	<b>-4.18</b>	<b>-278.10</b>	<b>-3.74</b>	<b>-602.49</b>	<b>-8.42</b>
Páramo	8.15	5.05	113.72	67.04	121.87	75.47
Agricultural lands	316.24	16.37	161.33	7.18	477.57	24.72
Bare soil	0.00	0.03	0.01	0.05	0.01	0.08
Urban areas	0.00	0.00	3.04	24.19	3.04	24.19
<b>Total inappropriate habitat</b>	<b>324.39</b>	<b>15.33</b>	<b>278.10</b>	<b>11.39</b>	<b>602.49</b>	<b>22.16</b>

breasted Puffleg *E. nigrivestis*, seems to have expanded its altitudinal range in recent years (Jahn 2008). In summary, with natural habitat in the species' upper altitudinal range mostly destroyed, shifting climate zones caused by global warming and growing competition from at least one other similar-sized hummingbird, the Black-breasted Puffleg may quite literally have nowhere to go unless grass páramos on Pichincha, Atacazo, and Cordillera de Toisán reforest during coming years and decades. Disease or pathogens are not known to limit the species' population. If they do play a role, it is likely that habitat alteration and or global warming are exacerbating factors. Thus, conservation action should concentrate on habitat maintenance and restoration (e.g., Chapters 4.1 and 4.2). It is unknown if hummingbird feeders promote the transmission of pathogens that could affect Black-breasted Puffleg.

*Action in place.* – In addition to the GIS-based study on the status and changes in suitable habitat (Santander *et al.* 2004), general data on threats, such as habitat destruction through timber extraction, charcoal production, and the expansion of the agricultural frontier, have been collected opportunistically for certain localities as part of the monitoring project carried out by Aves & Conservación on the northwestern slope of Volcán Pichincha (Chapter 3.9).

*Action needed.* – The extent and condition of suitable habitat should be monitored at five-year intervals (Chapter 3.4). Data collected during the proposed long-term monitoring study (Chapter 3.9) should be assessed for indications of increasing interspecific competition and other impacts of climate change. In particular, the conditions under which Gorgeted Sunangel migrate upslope should be studied, as should the potential impacts of an increased abundance of this species above 2,800 m on populations of Black-breasted Puffleg. Although appropriately managed hummingbird feeders have not been reported to have negative impacts on hummingbird populations, studies should be undertaken on feeder-transmitted diseases to exclude this as a factor affecting Black-breasted Puffleg populations (Chapter 5.5). During the workshop on 22 January 2007 in Quito, Nubesierra Foundation and Jocotoco Foundation declared their interest in collaborating in a study on feeder-transmitted diseases. Habitat and site-based conservation action are proposed in Chapter 4.1.

### 3.6 USES AND HARVEST LEVELS

*Current situation.* – Local people from the northwestern slope of Volcán Pichincha report that until the 1970s (and possibly later) hummingbirds, including the Black-breasted Puffleg, were intensively trapped for international bird markets. Blowguns and mist-nets were the most frequently used methods to trap them. Fortunately, the illegal trade has ceased in recent decades, thanks in part to stricter controls at most international airports. In 2007, the import of wild birds into European Union member states was permanently banned, after politicians realized that the trade could promote the spread of avian influenza and other avian-borne diseases.

### 3.7 CULTURAL RELEVANCE

*Current situation.* – Although indigenous peoples throughout Latin America have traditionally used whole hummingbirds, feathers and nests, in adornments and cultural rituals (Schuchmann 1999), Black-breasted Puffleg does not appear to have a special cultural relevance. This is perhaps because most contemporary human settlements in the species' range were founded only a few decades ago, usually by landless farm workers, emigrating from other regions of Ecuador.

*Action in place.* – Black-breasted Puffleg has been declared as “the emblematic bird of Quito” by the city's municipal council (Chapter 2.2).

*Action needed.* – Stakeholders should develop and implement strategies promoting wider recognition of Black-breasted Puffleg by the general public and representatives of the municipality, exploiting that it is the emblematic bird of Ecuador's capital, an attraction for visiting bird watchers, and one of the most threatened species in the country.

### 3.8 CONSERVATION MEASURES

*Current situation.* – The only existing research-based conservation measure is the monitoring project carried out by Aves & Conservación on the northwestern slope of Volcán Pichincha (Chapter 3.9).

*Action in place.* – The aforementioned monitoring project led by Aves & Conservación, which now has a refined methodology that will generate quantitative data (Chapter 3.9).

*Action needed.* – In order to assess the effectiveness of implemented and proposed conservation measures and to study the impacts of global warming, it is necessary to monitor changes in the population and habitat status along altitudinal gradients within the species' range. The proposed bird monitoring study is designed to provide this information (Chapter 3.9). Studies on reforestation techniques for degraded lands (e.g., pastures) and grass páramos are another critical area for research-based conservation action (Chapter 4.2). Unfortunately, in the high Andes, subzero temperatures at night and strong winds are a major obstacle for habitat restoration efforts during the dry season. Considerable research has to be undertaken to develop viable solutions for appropriate reforestation programs. An additional challenge is the restoration of diverse mountain forests, containing important food plants for Black-breasted Puffleg, i.e., the hummingbird will not benefit from a monoculture of *Polylepis* trees. Considering the increasing use of hummingbird feeders in the area, studies on feeder-transmitted diseases should be carried out to exclude potential negative impacts on the species' population (Chapter 5.4).

### 3.9 TRENDS/MONITORING

*Current situation.* – Since October 2000, Aves & Conservación has been monitoring the presence/absence of Black-breasted Puffleg (and other birds) at 1-4 key sites on the northwestern slope of Volcán Pichincha.



The Black-breasted Puffleg might be present also on the volcano's west slope, which is covered by primary forest but remains unstudied due to its inaccessibility (Guarumos, Pichincha, 2,700 m, 4 March 2002; photo: Tatiana Santander - Aves & Conservación).

Until 2002, methods focused on standardized and non-standardized mist-netting. Since then, audio-visual methods, e.g., point counts and opportunistic observations at flowering food plants have been used. However, these survey techniques do not permit the estimation of the hummingbird's absolute population density, or the monitoring of changes in population size using statistical methods. Habitat changes have been assessed just once (in 2003) for the period 1986-2001.

*Action in place.* – Since 2007, Aves & Conservación and the Museo Ecuatoriano de Ciencias Naturales (MECN) have been implementing a monitoring program based on the Transect Mapping (MTW) protocol developed by Jahn (in press). Sites included in the initial phase of this monitoring study are the Yanacocha Reserve, Hacienda Verdecocha, and the community of Alaspungo. In 2007, a total of 19 records of at least 8 individuals of Black-breasted Puffleg were obtained on three of the four transects studied (E. Guevara, P. Mena V., and J.C. Valarezo, pers comm.). The Jocotoco Foundation, Nubesierra Foundation, and the communities of Alaspungo and Yanacocha have been providing logistical support for the study. In 2008, two additional transects were established and monitored in Hacienda Verdecocha.

*Action needed.* – Two types of monitoring programs are needed: (a) GIS-based analysis of habitat status and change repeated at five-yearly intervals (Chapter 3.4) and (b) long-term monitoring study to determine the absolute population density of the species, permitting the estimation of overall population size and the statistical testing of trends. The monitoring

program should be extended into poorly studied areas of suitable habitat in order to determine the Extent of Occurrence and Area of Occupancy of the species (Chapter 3.2), specifically, the western and southern slopes of Volcán Atacazo, the western and southern slopes of Volcán Pichincha, and the eastern and western slopes of the main massif of the Cordillera de Toisán (Tab. 3-7). Surveys should be carried out in the upper parts of the Maquipucuna Reserve.

The survey methods used in these studies should be the same as those used in long-term monitoring program, thereby ensuring the compatibility of the data. Selection of an appropriate monitoring method took into consideration that permanent marking (i.e. banding) of hummingbirds is problematic due to their very short tarsi (e.g. Stiles 1973). In consequence, capture-recapture studies of hummingbirds have their risks (e.g. Waser 1975), and thus are not recommendable for a Critically Endangered taxon. The 'Multi Time-Window Transect-Mapping' (MTW) protocol for monitoring studies provides a feasible alternative (Jahn in press). This audio-visual method permits the estimation of absolute population density of territorial species and other breeding residents, and thus the monitoring of changes in population size (Appendix 5).

Two peculiarities of the behavior of Black-breasted Puffleg influence the species' probability of detection in audio-visual surveys. On the one hand, it rarely vocalizes, and thus can be easily overlooked. However, on the other hand, it inhabits the shrub level where its wing whirrs can be detected. Thus, monitoring staff have to be well trained in tracking down the source of hummingbird wing whirrs, so that the number of Black-breasted Pufflegs detected reflect the true number of individuals present along the transect routes. Due to the fact that training a sufficient number of skilled researchers will take some time, the long-term monitoring program should be implemented over a period of about four years (See Appendix 5). Although four to six occupied transects could be enough to permit basic statistical testing between years and study periods (i.e., Mann-Whitney U and Wilcoxon's tests for matched pairs, respectively), the total number of surveyed transects needs to be considerably higher in the case of Black-breasted Puffleg.

This is due to the species' overall rareness and somewhat erratic seasonal movements. However, more transects mean higher costs. For this reason, we recommend that transects only be surveyed every second year (Tab. 3-7). The study design described here, is complementary with other standardized monitoring programs to be implemented by members of the Monitoring Network of Ecuadorian Vertebrates (Red MOVE-EC), an association of organizations and individuals who want to use Transect Mapping in various habitats and biogeographic regions of Ecuador in order to promote comparability and statistical testing of animal population data, by storing and analyzing them in a centralized database.



## 4. HABITAT AND SITE-BASED ACTIONS



Black-breasted Puffleg has been recorded from elfin forest on ridge-crests and montane passes, in the interior of montane forest (of canopy height >15 m), in light gaps, on steep slopes with stunted vegetation, and even from bushy forest-edges at road-sides (Yanacocha Reserve, Pichincha, 3,500 m, 13 October 2006; photo: G. Toasa).

### 4.1 MAINTENANCE/CONSERVATION

*Current situation.* – Part of the known range of Black-breasted Puffleg is located within governmental and private reserves (Tab. 1-1). However, our knowledge of the current conservation status and management of these reserves is very limited, particularly for those located in Imbabura province.

The situation in the better-known reserves can be summarized as follows: (1) As a result of funding constraints, no effective wardening/surveillance system has been implemented in the Bosque Protector Mindo-Nambillo. Consequently, numerous problems go unchecked, such as invasions by landless farmers and the expansion of the agricultural frontier beyond the farms with legal land titles in the reserve (Valarezo 2006). (2) The situation is better in the Cotacachi-Cayapas Ecological Reserve, where about six park rangers patrol the area that overlaps with the presumed northern range of Black-breasted Puffleg. However, these patrols have not proved sufficient to stop the expansion of the agricultural frontier within the borders of the reserve (O. Jahn pers. obs.). Furthermore, the burning of páramo grassland, scrubland, and forest is still a common practice, destroying the habitat of Black-breasted Puffleg and many other species. (3) Conservation efforts in the Yanacocha Reserve are focused on the preservation of the hummingbird's key habitat. The main threat is human-induced fires close to the reserve's boundaries during the dry season. (4) Nubesierra Foundation has also implemented various conservation

measures that aim to maintain and restore the high-Andean forests at Hacienda Verdecocha. However, neither Verdecocha nor Yanacocha have formal protected status (Chapter 1.2.1.2). Habitat maintenance is much more complex in community reserves (Chapter 4.5) and unprotected lands, such as on the northwestern slope of Volcán Pichincha and the eastern slopes of the Cordillera de Toisán.

*Action in place.* – In the main governmental reserves, Cotacachi-Cayapas Ecological Reserve and Bosque Protector Mindo-Nambillo, habitat conservation should benefit from new management plans (Chapter 1.1). After a dangerous forest fire in Yanacocha Reserve in August 2004, Jocotoco Foundation laid a hosepipe along the main access road to permit immediate responses to future fires (Chapter 1.1.1).

The Ecoruta 'El Paseo del Quinde: Nono – Tandayapa – San Tadeo' has been included in the 'National Strategy for Bird-related Tourism' (Mindo Cloudforest Foundation 2006), which is promoted by various NGOs (Mindo Cloudforest Foundation, Corporación Ecoruta), the Ministry of Tourism, and Ministry of the Environment. Hopefully, this will improve the conservation outlook for the puffleg's habitat, as ecotourism might generate direct benefits for local stakeholders, motivating them to maintain the remnant forest cover.

Since 2007, Aves & Conservación is promoting the formation of Local Conservation Groups (LCGs) for three IBAs in Pichincha province,





Human have altered high-Andean forests and páramos for thousands of years, particularly through wood-cutting, burning, and animal grazing. Today, the once continuous montane forests have been replaced by extensive grass páramo, dominated by fire-resistant bunch grasses. In coming decades, Black-breasted Puffleg may be literally forced out of existence by global warming, unless grass páramos on Pichincha, Atacazo, and in the Cotacachi-Cayapas Ecological Reserve are reforested with diverse communities of native plants (páramo of Piñán, Cotacachi-Cayapas Ecological Reserve, Imbabura, 3,400 m, 20 September 2007; photo: Olaf Jahn).

including the IBA ‘Mindó and western slopes of Volcán Pichincha’. The LCGs are being trained in project administration, bookkeeping, fundraising, and basic bird monitoring techniques in order to build their capacity to participate in and benefit from future conservation and development projects in the area.

*Action needed.* – Fieldwork is required to determine the status of Black-breasted Puffleg on the west slope of Volcán Pichincha, on Volcán Atacazo, and in the main massif of the Cordillera de Toisán (Chapter 3.9). A GIS database on land-ownership (Chapter 1.4.1) together with an analysis of habitat status (Chapter 3.9) will facilitate the design of strategies for habitat conservation and restoration in each area (e.g., Appendix 3a), including for existing reserves (Tab. 1-1). Formal legal protection should be obtained for all private reserves within the range of the species, through their declaration as ‘protection forests’ (bosques protectores), or other legal mechanisms that might be available in the future (Chapter 1.2.1.2). To minimize the impact of forest fires, an ongoing awareness campaign needs to be conducted in local communities with a focus on fire prevention and the formation of fire fighting brigades (Chapter 2.2).

The formation of Local Conservation Groups should be also promoted for other IBAs of importance for Black-breasted Puffleg, e.g., in the Íntag valley. For better-known reserves, conservation actions which need to be undertaken can be summarized as follows: (1) The implementation of an effective wardening/surveillance system for the Bosque Protector Mindó-Nambillo. This is an urgent priority, and to be effective, should employ at least six park rangers (Valarezo 2006). However, considering the limited funds available, it might not be feasible to maintain six full-time government employees. As an alternative, a community park-ranger scheme could be implemented (Chapter 1.1.2). Furthermore, the reserve limits and private lands have to be clearly demarcated with signs and boundary stones to deter colonists and discourage the expansion of the agricultural frontier within the park boundaries. (2) In the Cotacachi-Cayapas Ecological Reserve delimitation of the reserve boundaries with signs and boundary stones is also an urgent priority. At present, even the park rangers do not know the precise reserve boundaries. The surveillance system has to be improved to deter invasions and the expansion of the agricultural frontier. (3) The Yanacocha Reserve is an important access route to the western flanks of Volcán Pichincha, an area that can be reached with relative ease via the aqueduct trail (Santander *et al.* 2004). The Jocotoco Foundation plays, therefore, a key role in controlling access to the northeastern limit of Bosque Protector Mindó-Nambillo, and should coordinate surveillance activities and park-ranger training with the Ministry of the Environment, the Metropolitan Water Company

(EMAAP-Q), and Hacienda Verdecocha. (4) Hacienda Verdecocha needs an emergency plan for forest fires. This and other private reserves urgently need formal (legal) recognition of their status (Chapter 1.2.1.2). Additional site-specific conservation action is needed to improve habitat maintenance outside governmental and private reserves (Appendix 2a and 3a).

## 4.2 RESTORATION

*Current situation.* – Habitat restoration is an urgent priority within the upper altitudinal range of the species to help mitigate the likely impacts of global warming (Chapter 3.5). The new management plan for the Cotacachi-Cayapas Ecological Reserve, which was finished in June 2007, includes the recommendation that native woody vegetation should be restored in at least 30% (c.6,250 ha) of grass páramo within the reserve over a period of 25 years (Jahn 2006). However, the fact that most of the páramo lands are privately- or community-owned is a major obstacle to the implementation of such a program. A further problem is the climatic conditions, with night-time frosts during the dry season killing many planted trees. A possible alternative is natural regeneration. In this case, grazing animals have to be excluded (through fencing) and fires avoided. Habitat should also be partially restored on the northwestern slope of Volcán Pichincha and on the eastern slopes of the Cordillera de Toisán. In Bosque Protector Mindó-Nambillo, the government owns c.2,000 ha of grass páramo which would be ideal for the implementation of such a program.

*Action in place.* – Nubesierra Foundation has reforested 15 ha at Hacienda Verdecocha, and the goal is to restore up to 50 ha (R. Maldonado pers. comm.). Another reforestation program has been implemented in the Maquipucana Reserve (B. Castro pers. comm.), located at the periphery of the known range of Black-breasted Puffleg. Jocotoco Foundation recently purchased 30 ha of cattle pastures at the lower altitudinal limits of Yanacocha Reserve (F. Sornoza pers. comm.). Some funds for reforestation are already available, and Jocotoco also plans to promote the restoration of woody vegetation at the higher altitudinal limits of the reserve (between about 3,400-3,700 m). DECOIN has promoted reforestation in five community reserves in the Íntag valley, with a total of 20,000 trees planted. However, it is unclear if these reserves were located within the altitudinal range of Black-breasted Puffleg. Some communities on the northwestern slope of Volcán Pichincha are also interested in reforestation. The community of Alaspungo established a tree nursery with 3,000 trees of a none-native species, which will be planted within pastures and as ‘living fences’ at their limits. The ‘Corporación Vida para Quito’ has been providing trees for reforestation efforts in various areas within Canton Quito and would be interested in collaborating in similar efforts on the northwestern slopes of Volcán Pichincha. In the same area, the Ecoruta Project is planning to raise funds for additional reforestation efforts in local communities.



The expansion of the agricultural frontier, and particularly the establishment of cattle pastures and the felling of montane forest for timber and charcoal production, is the main threat to the species’ survival (Alaspungo, Pichincha, 2,800 m, 3 June 2006; photo: Camila Mafla – Aves & Conservación).



In 2006, a small but important population of Black-breasted Puffleg was discovered on the western slope of the Cordillera de Toisán. Intentionally set fires impede natural forest recovery on the ridge (Cayapachupa area, Cotacachi-Cayapas Ecological Reserve, at the limit between Esmeraldas and Imbabura, 3,450 m, 27 September 2007; photo: Olaf Jahn).

The Metropolitan Water Company (EMAAP-Q) planted thousands of *Polylepis* trees in the drainage of Río Pichán above Yanachocha, with limited success (most trees died in the dry season).

*Action needed.* – Key stakeholders should lobby for the partial restoration of native woody vegetation in deforested areas and the grass páramos of Pichincha, Atacazo, Cordillera de Toisán, and Cotacachi-Cayapas Ecological Reserve. In the corresponding awareness campaign, the main emphasis should be laid on the protection of critical watersheds and the protection of biodiversity (Chapter 2.2). Any reforestation program should be carefully planned. It is very important to restore biologically diverse plant communities, including hummingbird-pollinated tree and shrub species; i.e., Black-breasted Puffleg will not benefit from a monoculture of *Polylepis* trees. Due to the challenges represented by a restoration of woody vegetation in grass páramos, any mayor effort in this direction should begin with reforestation experiments, helping to determine the most cost effective techniques. The Ministry of the Environment is planning to raise funds for the implementation of the National Reforestation Plan which takes into consideration biodiversity conservation needs. Local and national stakeholders should also promote reforestation programs at lower altitudes ( $\leq 3,400$  m), particularly on the northwestern and northern slopes of Volcán Pichincha, the upper Íntag valley and the eastern slope of the Cordillera de Toisán. These programs should be developed within the context of the proposed GIS-database on vegetation cover (Chapter 3.4). In addition, agro-forestry plantations could provide livelihood alternatives for local people (Chapter 1.3.3).

### 4.3 CORRIDORS

*Current situation.* – Appropriate habitat on the northwestern flanks of Volcán Pichincha, western slopes of Volcán Atacazo, and the upper Íntag valley is now severely fragmented. Some known sites for Black-breasted Puffleg are already isolated from continuous habitat, such as the Hacienda La Merced de Nono on the northernmost slope of Volcán Pichincha. In other areas, e.g., the Río Alambi watershed, forest corridors persist locally. Some consist of large fragments of remnant natural forest, e.g., the community reserve of Alaspungo. Others represent only groups of shrubs and trees lining rivers and streams or forming ‘living fences’ between properties. The latter often consist of introduced plant species. As yet, it is unknown whether such narrow and often incomplete corridors facilitate the dispersion of Black-breasted Puffleg.

*Action in place.* – Although existing reserves maintain local habitat connectivity, to our knowledge there is no specific action in place that aims to maintain or reestablish corridors on a larger scale, such as entire watersheds (e.g., Río Alambi drainage).

*Action needed.* – Forest corridors are needed to connect habitat fragments in the areas of Nono, Alaspungo–Chiquilpe (Santander *et al.* 2004), and Hacienda Merced de Nono. It is likely that similar conservation action should be implemented also in the upper Íntag valley.

The analysis of current vegetation cover might reveal other sites where the establishment of corridors could restore habitat connectivity. The establishment of forest corridors should be designed using the proposed GIS database of vegetation cover and land-ownership (Chapters 1.4.1 and 3.4). The maintenance of existing corridors of remnant natural vegetation should have absolute priority. In the case of reestablishment of habitat connectivity, the same basic considerations should apply as those proposed for the reforestation program, particularly the need for careful planning and the restoration of biologically diverse plant communities (Chapter 4.2). In an initial phase, habitat connectivity could be reestablished through planting of hedgerows and similar types of ‘living fences,’ using native plant species.

## 4.4 PROTECTED AREAS

### 4.4.1 IDENTIFICATION OF NEW PROTECTED AREAS

*Current situation.* – Forest remnants at Loma Frutillas and Cerro Chiquilpe, both on the northwestern slope of Volcán Pichincha, have been identified as key sites for Black-breasted Puffleg that require absolute protection, e.g. through land purchase to create new protected areas (Santander *et al.* 2004). An alternative strategy would be the establishment of community or private reserves through payments for environmental services, or the implementation of projects providing livelihood alternatives (Chapter 1.3.3).

*Action in place.* – Some parts of the Important Bird Areas (IBAs) that overlap with the known and presumed range of Black-breasted Puffleg are not protected in any way. Thus, they should be regarded as potential areas for the establishment of new reserves. For example, most of the forested lands to the north of Bosque Protector Mindo-Nambillo are also located within the Important Bird Area ‘Mindo and western slopes of Volcán Pichincha’ (IBA-EC043; Freile & Santander 2005b) but are not formally protected.

*Action needed.* – Additional sites for the establishment of protected areas should be identified during future fieldwork (Chapter 3.9) supported by the GIS database on land-ownership and vegetation cover (Chapters 1.4.1 and 3.4).

### 4.4.2 ESTABLISHMENT

*Current situation.* – The establishment of new government-owned reserves is unlikely as the Ministry of Environment barely has the



View of the southwestern slope of the Íntag valley, a historical collection site of Black-breasted Puffleg, where some appropriate habitat remains. However, encroachment of the agricultural frontier and planned mining activities threaten large parts of the valley and the Cordillera de Toisán (Cayapachupa area, Cotacachi-Cayapas Ecological Reserve, Imbabura, 3,450 m, 25 September 2007; photo: Olaf Jahn).





Evidence of once continuous forest cover in the páramo of Piñán. Today, forest fragments are mostly restricted to valleys and gullies where they are protected from the direct impact of wind-driven fires. Ongoing natural regeneration of woody vegetation is reversed through man-set fires.

resources to maintain and manage the existing network of protected areas and ‘protection forests’ (bosques protectores). However, there is good potential for the establishment of additional private and community reserves on the northwestern slopes of Volcán Pichincha and in the upper Íntag valley.

*Action in place.* – The community of Alaspungo maintains a forest reserve of 900 ha, while Rosendo Albarracín of the La Sierra community maintains a 1,200 ha reserve of primary forest on his property. The establishment of these reserves was motivated by the EcoRuta Project. However, ecotourism activities are only slowly generating benefits for the local communities/individuals, causing some frustration to the people involved. Furthermore, these areas are not formally recognized (and hence protected) by the Ministry of the Environment. In the Íntag valley, DECOIN is promoting the establishment of new community reserves to protect watershed headwaters (Carlos Zorilla pers. comm.). Some of these may be located in the altitudinal range of Black-breasted Puffleg.

*Action needed.* – For the long-term success of conservation actions, particularly the establishment and maintenance of community reserves and forest corridors, it will be crucial to provide livelihood alternatives for local people (Chapter 1.3.3). Training programs, e.g., those improving the people’s ability to provide services to tourists, could help to bridge the painful gap between high expectations caused by the EcoRuta and other projects and the moment when these initiatives generate significant economic benefits, lowering the risk of widespread frustration among local stakeholders. In the future, the protection of new private and community reserves could be guaranteed through payments for environmental services and similar conservation easements (Chapter 1.3.3). However, a prerequisite for the widespread use and sustainability of this tool would be the creation of an endowment fund. Furthermore, it will be critical to establish legal instruments that facilitate the formal recognition of private and community reserves (Chapter 1.2.1.2). Mechanisms and strategies for the conservation of extant forests need to be promoted at Loma Frutillas, Cerro Chiquilpe, Alaspungo, and other sites to be identified, including the Íntag valley.

#### 4.4.3 MANAGEMENT

*Current situation.* – As Black-breasted Puffleg inhabits forests and their borders, appropriate reserve management is essentially limited to habitat maintenance (Chapter 4.1), restoration of high-Andean forest (Chapter 4.2), and the establishment of biological corridors. However, our

knowledge of existing management strategies in private and community reserves is very limited. Currently, there is no active conservation management of natural resources within any government-owned reserve within the range of the species.

*Action in place.* – Habitat management in the government-owned reserves should improve with the implementation of new management plans (Chapter 1.1). Habitat protection at Jocotoco’s Yanacocha Reserve is strict, a forest fire emergency plan has been implemented, and a reforestation program was initiated in 2007. Nubesierra Foundation has a management plan, and has started a reforestation program and constructed ecotourism facilities at Hacienda Verdecocha. It has also signed a contract with the Bosques para la Conservación Foundation, which was founded as part of the initiative “Forests Absorbing Carbon Dioxide Emissions” (FACE).

*Action needed.* – Basic information on existing management strategies needs to be included in the GIS database of land-ownership (Chapter 1.4.1). The management actions required in some of the better-known reserves are listed in Appendix 3a.

#### 4.4.4 EXPANSION

*Current situation.* – The expansion of the government-owned reserves within the range of Black-breasted Puffleg is unlikely, as most of the land at their periphery is private or community-owned. Jocotoco Foundation plans to expand the Yanacocha Reserve, mainly through the purchase and reforestation of abandoned cattle pastures.

*Action in place.* – Nubesierra Foundation recently expanded the Hacienda Verdecocha reserve to 1,269 ha. Jocotoco Foundation purchased 30 ha of cattle pastures, which will be reforested in the coming years.

*Action needed.* – Fundraising efforts for the expansion and consolidation of existing private and community reserves are needed (e.g., community-managed reserves in the Íntag valley, Jocotoco’s Yanacocha Reserve, and others). As an alternative to the expansion of private reserves through land purchase, landowners should consider the involvement of neighboring communities in their conservation efforts, e.g., through the payment of conservation easements or the implementation of projects providing livelihood alternatives (Chapter 1.3.3.).

#### 4.5 COMMUNITY-BASED INITIATIVES

*Current situation.* – In Pichincha province, the Ecoruta Project has led to an increase in community-based initiatives within the range of Black-breasted Puffleg (Chapters 1.3.2 and 1.3.3). In the Íntag valley, DECOIN, and Rainforest Concern have promoted the establishment of community-managed forest reserves. Their strategies and experiences should serve as an example for similar efforts in Pichincha.

*Action in place.* – Aves & Conservación is promoting the formation of Local Conservation Groups (LCGs) (see Chapter 4.1), in the vicinity of the IBA ‘Mindo and western Slopes of Volcán Pichincha,’ (EC043; Freile & Santander 2005b). This is accompanied by an intense community outreach and awareness campaign (Chapter 2.2).

*Action needed.* – Efforts to promote community-based initiatives, e.g., establishment of community reserves, reforestation, capacity-building in conservation management practices, and ecotourism programs, should be intensified in the entire known and presumed range of Black-breasted Puffleg. In most cases, long-term support to these conservation efforts will be crucial to guarantee their sustainability. The expectations of local people should be carefully managed in order to avoid frustration due to slow progress of the projects, which could threaten the long-term success of these conservation initiatives.

# 5. SPECIES-BASED ACTIONS

## 5.1 REINTRODUCTIONS

*Current situation.* – Three discrete populations of Black-breasted Puffleg are still extant (Volcán Pichincha, Cordillera de Toisán) or likely extant (Volcán Atacazo). Historical reports of the presence of the species at other sites, such as localities on the east slope of the Andes (e.g. Papallacta) are not well documented and generally not considered plausible (see Collar *et al.* 1992).

*Action in place.* – None.

*Action needed.* – If a local extinction were to occur at one of the known sites, e.g., at Volcán Atacazo, a precondition for any reintroduction programs would be a sufficient restoration of native vegetation cover between about 2,000 and 4,300 m (Chapter 4.2). Furthermore, the likely impacts of the removal of individuals from the source population should be carefully evaluated before starting a reintroduction program.

## 5.2 BENIGN INTRODUCTIONS

Not applicable. Appropriate and extensive habitat for Black-breasted Puffleg probably exists also on the east slope of the Andes. However, these areas are inhabited by the similar but much more common Glowing Puffleg *Eriocnemis vestitus*. Biogeographic evidence suggests that the two taxa are ecologically exclusive. In other words, benign introductions of Black-breasted Puffleg on the east slope of the Andes are likely to fail due to competition from its sister taxon.

## 5.3 SUSTAINABLE USE

### 5.3.1 HARVEST MANAGEMENT

Not applicable. To our knowledge, in recent years the species has not suffered from direct persecution such as trapping for the pet trade.

### 5.3.2 TRADE MANAGEMENT

*Current situation.* – To our knowledge, in recent years the species has not been traded.

*Action in place.* – Black-breasted Puffleg is listed in Appendix II of CITES (Chapter 1.2.2.1). In 2007, the import of wild birds into European Union member states was permanently banned (Chapter 3.6).

*Action needed.* – The species should be transferred to Appendix I of CITES (Chapter 1.2.2.1). Furthermore, the international and national bird trade (legal and illegal) needs to be carefully monitored to avoid any future trading of the hummingbird.

## 5.4 RECOVERY MANAGEMENT

*Current situation.* – Black-breasted Puffleg has been observed on several occasions at hummingbird feeders in Jocotoco's Yanacocha reserve and at other sites. In some years, particularly during periods of extreme weather events, the species could suffer from a shortage of food supplies, perhaps aggravated by interspecific competition for these resources. Habitat destruction and global warming will likely exacerbate these problems. With a sufficient number of hummingbird feeders at key sites it might be possible to alleviate such bottleneck situations. Supplementary feeding would be particularly important after volcano eruptions, when ash covers plants and their flowers. However, it may prove impossible to maintain feeders after such events, as ash or lava may block roads.

*Action in place.* – In the species' normal altitudinal range in Pichincha province, hummingbird feeders are installed at the Yanacocha Reserve, Hacienda Verdecocha, San Jorge Lodge, and other sites. Mindo Cloudforest Foundation and Jocotoco Foundation are promoting the use of hummingbird feeders along the EcoRuta, and are implementing

an education campaign regarding their correct maintenance. We have no information about the use of hummingbird feeders in the Íntag valley.

*Action needed.* – Hummingbird feeders should be installed in all private reserves within the range of Black-breasted Puffleg. However, considering the critical conservation status of the species, maintenance of the feeders should follow strict hygiene rules. Owners of hummingbird feeders should be provided with guidelines for their appropriate maintenance.

## 5.5 DISEASE, PATHOGEN, PARASITE MANAGEMENT

*Current situation.* – If disease or pathogens play a role as a factor limiting the species' population, then habitat alteration and/or global warming will likely exacerbate this situation. Thus, conservation action should concentrate on habitat maintenance and restoration (e.g., Chapters 4.1 and 4.2). It is not known if hummingbird feeders promote the transmission of pathogens that could affect Black-breasted Puffleg.

*Action in place.* – None.

*Action needed.* – Studies of feeder-transmitted diseases should be carried out to avoid potential negative impacts of increasing use of hummingbird feeders on populations of Black-breasted Puffleg.

## 5.6 LIMITING POPULATION GROWTH

Not applicable.

## 5.7 EX SITU CONSERVATION ACTIONS

### 5.7.1 CAPTIVE BREEDING/ARTIFICIAL PROPAGATION

Not applicable. To our knowledge, the species is not held in captivity anywhere. Considering the difficulties inherent in developing a captive breeding program for hummingbirds, conservation action should focus on wild populations and their habitat.

### 5.7.2 GENOME RESOURCE BANK

Not applicable. We are not aware about any gene bank storing tissue or blood samples of Black-breasted Puffleg.



A male Black-breasted Puffleg at a feeder. Studies of feeder-transmitted diseases should be carried out to avoid potential negative impacts on Black-breasted Puffleg populations through the spread of disease by the increasing use of hummingbird feeders. (Yanacocha Reserve, Pichincha, 3,500 m, 2 June 2003; photo: Kerem A. Boyla).

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# ■ APPENDIX

## APPENDIX 1A. CONSERVATION ACTIONS AUTHORITY FILE (VERSION 1.0)

In using this hierarchical classification of conservation actions, assessors are asked to indicate the conservation actions or measures that are in place and/or that are needed for each taxon. In suggesting what actions are needed, assessors are asked to be realistic and not simply select everything. The selection should be for those actions which are most needed and which could realistically be achieved in approximately the next five years. Selection of a higher level action e.g., 1.2. Legislation, does not mean that all the actions below this e.g., 1.2.1 Development and 1.2.2. Implementation, are indicated. It simply indicates that legislation is either in place or is needed as part of a policy-based action for the taxon concerned. Selection of any action lower down the hierarchy automatically implies that the higher levels are indicated, i.e. it is not necessary to indicate all the levels, just the lowest. For example, selecting action 4.4.2. Establishment, indicates that establishment of a protected area (action 4.4) is one of the habitat and site based actions (action 4.) required for the taxon concerned. Multiple conservation actions can be selected as required. If 'Other' is selected, the conservation action or measure must be specified. Multiple additions under 'Other' are allowed, although extensive use of this is not encouraged. If no conservation actions or measures are in place, this should be recorded, against conservation action 0. Similarly, if no conservation actions are needed, then it is also important to record this against conservation action 0 (both 'In Place' and the 'Needed' columns could be ticked). To indicate the actions use: Yes or Y or a tick. Source: <http://www.iucn.org/themes/ssc/sis/authority.htm>.

CONSERVATION ACTION	IN PLACE	NEEDED
<b>0. No conservation actions</b>		
<b>1. Policy-based actions</b>		
1.1. Management plans		
1.1.1. Development	x	x
1.1.2. Implementation	x	x
1.2. Legislation		
1.2.1. Development		
1.2.1.1. International level	x	x
1.2.1.2. National level	x	x
1.2.1.3. Sub-national level	x	x
1.2.2. Implementation		
1.2.2.1. International level	x	
1.2.2.2. National level	x	x
1.2.2.3. Sub-national level	x	x
1.3. Community management		
1.3.1. Governance	x	
1.3.2. Resource stewardship	x	x
1.3.3. Livelihood alternatives	x	x
1.4. Landownership and stakeholder analysis		
1.4.1. Landownership	x	x
1.4.2. Stakeholder analysis		
1.4.2.1. Private landowners	x	x
1.4.2.2. Communities	x	x
1.4.2.3. Governmental Organizations	x	x
1.4.2.4. Nongovernmental Organizations	x	x
<b>2. Communication and Education</b>		
2.1. Formal education	x	
2.2. Awareness	x	x
2.3. Capacity-building/Training	x	x
2.4. Other		

APPENDIX 1A. CONSERVATION ACTIONS AUTHORITY FILE (VERSION 1.0)		
CONSERVATION ACTION	IN PLACE	NEEDED
<b>3. Research actions</b>		
3.1. Taxonomy		
3.2. Population numbers and range		x
3.3. Biology and Ecology	x	x
3.4. Habitat status		x
3.5. Threats		x
3.6. Uses and harvest levels		
3.7. Cultural relevance		
3.8. Conservation measures	x	x
3.9. Trends/Monitoring	x	x
3.10. Other		
<b>4. Habitat and site-based actions</b>		
4.1. Maintenance/Conservation	x	x
4.2. Restoration	x	x
4.3. Corridors		x
4.4. Protected areas		
4.4.1. Identification of new protected areas	x	x
4.4.2. Establishment	x	x
4.4.3. Management	x	x
4.4.4. Expansion	x	x
4.5. Community-based initiatives	x	x
4.6. Other		
<b>5. Species-based actions</b>		
5.1. Re-introductions		
5.2. Benign introductions		
5.3. Sustainable use		
5.3.1. Harvest management		
5.3.2. Trade management		
5.4. Recovery management	x	x
5.5. Disease, pathogen, parasite management		x
5.6. Limiting population growth		
5.7. Ex situ conservation actions		
5.7.1. Captive breeding/Artificial propagation		
5.7.2. Genome resource bank		
5.8. Other		
<b>6. Other</b>		



# ■ APÉNDICES

## APÉNDICE 1B. DOCUMENTO OFICIAL DE LA UICN PARA ACCIONES DE CONSERVACIÓN (VERSIÓN 1.0).

Al usar esta clasificación jerárquica de acciones de conservación, se solicita a los asesores que indiquen qué acciones o medidas de conservación están implementadas y/o son necesarias para cada taxón. Al sugerir acciones necesarias, se solicita a los asesores que sean realistas y no que simplemente seleccionen todas las actividades. Se deben seleccionar aquellas acciones que son las más urgentes y que realmente pueden ser implementadas dentro de los cinco años siguientes, aproximadamente. La selección de una acción de un nivel más alto (por ej., 1.2. Legislación), no significa automáticamente que todas las acciones de niveles más bajos son indicadas (es decir, siguiendo con el ejemplo: 1.2.1 Desarrollo y 1.2.2 Implementación). La selección de esta acción (Legislación) simplemente indica que ésta ha sido implementada o es requerida como parte de las acciones políticas necesarias para el taxón correspondiente. Sin embargo, la selección de cualquier acción más abajo en la jerarquía implica de manera automática que los niveles más altos están siendo indicados, es decir, no es necesario indicar todos los niveles, solamente los más bajos. Por ejemplo, la selección de la acción 4.4.2 Establecimiento, indica que la creación de un área protegida (acción 4.4) es una de las Acciones basadas en el hábitat y sitios (acción 4.) requeridas para el taxón en cuestión. Se pueden seleccionar múltiples acciones de conservación de ser necesario. Si se selecciona 'Otras', se debe especificar la acción o medida de conservación propuesta. También es posible indicar múltiples acciones bajo 'Otras', aunque no se aconseja hacer uso excesivo de esta opción. Si no existe ninguna acción o medida de conservación implementada, esto se debe registrar bajo Acciones de conservación 0. Igualmente, si no se requiere ninguna acción de conservación, también es importante anotar este hecho bajo Acciones de conservación 0 (se podría marcar ambos campos 'Implementada' y 'Necesaria'). Para indicar la acción usar: 'Si' o 'S' o 'x'. Fuente: <http://www.iucn.org/themes/ssc/sis/authority.htm>.

ACCIONES DE CONSERVACIÓN	IMPLEMENTADA	NECESARIA
<b>0. Ninguna acción de conservación</b>		
<b>1. Acciones basadas en políticas</b>		
1.1. Planes de manejo		
1.1.1. Desarrollo	x	x
1.1.2. Implementación	x	x
1.2. Legislación		
1.2.1. Desarrollo		
1.2.1.1. Nivel internacional	x	x
1.2.1.2. Nivel nacional	x	x
1.2.1.3. Nivel sub-nacional	x	x
1.2.2. Implementación		
1.2.2.1. Nivel internacional	x	
1.2.2.2. Nivel nacional	x	x
1.2.2.3. Nivel sub-nacional	x	x
1.3. Manejo comunitario		
1.3.1. Administración	x	
1.3.2. Administración de recursos	x	x
1.3.3. Alternativas económicas	x	x
1.4. Tenencia de tierra y análisis de los actores locales		
1.4.1. Tenencia de tierra	x	x
1.4.2. Análisis de los actores locales		
1.4.2.1. Propietarios privados	x	x
1.4.2.2. Comunidades	x	x
1.4.2.3. Organizaciones gubernamentales	x	x
1.4.2.4. Organizaciones no-gubernamentales	x	x
<b>2. Comunicación y Educación</b>		
2.1. Educación formal	x	

APÉNDICE 1B. DOCUMENTO OFICIAL DE LA UICN PARA ACCIONES DE CONSERVACIÓN (VERSIÓN 1.0).		
ACCIONES DE CONSERVACIÓN	IMPLEMENTADA	NECESARIA
2.2. Concienciación	x	x
2.3. Formación de capacidades/Entrenamiento	x	x
2.4. Otras		
<b>3. Acciones de Investigación</b>		
3.1. Taxonomía		
3.2. Números poblacionales y rango		x
3.3. Biología y Ecología	x	x
3.4. Estado del hábitat		x
3.5. Amenazas		x
3.6. Usos y nivel de aprovechamiento		
3.7. Relevancia cultural		
3.8. Medidas de conservación	x	x
3.9. Tendencias / Monitoreo	x	x
3.10. Otras		
<b>4. Acciones basadas en hábitat y sitios</b>		
4.1. Mantenimiento/Conservación	x	x
4.2. Restauración	x	x
4.3. Corredores		x
4.4. Áreas protegidas		
4.4.1. Identificación de nuevas áreas protegidas	x	x
4.4.2. Establecimiento	x	x
4.4.3. Manejo	x	x
4.4.4. Expansión	x	x
4.5. Iniciativas comunitarias	x	x
4.6. Otras		
<b>5. Acciones basadas en la especie</b>		
5.1. Re-introducciones		
5.2. Introducciones benignas		
5.3. Uso sostenible		
5.3.1. Manejo para el aprovechamiento		
5.3.2. Manejo comercial		
5.4. Manejo para recuperación	x	x
5.5. Enfermedades, patógenos, manejo de parásitos		x
5.6. Limitando el crecimiento poblacional		
5.7. Acciones de conservación ex situ		
5.7.1. Reproducción en cautiverio/Propagación artificial		
5.7.2. Banco de recursos genéticos		
5.8. Otras		
<b>6. Otras</b>		

## APPENDIX 2A. SPECIES CONSERVATION ACTION PLAN FOR BLACK-BREADED PUFFLEG: ACTIVITY SCHEDULE, PRIORITY, AND RESPONSIBILITIES.

See Appendix 2B for the Spanish version and Appendix 3A for proposed site-based conservation action and priorities. Organizations written in brackets could potentially cooperate in the proposed conservation action, in addition to those institutions that declared their interest in collaboration during the first workshop in Quito (Appendix 6). Priority of activity: \* = low, \*\* = medium, \*\*\* = high. Abbreviations used: CDC= Centro de Datos para la Conservación (NGO); CI= Conservación Internacional; CORPEI= Corporación de Promoción de Exportaciones e Inversiones; DECOIN= Defensa y Conservación de Iniatg (NGO); DMQ= Metropolitan District of Quito; EMAAP-Q= Empresa Metropolitana de Alcantarillado y Agua Potable de Quito (Metropolitan Water Company of Quito); FAN= Fondo Ambiental Nacional (National Environmental Fund); GIS= Geographic Information System; IUCN= International Union for the Conservation of Nature; MCF= Mindo Cloudforest Foundation; MECN= Museo Ecuatoriano de Ciencias Naturales; MAE= Ministry of Environment of Ecuador; USFQ= University San Francisco de Quito.

THREATS	OBJECTIVES	ACTIVITY (CHAPTER NO.)	PRIORITY	STAKEHOLDER(S)	FREQUENCY, TIMING	INDICATOR, MEANS OF VERIFICATION
Habitat deterioration and loss through ecologically unsustainable land management.	Improve the knowledge of land-ownership and stakeholders for planning site-specific conservation action.	Establish and strengthen contacts with local stakeholders (e.g., communities, landowners, NGOs, and government institutions) in order to agree on and coordinate the planning and implementation of conservation action in favor of Black-breasted Puffleg (1.4, 2.2).	***	Aves & Conservación and others.	Ongoing.	Network of local stakeholders who have agreed on and coordinate the planning and implementation of established conservation goals.
		Develop and maintain a GIS database on land-ownership and additional socio-economic and political information for the known and presumed range of Black-breasted Puffleg (1.4.1).	***	Aves & Conservación, MCF, Corporación Ecoruta, Forestry Division of MAE, Maquipucuna Foundation, Nubesierra Foundation, Municipality of Quito, and others (e.g., ESQUEL: information on reserve network).	Continuous; planned to start in 2008.	Up-to-date GIS database on land-ownership and socio-economic and political information.
		Identify potential key sites for the conservation of the species during fieldwork (3.9) and with help of the land-ownership database (1.4.1).	***	Aves & Conservación, MECN, and others.	Ongoing.	Up-to-date information on key sites for Black-breasted Puffleg.
		Identify private landowners, communities, and development projects in execution or planning (e.g., those implemented by NGOs and provincial governments) causing direct impacts on the habitat status within the range of Black-breasted Puffleg (1.4.2.1–1.4.2.4).	***	Aves & Conservación and others.	Ongoing.	Up-to-date information on private landowners, communities and development projects, causing direct impacts on the habitat status.
	Improve knowledge of habitat status within the range of Black-breasted Puffleg and quantify changes.	Carry out habitat monitoring and change detection using aerial photographs and/or satellite images (3.4).	***	Aves & Conservación, Maquipucuna Foundation, Environmental Division of the Municipality of Quito, and others (e.g., Corporación Vida para Quito).	Every five years; years of reference 2001, 2006, 2011, etc.	(1) Maps showing habitat change. (2) Quantitative analysis (tables) of habitat change by habitat type, region (Volcán Atacazo, Volcán Pichincha, Cordillera de Toisán), and political units (e.g., administrative districts, community lands, private properties, governmental reserves, etc.).



## APPENDIX 2A. SPECIES CONSERVATION ACTION PLAN FOR BLACK-BREADED PUFFLEG: ACTIVITY SCHEDULE, PRIORITY, AND RESPONSIBILITIES.

THREATS	OBJECTIVES	ACTIVITY (CHAPTER NO.)	PRIORITY	STAKEHOLDER(S)	FREQUENCY, TIMING	INDICATOR, MEANS OF VERIFICATION
(See previous page.)	Reduce habitat deterioration and loss caused by ecologically unsustainable land management.	Built alliances with NGOs, communities, private landowners, development agencies, and governmental institutions for the design and implementation of conservation and development projects, providing livelihood alternatives for local people, especially for those who might have direct impacts on habitat status within the range of Black-breasted Puffleg (1.3.3, 1.4.2.1-1.4.2.4).	***	Aves & Conservación, Municipality of Quito, Ministry of Tourism, provincial government, Jatun Sacha, Maquipucuna Foundation, MCF, Corporación Ecoruta, CORPEI, Nubesierra Foundation, and others (ej., USFQ, Fundación Cordillera, DECOIN, Randi Randi, EcoCiencia).	Ongoing.	(1) Number of organizations and institutions involved in the design and implementation of conservation and development projects. (2) Number of local people benefiting from these projects.
		Prepare educational materials for an awareness campaign (2.2) focusing on resource stewardship and livelihood alternatives.	***	Aves & Conservación, Corporación Ecoruta, CORPEI, Ministry of Tourism and others (e.g., USFQ).	Ongoing.	Educational materials (booklets, posters, flyers etc.).
		Promote community-based resource stewardship (1.3.2) through a comprehensive community outreach and awareness campaign (2.2).	***	Aves & Conservación, Maquipucuna Foundation, and others (e.g., DECOIN).	Continuous. Pichincha: ongoing; Imbabura: ongoing.	Increase in number and area of community-based resource stewardships.
		Promote reforestation of community lands and watersheds (4.2) and the establishment of forest corridors (4.3).	***	Aves & Conservación, Corporación Vida para Quito, Maquipucuna Foundation, Jatun Sacha, MAE, and others (ej., DECOIN, Environmental Division of the Municipality of Quito, EMAAP-Q).	Continuous. Pichincha: ongoing; Imbabura: ongoing.	Area reforested and kilometers of biological corridors (living fences) established.
		Develop and implement fire emergency plans (4.1).	***	Jocotoco Foundation, Nubesierra Foundation, Municipality of Quito, and others (e.g., firefighter departments).	Continuous.	(1) Number of emergency plans prepared. (2) Number of communities with firefighter brigades.
		Lobby for legislation that regulates the production of charcoal (e.g. through municipal decrees) and/or implement mechanisms for the efficient and/or sustainable production of charcoal and provision of livelihood alternatives (1.2.1.3).	**	Aves & Conservación, MAE, Dirección Metropolitana de Medio Ambiente, and others.	Starting as soon as possible.	(1) Legislation that regulates the production of charcoal. (2) Mechanisms for the efficient and/or sustainable production of charcoal

APPENDIX 2A. SPECIES CONSERVATION ACTION PLAN FOR BLACK-BREASTED PUFFLEG: ACTIVITY SCHEDULE, PRIORITY, AND RESPONSIBILITIES.						
THREATS	OBJECTIVES	ACTIVITY (CHAPTER NO.)	PRIORITY	STAKEHOLDER(S)	FREQUENCY, TIMING	INDICATOR, MEANS OF VERIFICATION
(See first page of Appendix 2A.)		Implement controls that reduce the unsustainable production of charcoal and timber (1.2.1.3).	**	(MAE, Environmental Division of the Metropolitan Police, and others.)	Starting as soon as possible.	Official statistics on (a) the frequency of law enforcement controls and (b) number of law infractions detected and actions taken to combat them.
		Inform local communities about the reach and implementation of the existing contingency plan for accidents involving the OCP pipeline (2.2).	***	(Consortium OCP Ecuador), MAE, communities, and others.	Starting as soon as possible.	(1) Number and locality of workshops held to inform about the reach and implementation of the OCP contingency plan. (2) Number of communities that have participated in workshops.
	Protect the habitat at key sites outside formally protected areas.	Establish new private and community reserves at key sites for Black-breasted Puffleg (4.4.2).	***	Communities of Alambi, La Sierra, Yanacocha, and Alaspungo; Jocotoco Foundation, Nubesierra Foundation, Mindo Cloudforest Foundation, Maquipucuna Foundation, and others (e.g., DECOIN).	Starting as soon as possible.	Number of key sites and area of additionally protected habitat.
		Develop an endowment fund strategy for conservation easements (1.3.3)	***	Aves & Conservación, MCF, FAN, DMQ and others	Starting as soon as possible.	Technical document on the endowment fund strategy.
	Optimize habitat protection and restoration in private and community reserves.	Continue with habitat preservation.	***	Jocotoco Foundation, Maquipucuna Foundation, Nubesierra Foundation, and others (e.g., DECOIN).	Ongoing.	Rate of habitat change within the limits of private and community reserves.
		Raise funds for the expansion of existing private and community reserves (4.4.4).	**	Jocotoco Foundation, Nubesierra Foundation, Maquipucuna Foundation, and others, (e.g., DECOIN).	Continuous.	Area of additionally protected habitat.

APPENDIX 2A. SPECIES CONSERVATION ACTION PLAN FOR BLACK-BREASTED PUFFLEG: ACTIVITY SCHEDULE, PRIORITY, AND RESPONSIBILITIES.						
THREATS	OBJECTIVES	ACTIVITY (CHAPTER NO.)	PRIORITY	STAKEHOLDER(S)	FREQUENCY, TIMING	INDICATOR, MEANS OF VERIFICATION
(See first page of Appendix 2A.)		Develop management plans for private and community reserves (1.1.1).	*	Aves & Conservación, Environmental Division of the Municipality, MECN, Maquipucuna Foundation, Jocotoco Foundation, and others (e.g. DECOIN).	Starting as soon as possible.	Site-specific management plans for private and community reserves.
		Carry out reforestation and habitat restoration on abandoned agricultural land and grass páramo using native plant species (4.2).	***	Jocotoco Foundation, Maquipucuna Foundation, Nubesierra Foundation, Jatun Sacha, and others (e.g. DECOIN).	Continuous	Area of restored habitat.
		Formalize the conservation status of private and community reserves (1.2.1.2).	**	MAE, Jocotoco Foundation, Nubesierra Foundation, communities, and others (e.g. DECOIN).	Continuous.	Official registration of private and community reserves.
	Study potential health risks of supplementary feeding for Black-breasted Puffleg and promote the use of hummingbird feeders at private and community reserves, if their use is safe.	Carry out studies on feeder-transmitted diseases to exclude potential negative impacts of increasing use of hummingbird feeders on populations of Black-breasted Puffleg (5.5).	***	Aves & Conservación (in cooperation with logistic universities) with logistic support from Jocotoco Foundation and Nubesierra Foundation.	Duration: 1-2 years; starting as soon as possible.	(1) Technical reports. (2) Scientific publications.
		If studies on feeder-transmitted diseases prove the use of hummingbird feeders to be safe, promote their use. Guarantee the maintenance of the feeders always follows strict rules of hygiene through the provision of guidelines and awareness campaigns (5.4).	**	Aves & Conservación, Jocotoco Foundation, Nubesierra Foundation, Maquipucuna Foundation, Hacienda La Merced de Nono, MCF, and others.	Continuous.	(1) Number of well maintained hummingbird feeders. (2) Leaflet with guidelines for an appropriate maintenance of feeders.
	Maintain suitable habitat in Bosque Protector Mindo-Nambillo: avoid new invasions and extension of private properties beyond legally established limits.	Implement new management plan, particularly the marking of the reserve limits, effective surveillance system, and collaboration with local stakeholders (1.1.2, 4.1).	***	MAE and others (e.g., Coporación Ecoruta, Jocotoco Foundation, Nubesierra Foundation, and local communities).	Continuous; starting as soon as possible.	(1) Official statistics on (a) kilometers of reserve limits marked with signs and boundary stones, (b) kilometers of reserve limits maintained, (c) frequency of patrols carried out by park rangers per district, (d) number of law infractions detected and actions taken to combat them. (2) Rate of habitat change within the limits of the reserve.



APPENDIX 2A. SPECIES CONSERVATION ACTION PLAN FOR BLACK-BREADED PUFFLEG: ACTIVITY SCHEDULE, PRIORITY, AND RESPONSIBILITIES.						
THREATS	OBJECTIVES	ACTIVITY (CHAPTER NO.)	PRIORITY	STAKEHOLDER(S)	FREQUENCY, TIMING	INDICATOR, MEANS OF VERIFICATION
(See first page of Appendix 2A.)		Control access to the western flanks of Volcán Pichincha (4.1).	**	MAE, Jocotoco Foundation, Nubesierra Foundation, local communities, landowners, and others (e.g., EMAAP-Q).	Continuous.	(1) Frequency of patrols carried out by park rangers. (2) Rate of habitat change on the upper western flanks of Volcán Pichincha.
		Carry out awareness campaign for park rangers and private landowners within the reserve limits (2.2).	**	MAE, Aves & Conservación, and others (e.g., Ministry of Tourism).	Continuous; starting as soon as possible.	(1) Number of awareness events carried out. (2) Number of participants.
	Maintain suitable habitat in Cotacachi-Cayapas Ecological Reserve.	Implement new management plan through marking of the reserve limits, effective surveillance system, and collaboration with other stakeholders (1.1.2, 4.1).	***	MAE and others.	Continuous.	(1) Official statistics on (a) kilometers of reserve limits marked with signs and boundary stones, (b) kilometers of reserve limits maintained, (c) frequency of patrols carried out by park rangers per district, (d) number of law infractions detected and actions taken to combat them. (2) Rate of habitat change within the limits of the reserve.
		Carry out awareness campaign for park rangers, private landowners, and communities within the reserve limits (2.2).	**	Aves & Conservación and others.	Continuous; starting as soon as possible.	(1) Number of awareness events carried out. (2) Number of participants.
	Ensure that suitable habitat is not affected by mining.	Lobby for a ministerial or presidential decree that unambiguously prohibits the activity of mining, within the Cotacachi-Cayapas Ecological Reserve, on the eastern slope of the Cordillera de Toisán, and the upper Intag valley above an altitude of 2,000 m (1.2.1.2, 1.2.2.2).	***	Aves & Conservación, MAE, and others (e.g., DECOIN).	Starting as soon as possible; to be continued until success of action.	Ministerial or presidential decree prohibiting the activity of mining in the range of Black-breasted Puffleg.
Extinction risk due to climate change and previous destruction of forest and scrubland habitat at the species' upper altitudinal range limit (above 3,500m).	Promote an international agreement on a gradual reduction of greenhouse gas emissions.	Lobby for an effective international agreement on greenhouse gas emissions (1.2.1.1).	***	(Ecuadorian government, and national and international NGOs.)	Ongoing.	Effective international agreement on reduction of greenhouse gas emissions that replaces the Kyoto Protocol in 2012.

APPENDIX 2A. SPECIES CONSERVATION ACTION PLAN FOR BLACK-BREADED PUFFLEG: ACTIVITY SCHEDULE, PRIORITY, AND RESPONSIBILITIES.						
THREATS	OBJECTIVES	ACTIVITY (CHAPTER NO.)	PRIORITY	STAKEHOLDER(S)	FREQUENCY, TIMING	INDICATOR, MEANS OF VERIFICATION
(See previous page.)	Restore 30–50% of the grass páramos of Volcán Atacazo, Volcán Pichincha, Cordillera de Toisán, and páramo de Piñán with native, woody, and diverse vegetation.	Design and implement a pilot study in order to develop techniques for the restoration of native, woody, and diverse vegetation cover, providing appropriate habitat for Black-breasted Puffleg.	***	(Jatun Sacha and others.)	Continuous; starting as soon as possible.	Technical reports and/or publications on appropriate habitat restoration methods.
		Design and implement habitat restoration programs at the hummingbirds' upper altitudinal range (4.2).	***	Jocotoco Foundation, Corporación Vida para Quito, Jatun Sacha, MAE, communities, and others (e.g., EMAAP–Q).	Continuous; starting as soon as possible.	Area restored with native woody vegetation, providing appropriate habitat for Black-breasted Puffleg.
Lack of essential information on the distribution, ecology, population size, and trends of Black-breasted Puffleg.	Build technical capacity.	Implement a training program for technicians involved in the monitoring program (2.3).	***	Aves & Conservación, MECN, and others.	Ongoing.	(1) Number of capacity building events. (2) Number of technicians trained.
	Determine the species' Extent of Occurrence.	Carry out expeditions in poorly studied areas of suitable habitat (3.2), specifically Volcán Atacazo, Volcán Pichincha, and main massif of the Cordillera de Toisán. The survey methods used should be the same as in the long-term monitoring program (3.9).	***	Aves & Conservación, MECN with logistical support from MAE, Dirección Metropolitana de Medio Ambiente, Jocotoco Foundation, Nubesierra Foundation, Maquipucuna Foundation, communities, and others.	About 5–10 unvisited sites should be visited during the implementation phase of the monitoring study.	(1) Photos and sound recordings from the expeditions. (2) Database on the survey results.
	Determine the species' absolute population size and population trends.	Implement a long-term monitoring program over a three-year cycle of all three extant or presumed extant populations, i.e., Volcán Atacazo, Volcán Pichincha, and Cordillera de Toisán (3.9).	***	Aves & Conservación, MECN, and others.	Ongoing.	(1) Photos and sound recordings from the monitoring surveys. (2) Database on the survey results.

APPENDIX 2A. SPECIES CONSERVATION ACTION PLAN FOR BLACK-BREADED PUFFLEG: ACTIVITY SCHEDULE, PRIORITY, AND RESPONSIBILITIES.						
THREATS	OBJECTIVES	ACTIVITY (CHAPTER NO.)	PRIORITY	STAKEHOLDER(S)	FREQUENCY, TIMING	INDICATOR, MEANS OF VERIFICATION
(See previous page.)		Calculate the species absolute population size and perform statistical tests on trends (3.9).	***	Aves & Conservación, MECN and others.	Continuous; starting in 2008.	(1) Technical reports. (2) Scientific publications.
		Test the monitoring data for signs of increasing interspecific competition and other impacts of climate change (3.5, 3.9).	***	Aves & Conservación, MECN, and others.	From the second year after the implementation of the monitoring study onwards.	(1) Technical reports. (2) Scientific publications.
	Improve the knowledge on the biology and ecology of the species.	Collect additional data on the biology and ecology of Black-breasted Puffleg (3.3, 3.9).	**	Aves & Conservación, Jocotoco, and others	During regular field trips as part of the monitoring study.	(1) Database on the biology and ecology of Black-breasted Puffleg. (2) Scientific publications.
Insufficient knowledge of Black-breasted Puffleg and understanding of the importance of its main habitat for provision of environmental services and biodiversity conservation.	Promote widespread recognition of the species and attitudes supportive of measures to conserve its habitat and associated biodiversity.	Design and implement comprehensive multilevel awareness program in the Cantons of Quito, Los Bancos, and Cotacachi (2.2).	***	Aves & Conservación and others	Continuous; Pichincha; Imbabura; starting as soon as possible.	(1) Number of awareness events carried out. (2) Number of participants and their profiles (e.g., schoolchildren, adults, government representatives etc.). (3) Measures of improved recognition of Black-breasted Puffleg and support to habitat conservation.
		Prepare educational material for the awareness campaign (2.2), focusing on Black-breasted Puffleg, its habitat, and biodiversity conservation.	***	Aves & Conservación, Juan Manuel Carrión, Paul Greenfield, Econuta Project, Ministry of Tourism, CORPEL, Municipality of Quito, and others.	Starting in 2007.	Educational materials (booklets, posters, flyers etc.).
		Construct and maintain center for environmental education at Jocotoco Reserve Yanacocha.	*	Jocotoco Foundation.	Continuous. Starting as soon as possible.	Number of environmental education events carried out per year.



**APÉNDICE 2B. PLAN DE ACCIÓN PARA LA CONSERVACIÓN DEL ZAMARRITO PECHINEGRO: CRONOGRAMA DE ACTIVIDADES, PRIORIDADES Y RESPONSABILIDAD**

Ver el Apéndice 2A para la versión en inglés y Apéndice 3B para referirse a las acciones de conservación propuestas en base a los sitios y las prioridades de éstos. Las organizaciones anotadas en paréntesis podrían potencialmente aportar en la implementación de las acciones de conservación adicionalmente de las instituciones que ya declararon su interés en colaborar durante el primer taller en Quito (Apéndice 6). Prioridad de la actividad: \* = baja, \*\* = media, \*\*\* = alta. Abreviaturas: CDC= Centro de Datos para la Conservación; CI= Conservación Internacional; CORPEI= Corporación de Promoción de Exportaciones e Inversiones; DECOIN= Defensa y Conservación de Íntag; EMAAP-Q= Empresa Metropolitana de Alcantarillado y Agua Potable de Quito, FAN= Fondo Ambiental Nacional; MECN= Museo Ecuatoriano de Ciencias Naturales; MAE= Ministerio del Ambiente; MCF= Mindo Cloudforest Foundation; SIG= Sistema de Información Geográfica, UICN= Unión Mundial para la Naturaleza; USFQ= Universidad San Francisco de Quito.

AMENAZAS	OBJETIVOS	ACTIVIDADES (CAPÍTULO NO.)	PRIORIDAD	ACTOR(ES)	FRECUENCIA Y PLAZOS	INDICADORES Y MEDIOS DE VERIFICACIÓN
Deterioro y pérdida del hábitat debido a un uso de suelo ecológicamente no sostenible.	Mejorar el conocimiento acerca de actores locales y la tenencia de tierra para la adecuada planificación de acciones de conservación específicas para cada sitio.	Establecer y fortalecer contactos con los actores locales (ej., comunidades, propietarios, ONGs e instituciones gubernamentales) para coordinar la planificación e implementación de acciones de conservación a favor del Zamarrito Pechinegro (1.4, 2.2).	***	Aves & Conservación y otros.	Continua.	Red de actores locales que coordinan la planificación e implementación de metas establecidas de conservación.
		Desarrollar y mantener una base de datos en un SIG sobre la tenencia de tierra e información adicional socioeconómica y política para el rango de distribución conocido y supuesto del Zamarrito Pechinegro (1.4.1).	***	Aves & Conservación, MCF, Corporación Ecoruía, Dirección Forestal de MAE, Fundación Maquipucuna, Fundación Nubesierra, Municipio de Quito y otros (ej., ESQUEL: información Red de Reservas).	Continua; se planifica iniciar en 2007–2008.	Base de datos SIG actualizada sobre tenencia de tierra y adicionalmente información socioeconómica y política.
		Identificar sitios potenciales clave para la conservación de la especie a través de trabajo de campo (3.9) y con ayuda de la base de datos de tenencia de tierras (1.4.1).	***	Aves & Conservación, MECN y otros.	Continua.	Información actualizada sobre los sitios clave para la conservación del Zamarrito Pechinegro.
		Identificar propietarios privados, comunidades y proyectos de desarrollo (ej., aquellas implementadas por los consejos provinciales y ONGs) que causan impactos directos en el estado del hábitat dentro del rango del Zamarrito Pechinegro (1.4.2.1–1.4.2.4).	***	Aves & Conservación y otros.	Continua.	Información actualizada sobre propietarios privados, comunidades y proyectos de desarrollo que causan impactos directos en el estado del hábitat.

APÉNDICE 2B. PLAN DE ACCIÓN PARA LA CONSERVACIÓN DEL ZAMARRITO PECHINEGRO: CRONOGRAMA DE ACTIVIDADES, PRIORIDADES Y RESPONSABILIDAD

AMENAZAS	OBJETIVOS	ACTIVIDADES (CAPÍTULO NO.)	PRIORIDAD	ACTOR(ES)	FRECUENCIA Y PLAZOS	INDICADORES Y MEDIOS DE VERIFICACIÓN
(Ver página anterior.)	Mejorar el conocimiento sobre el estado del hábitat dentro del rango del Zamarrito Pechinegro y cuantificar los cambios.	Llevar a cabo un monitoreo del estado del hábitat y su cambio usando fotografías aéreas o imágenes satelitales (3.4).	***	Aves & Conservación, Fundación Maquipucuna, Dirección de Medio Ambiente del Municipio de Quito y otros (ej., Corporación Vida para Quito).	Cada cinco años; años de referencia 2001, 2006, 2011, etc.	(1) Mapas que evidencien los cambios. (2) Análisis numérico (tablas) de la transformación del hábitat por: tipo de hábitat, región (Volcán Atacazo, Volcán Pichincha, Cordillera de Toisan) y unidades políticas (ej., distritos administrativos, tierras comunales, propiedades privadas, reservas gubernamentales, etc.).
	Reducir el deterioro y pérdida del hábitat causado por el manejo de tierra ecológicamente no sustentable.	Establecer alianzas con ONGs, comunidades, propietarios privados, agencias de desarrollo e instituciones gubernamentales para el diseño e implementación de proyectos integrados de conservación y desarrollo, que provean alternativas de subsistencia para la gente local, especialmente para aquellos que puedan tener impacto directo en el estado del hábitat dentro del rango del Zamarrito Pechinegro (1.3.3, 1.4.2.1-1.4.2.4).	***	Aves & Conservación, Municipio de Quito, Ministerio de Turismo, Consejo Provincial de Pichincha, Jatun Sacha, Fundación Maquipucuna, MCF, Corporación Ecoruta, CORPEI, Fundación Nubestia, y otros (ej., Fundación Cordillera, DECOIN, Randi Randi, EcoCiencia).	Continúa; se planifica iniciar en 2007-2008.	(1) Número de organizaciones e instituciones relacionadas con el diseño e implementación de proyectos integrados de conservación y desarrollo. (2) Número de beneficiarios locales de estos proyectos.
		Preparar materiales de educación para una campaña de concienciación (2.2) con énfasis en la administración de los recursos y alternativas de subsistencia.	***	Aves & Conservación, Corporación Ecoruta, CORPEI, Ministerio de Turismo y otros (ej., USFQ).	Se planifica iniciar en 2008.	Materiales de educación (folletos, afiches, volantes etc.).
		Promover la administración de recursos por parte de las comunidades (1.3.2) a través de una campaña de concienciación (2.2).	***	Aves & Conservación, Fundación Maquipucuna y otros (ej., DECOIN).	Continúa. Pichincha: se planifica iniciar en 2007; (Imbabura: continua).	Incremento en el número y área donde la administración de recursos sea promovidas por las comunidades.
		Promover la reforestación de tierras comunitarias y cuencas hídricas (4.2) y el establecimiento de corredores de bosque (4.3).	***	Aves & Conservación, Corporación Vida para Quito, Fundación Maquipucuna, MAE y otros (ej., DECOIN, División Ambiental del Municipio de Quito; EMAAP-Q).	Continúa. Pichincha: se planifica iniciar en 2007; (Imbabura: continua).	Área reforestada y kilómetros de corredores biológicos establecidos (ej., cercas vivas).

APÉNDICE 2B. PLAN DE ACCIÓN PARA LA CONSERVACIÓN DEL ZAMARRITO PECHINEGO: CRONOGRAMA DE ACTIVIDADES, PRIORIDADES Y RESPONSABILIDAD						
AMENAZAS	OBJETIVOS	ACTIVIDADES (CAPÍTULO NO.)	PRIORIDAD	ACTOR(ES)	FRECUENCIA Y PLAZOS	INDICADORES Y MEDIOS DE VERIFICACIÓN
(Ver la primera página del Apéndice 2B.)		Desarrollar e implementar planes de contingencia contra incendios forestales (4.1).	***	Fundación Jocotoco, Fundación Nubesierra, Municipio de Quito y otros (ej., bomberos).	Continúa.	(1) Número de planes de contingencia implementados. (2) Número de comunidades con brigadas contra incendios forestales.
		Cabildear el desarrollo de legislación que regule la deforestación causada por la producción no sustentable de carbono (ej. mediante decretos municipales) e implementar mecanismos para la producción eficiente y/o sostenible de carbón y la provisión de alternativas económicas (1.2.1.3).	**	Aves & Conservación, MAE, Dirección Metropolitana de Medio Ambiente y otros.	Inicia tan pronto como sea posible.	(1) Legislación que regule la deforestación causada por la producción no sustentable de carbono. (2) Mecanismos para la producción eficiente y/o sostenible de carbón.
		Implementar controles que reduzcan la producción no sustentable de carbón y madera (1.2.1.3).	**	(MAE, División Ambiental de la Policía Metropolitana y otros.)	Inicio tan pronto como sea posible.	Estadísticas oficiales sobre (a) la frecuencia de los controles realizados para aplicar la ley. (b) número de infracciones a la ley detectadas y acciones tomadas para evitarlas.
		Informar a las comunidades locales sobre el alcance e implementación del plan de contingencia de accidentes del oleoducto OCP (2.2).	***	(Consortio OCP Ecuador), MAE, comunidades y otros.	Inicia tan pronto como sea posible.	(1) Número de talleres que informan sobre el alcance e implementación del plan de contingencia del OCP. (2) Número de comunidades donde se han realizado los talleres.
	Proteger el hábitat en sitios clave fuera de áreas formalmente protegidas.	Establecer nuevas reservas privadas y comunitarias en sitios claves para el Zamarrito Pechinego (4.4.2).	***	Comunidades de Alambi, La Sierra, Yanacocha y Alaspungo; Fundación Jocotoco, Fundación Nubesierra, MCF, Fundación Maquipucuna y otros (ej., DECOIN).	Inicia tan pronto como sea posible.	Número de sitios clave y área adicional de hábitat protegido.
		Desarrollar una estrategia para la creación de un fondo fiduciario para pagos por servicios ambientales.	***	Aves & Conservación, MCF, FAN y otros	Inicia tan pronto como sea posible.	Documento técnico sobre la estrategia de creación del fondo fiduciario.
	Optimizar la protección del hábitat y su restauración en reservas privadas y comunitarias.	Continuar con la protección del hábitat.	***	Fundación Jocotoco, Fundación Maquipucuna, Fundación Nubesierra y otros (ej., DECOIN).	Continúa.	Tasa de transformación del hábitat dentro de los límites de las reservas privadas y comunitarias.



APÉNDICE 2B. PLAN DE ACCIÓN PARA LA CONSERVACIÓN DEL ZAMARRITO PECHINEGRO: CRONOGRAMA DE ACTIVIDADES, PRIORIDADES Y RESPONSABILIDAD

AMENAZAS	OBJETIVOS	ACTIVIDADES (CAPÍTULO NO.)	PRIORIDAD	ACTOR(ES)	FRECUENCIA Y PLAZOS	INDICADORES Y MEDIOS DE VERIFICACIÓN
(Ver la primera página del Apéndice 2B.)		Levantar fondos que permitan la expansión de reservas privadas y comunitarias existentes (4.4.4).	**	Fundación Jocotoco, Fundación Nubesierra, Fundación Maquipucuna y otros (ej., DECOIN).	Continua.	Área adicional de hábitat protegido.
		Desarrollar planes de manejo para las reservas privadas y comunitarias (1.1.1).	*	Aves & Conservación, Dirección Metropolitana de Medio Ambiente, MECN, Fundación Maquipucuna, Fundación Jocotoco y otros (ej., DECOIN).	Inicia tan pronto como sea posible.	Planes de manejo específicos para reservas privadas y comunitarias.
		Llevar a cabo actividades de reforestación y restauración de hábitat en tierras agrícolas abandonadas y páramo herbáceo usando especies de plantas nativas (4.2).	***	Fundación Jocotoco, Fundación Maquipucuna, Fundación Nubesierra y otros (ej., DECOIN).	Continua.	Área de hábitat restaurado.
		Formalizar el estado de conservación de las reservas privadas y comunitarias (1.2.1.2).	**	Fundación Jocotoco, Fundación Nubesierra, MAE, comunidades y otros (ej., DECOIN).	Continua.	Registro oficial de las reservas comunitarias y privadas.
	Proveer alimentación suplementaria en reservas privadas y comunitarias y estudiar los riesgos potenciales de salud para el Zamarrito Pechinegro.	Colocar un adecuado número de alimentadores para colibríes. Garantizar que el mantenimiento de los alimentadores artificiales siga siempre normas estrictas de higiene a través de la provisión de lineamientos y campañas de concienciación (5.4).	**	Aves & Conservación, Fundación Jocotoco, Fundación Nubesierra, Fundación Maquipucuna, Hacienda La Merced de Nono, MCF y otros.	Continua.	(1) Número de alimentadores bien mantenidos. (2) Folleto con los lineamientos para el apropiado mantenimiento de los alimentadores.
		Llevar a cabo estudios sobre la transmisión de enfermedades a través de alimentadores artificiales para excluir la posibilidad de potenciales impactos negativos en las poblaciones del Zamarrito Pechinegro (5.5).	***	Aves & Conservación (en cooperación con universidades) con apoyo logístico de Fundación Jocotoco y Fundación Nubesierra.	Duración: 1-2 años; comenzando tan pronto como se cuente con fondos disponibles.	(1) Reportes técnicos. (2) Publicaciones científicas.

APÉNDICE 2B. PLAN DE ACCIÓN PARA LA CONSERVACIÓN DEL ZAMARRITO PECHINEGRO: CRONOGRAMA DE ACTIVIDADES, PRIORIDADES Y RESPONSABILIDAD

AMENAZAS	OBJETIVOS	ACTIVIDADES (CAPÍTULO NO.)	PRIORIDAD	ACTOR(ES)	FRECUENCIA Y PLAZOS	INDICADORES Y MEDIOS DE VERIFICACIÓN
(Ver la primera página del Apéndice 2B.)	Mantener hábitat apropiado en el Bosque Protector Mindo-Nambillo: evitar nuevas invasiones y la expansión de propiedades privadas más allá de los límites establecidos.	Implementar el nuevo plan de manejo, particularmente la señalización de los límites de la reserva y un sistema de vigilancia efectivo, promoviendo la colaboración con actores locales (1.1.2, 4.1).	***	MAE y otros (ej. Corporación Ecoruta, Fundación Jocotoco, Fundación Nubesierra y comunidades locales).	Continúa; se planifica iniciar en 2007 (?).	(1) Estadísticas oficiales sobre (a) kilómetros del límite de la reserva marcados con letreros e hitos, (b) kilómetros del límite de la reserva adecuadamente mantenidos, (c) frecuencia de patrullaje llevado a cabo por guardaparques en cada distrito, (d) número de infracciones a la ley detectadas y acciones tomadas para evitarlas.  (2) Tasas de transformación del hábitat dentro de los límites de la reserva.
		Controlar el acceso a la ladera occidental del Volcán Pichincha (4.1).	**	MAE, Fundación Jocotoco, Fundación Nubesierra, comunidades locales, propietarios y otros (ej., EMAAP-Q).	Continúa.	(1) Frecuencia de patrullaje llevado a cabo por guardaparques.  (2) Tasa de cambio de la vegetación en la parte alta de la ladera occidental del Volcán Pichincha.
		Llevar a cabo una campaña de concienciación dirigida a guardaparques y propietarios privados dentro de los límites de la reserva (2.2).	**	MAE, Aves & Conservación y otros (ej., Ministerio de Turismo).	Continúa; iniciar tan pronto como sea posible.	(1) Número de eventos de concienciación llevados a cabo.  (2) Número de participantes.
	Mantener el hábitat adecuado en la Reserva Ecológica Cotacachi-Cayapas.	Implementar el nuevo plan de manejo, particularmente la señalización de los límites de la reserva y un sistema de vigilancia efectivo, promoviendo la colaboración con actores locales (1.1.2, 4.1).	***	MAE y otros.	Continúa.	(1) Estadísticas oficiales sobre (a) kilómetros del límite de la reserva marcados con letreros e hitos, (b) kilómetros del límite de la reserva adecuadamente mantenidos, (c) frecuencia de patrullaje llevado a cabo por guardaparques en cada distrito, (d) número de infracciones a la ley detectadas y acciones tomadas para evitarlas.  (2) Tasas de transformación del hábitat dentro de los límites de la reserva.
		Llevar a cabo una campaña de concienciación dirigida a guardaparques, propietarios privados y comunidades dentro de los límites de la reserva (2.2).	**	Aves & Conservación y otras (?).	Continúa; iniciar tan pronto como sea posible.	(1) Número de eventos de concienciación llevados a cabo.  (2) Número de participantes.

APÉNDICE 2B. PLAN DE ACCIÓN PARA LA CONSERVACIÓN DEL ZAMARRITO PECHINEGRO: CRONOGRAMA DE ACTIVIDADES, PRIORIDADES Y RESPONSABILIDAD

AMENAZAS	OBJETIVOS	ACTIVIDADES (CAPÍTULO NO.)	PRIORIDAD	ACTOR(ES)	FRECUENCIA Y PLAZOS	INDICADORES Y MEDIOS DE VERIFICACIÓN
(Ver la primera página del Apéndice 2B.)	Evitar que el hábitat adecuado sea afectado por la minería.	Cabildear la creación de un decreto ministerial o presidencial que claramente prohíba las actividades de minería dentro de la Reserva Ecológica Cotacachi-Cayapas, la parte oriental de la Cordillera de Toisán y el valle alto de Intag sobre los 2.000 m (1.2.1.2, 1.2.2.2).	***	Aves & Conservación, MAE y otros (ej., DECOIN).	Se planifica iniciar tan pronto sea posible; continua hasta el éxito de la acción.	Decreto ministerial o presidencial prohibiendo la actividad de minería en el rango del Zamarrito Pechinegro.
Riesgo de extinción debido al cambio climático y a la previa destrucción del bosque y hábitat arbustivo en el límite superior de su rango altitudinal (sobre los 3,500 m).	Promover un acuerdo internacional que garantice una reducción gradual de la emisión de gases de efecto invernadero.	Cabildear un acuerdo internacional efectivo para la reducción de gases de efecto invernadero (1.2.1.1).	***	Organizaciones internacionales (ej., UICN, BirdLife International, CI, etc.).	Continúa.	Acuerdo internacional efectivo para la reducción de gases de efecto invernadero que reemplace el protocolo de Kyoto en 2012.
	Restaurar 30–50% del páramo herbáceo del Volcán Atacazo, Volcán Pichincha, Cordillera de Toisán y páramo de Piñán con vegetación leñosa, nativa y diversa.	Diseñar e implementar un estudio piloto para desarrollar técnicas de restauración de vegetación leñosa, nativa y diversa, proveyendo hábitat apropiado para el Zamarrito Pechinegro.	***	(Jatun Sacha and others.)	Continúa; comenzando tan pronto como sea posible.	Informes técnicos y/o publicaciones sobre métodos apropiados de restauración de hábitat.
		Diseñar e implementar programas de restauración de hábitat en la parte alta de su rango altitudinal (4.2).	***	Fundación Jocotoco, Corporación Vida para Quito, Jatun Sacha, MAE, comunidades y otros (ej., EMAAP-Q).	Continúa; comenzando tan pronto como sea posible.	Área restaurada con vegetación leñosa nativa, proveyendo hábitat apropiado para el Zamarrito Pechinegro.



APÉNDICE 2B. PLAN DE ACCIÓN PARA LA CONSERVACIÓN DEL ZAMARRITO PECHINEGRO: CRONOGRAMA DE ACTIVIDADES, PRIORIDADES Y RESPONSABILIDAD

AMENAZAS	OBJETIVOS	ACTIVIDADES (CAPÍTULO NO.)	PRIORIDAD	ACTOR(ES)	FRECUENCIA Y PLAZOS	INDICADORES Y MEDIOS DE VERIFICACIÓN
Falta de información básica sobre la distribución, ecología, tamaño poblacional y tendencias poblacionales del Zamarrito Pechinegro.	Incrementar la capacidad técnica.	Implementar un programa de capacitación para técnicos involucrados en el estudio de monitoreo (2.3).	***	Aves & Conservación, MECN y otros	Como se requiera, iniciando en el 2007.	(1) Número de eventos de capacitación. (2) Número de técnicos capacitados y entrenados.
	Determinar la extensión de ocurrencia de la especie.	Llevar a cabo expediciones en áreas pobremente estudiadas que tengan hábitat apropiado (3.2), particularmente en los flancos occidentales y australes del Volcán Atacazo y Volcán Pichincha, y laderas orientales y occidentales del macizo principal de la Cordillera de Toisán. Los métodos de búsqueda deberán ser los mismos del monitoreo de largo plazo (3.9).	***	Aves & Conservación, MECN; con apoyo logístico: del MAE, Dirección Metropolitana de Medio Ambiente, Fundación Jocotoco, Fundación Nubesierra, Fundación Maquipucuna; comunidades y otros.	Aproximadamente 5 a 10 sitios no estudiados deberían visitarse durante la fase de implementación del estudio de monitoreo.	(1) Fotografías y grabaciones de cantos de las expediciones. (2) Base de datos de los resultados de la investigación.
	Determinar el tamaño poblacional absoluto de la especie y la tendencia poblacional de la misma.	Implementar un programa de monitoreo a largo plazo en un lapso de tres años en cada una de las áreas de las tres subpoblaciones existentes, es decir Volcán Atacazo, Volcán Pichincha y Cordillera de Toisán (3.9).	***	Aves & Conservación, MECN y otros.	Continúa; iniciando en 2007.	(1) Fotografías y grabaciones de cantos de las expediciones. (2) Base de datos de los resultados de la investigación.
		Calcular el tamaño poblacional absoluto de la especie y efectuar pruebas estadísticas sobre las tendencias (3.9).	***	Aves & Conservación, MECN y otros.	Continúa; iniciando en 2007.	(1) Reportes técnicos. (2) Publicaciones científicas.
		Realizar pruebas de los datos del monitoreo en busca de señales sobre incremento de competencia inter-específica u otros impactos del cambio climático (3.5, 3.9).	***	Aves & Conservación, MECN y otros.	A partir del segundo año de la implementación del estudio de monitoreo en adelante.	(1) Reportes técnicos. (2) Publicaciones científicas.

APÉNDICE 2B. PLAN DE ACCIÓN PARA LA CONSERVACIÓN DEL ZAMARRITO PECHINEGRO: CRONOGRAMA DE ACTIVIDADES, PRIORIDADES Y RESPONSABILIDAD						
AMENAZAS	OBJETIVOS	ACTIVIDADES (CAPÍTULO NO.)	PRIORIDAD	ACTOR(ES)	FRECUENCIA Y PLAZOS	INDICADORES Y MEDIOS DE VERIFICACIÓN
(Ver página anterior.)	Mejorar el conocimiento sobre la biología y ecología de la especie.	Tomar datos adicionales sobre la biología y ecología del Zamarrito Pechinegro (3.3, 3.9).	**	Aves & Conservación y otros.	Durante viajes de campo regulares enmarcados en el estudio de monitoreo.	(1) Base de datos sobre la biología y ecología del Zamarrito Pechinegro. (2) Publicaciones científicas.
Conocimiento insuficiente sobre el Zamarrito Pechinegro y comprensión de la importancia de su hábitat principal para la provisión de servicios ambientales y conservación de la biodiversidad.	Promover un amplio reconocimiento de la especie y actitudes de apoyo para las medidas de conservación de su hábitat y la biodiversidad asociada.	Diseñar e implementar una campaña de concienciación y a varios niveles para los cantones de Quito, Los Bancos y Cotacachi (2.2).	***	Aves & Conservación y otros.	Continúa; Pichincha; se planifica iniciar en 2007; Ibarra: iniciando tan pronto sea posible.	(1) Número de eventos de concienciación efectuados. (2) Número de participantes y su caracterización (ej., niños de escuela, adultos, representantes del gobierno etc.). (3) Mejora en las medidas de reconocimiento y apoyo a la conservación del Zamarrito Pechinegro y su hábitat.
		Producir material educativo para la campaña de concienciación (2.2), con énfasis en la conservación del Zamarrito Pechinegro, su hábitat y otra biodiversidad.	***	Aves & Conservación, Juan Manuel Carrión, Paul Greenfield, Proyecto Ecoruta, Ministerio de Turismo, CORPEI, Municipio de Quito y otros.	Se planifica iniciar en 2007.	Materiales educativos (folletos, afiches, volantes, etc.).
		Construir y mantener un centro de educación ambiental en la Reserva Yanacocha de la Fundación Jocotoco.	*	Fundación Jocotoco	Continúa; comenzando tan pronto como sea posible.	Número de eventos de educación ambiental efectuados cada año.

**APPENDIX 3A. SPECIES CONSERVATION ACTION PLAN FOR BLACK-BREADED PUFFLEG: PROPOSED SITE-BASED CONSERVATION ACTION AND CONSERVATION PRIORITY OF EACH SITE IN THE KNOWN AND PRESUMED RANGE OF BLACK-BREADED PUFFLEG.**

Conservation priority: \* = low, \*\* = medium, \*\*\* = high. Abbreviations: RECC= Cotacachi-Cayapas Ecological Reserve. See corresponding chapters and Appendix 2A for details on the proposed conservation action. See Appendix 3B for Spanish version.

LOCALITY	PROVINCE	ALTITUDE (M)	CONSERVATION PRIORITY	PROPOSED CONSERVATION ACTION (SEE CORRESPONDING CHAPTER/S FOR DETAILS)
Communities: Yanacochoa – Nono –Alambi (severely altered areas)	Pichincha	2,700 – 3,200	*	<ul style="list-style-type: none"> <li>• Develop and implement awareness campaign about the species and its habitat (2.2).</li> <li>• Elaborate an ecological and socio-economic zoning with a Geographic Information System, facilitating the planning of land use strategies (1.4.1, 3.4).</li> <li>• Promote participative resource stewardship in communities and private lands through land use zoning, ranch management, and capacity building in alternative activities (1.3.2).</li> <li>• Develop and implement conservation and development projects, which promote a participative resource stewardship and generate conservation incentives (1.3.3).</li> <li>• Implement mechanisms for an efficient and/or sustainable production of charcoal and for governmental and social controls (1.2.1.3, 1.2.2.3).</li> <li>• Promote partial reforestation and establishment of corridors between forest fragments with native species (4.2, 4.3).</li> <li>• Develop an agroforestry program (restoration of vegetation using native and certain introduced species), generating economic benefit for communities and landowners (1.3.3).</li> <li>• Inform local communities about the reach and implementation of the existing contingency plan for accidents of the OCP pipeline (2.2).</li> </ul>
La Sierra (Loma La Esperanza, Guarumos, Loma La Bola) –Ataspungo (Cerro Chiquilpe) (slightly altered areas)	Pichincha	2,800 – 3,150	***	<ul style="list-style-type: none"> <li>• Develop and implement awareness campaign about the species and its habitat (2.2).</li> <li>• Elaborate an ecological and socio-economic zoning through a Geographic Information System, facilitating the planning of land use strategies (1.4.1, 3.4).</li> <li>• Promote participative resource stewardship in communities and private lands through land use zoning, ranch management plans, and capacity building in alternative activities (1.3.2).</li> <li>• Develop and implement conservation and development projects, promoting a participative resource stewardship and generating conservation incentives (1.3.3).</li> <li>• Implement mechanisms for an efficient and/or sustainable production of charcoal and timber, as well as for governmental and social controls (1.2.1.3, 1.2.2.3).</li> <li>• Promote partial reforestation and establishment of corridors between forest fragments with native species (4.2, 4.3).</li> <li>• Develop an agroforestry program (restoration of vegetation using native and certain introduced species), generating economic benefit for communities and landowners (1.3.3).</li> <li>• Identify key sites for new private and community reserves (4.4.2).</li> <li>• Plan and implement long-term monitoring program (3.9).</li> <li>• Inform local communities about the reach and implementation of the existing contingency plan for accidents of the OCP pipeline (2.2).</li> </ul>
Pomasqui, San Antonio and other communities on the southwestern slope of Volcán Pichincha (slightly altered areas)	Pichincha	2,000 - 3,400	***	<ul style="list-style-type: none"> <li>• Plan and carry out excursions in search of Black-breasted Puffleg (3.2, 3.9).</li> <li>• Plan and implement long-term monitoring (3.9) and other conservation measures if species is found.</li> <li>• Elaborate a tourism development plan for the area (1.3.3).</li> </ul>



APPENDIX 3A. SPECIES CONSERVATION ACTION PLAN FOR BLACK-BREADED PUFFLEG: PROPOSED SITE-BASED CONSERVATION ACTION AND CONSERVATION PRIORITY OF EACH SITE IN THE KNOWN AND PRESUMED RANGE OF BLACK-BREADED PUFFLEG.

LOCALITY	PROVINCE	ALTITUDE (M)	CONSERVATION PRIORITY	PROPOSED CONSERVATION ACTION (SEE CORRESPONDING CHAPTER/S FOR DETAILS)
Hacienda Verdecocha (Loma Monte Bravo, Cerro Pugsí, Loma Frutillas)	Pichincha	2,700 – 3,400	***	<ul style="list-style-type: none"> <li>• Continue with habitat preservation (4.1).</li> <li>• Continue with the restoration of native vegetation (4.2, 4.3).</li> <li>• Improve the existing management plan and develop and implement a contingency plan for the control of forest fires and burning of grasslands in coordination with public entities, environmental education activities, and surveillance through park rangers (1.1.1, 1.1.2, 4.1).</li> <li>• Collaborate with the MAE in the surveillance of the shared borders between Hacienda Verdecocha and the Bosque Protector Mindo-Nambillo (1.1.2, 4.1).</li> <li>• Formalize the reserve's protection status (1.2.1.2).</li> <li>• Involve the communities in the activities within the reserve to generate benefits for them (1.3.3).</li> <li>• Plan and implement long-term monitoring program (3.9).</li> </ul>
Yanacocha Reserve (See previous page.)	Pichincha	c. 3,400	***	<ul style="list-style-type: none"> <li>• Continue with habitat preservation (4.1).</li> <li>• Develop a management plan (1.1.1).</li> <li>• Control access to western slope of Volcán Pichincha and collaborate with the MAE in the surveillance of the shared borders between the Reserva Yanacocha and Bosque Protector Mindo-Nambillo (1.1.2, 4.1).</li> <li>• Implement a program for the restoration of woody vegetation in degraded areas (pastures) and grass páramo with native species (4.2, 4.3).</li> <li>• Expand the reserve (4.4.4).</li> <li>• Involve the communities in the activities within the reserve to generate benefits for them (1.3.3).</li> <li>• Develop a center for environmental education (2.2).</li> <li>• Plan and implement long-term monitoring program (3.9).</li> </ul>
Western flanks of Volcán Pichincha (Bosque Protector Mindo-Nambillo)	Pichincha	2,000 – 3,400	***	<ul style="list-style-type: none"> <li>• Implement effective surveillance system for the prevention of invasions, fires, and hunting in coordination with private landowners and neighboring communities (1.1.2, 4.1).</li> <li>• Develop and implement awareness campaign for park rangers (2.2).</li> <li>• Mark the limits of Bosque Protector Mindo-Nambillo with signs and boundary stones (4.1).</li> <li>• Develop and implement a contingency plan for the control of forest fires and burning of grasslands in coordination with public entities, environmental education activities and surveillance through park rangers (1.1.1, 1.1.2, 2.2, 4.1).</li> <li>• Elaborate an ecological and socio-economic zoning with a Geographic Information System, facilitating the planning of land use strategies (1.4.1, 3.4).</li> <li>• Promote resource stewardship by private landowners within the reserve through land use zoning, ranch management plans, and capacity building in alternative activities (1.3.2).</li> <li>• Develop and implement conservation and development projects together with the private landowners within the reserve, promoting a participative resource stewardship and generating conservation incentives (1.3.3).</li> <li>• Plan and carry out excursions in search of Black-breasted Puffleg (3.2, 3.9).</li> <li>• Identify key sites for new private reserves and establish them through land purchase or conservation easements (4.4.1).</li> <li>• Plan and implement long-term monitoring program (3.9).</li> </ul>

APPENDIX 3A. SPECIES CONSERVATION ACTION PLAN FOR BLACK-BREADED PUFFLEG: PROPOSED SITE-BASED CONSERVATION ACTION AND CONSERVATION PRIORITY OF EACH SITE IN THE KNOWN AND PRESUMED RANGE OF BLACK-BREADED PUFFLEG.				
LOCALITY	PROVINCE	ALTITUDE (M)	CONSERVATION PRIORITY	PROPOSED CONSERVATION ACTION (SEE CORRESPONDING CHAPTERS FOR DETAILS)
Páramo Volcán Pichincha		above 3,400	***	<ul style="list-style-type: none"> <li>Implement contingency plan and effective surveillance system for fire prevention (4.1).</li> <li>Elaborate an ecological and socio-economic zoning with a Geographic Information System, facilitating the planning of land use strategies (1.4.1, 3.4).</li> <li>Develop and implement a program for restoration of woody vegetation in at least 30% of grass páramo (4.2).</li> <li>Elaborate a tourism development plan for the area (1.3.3).</li> </ul>
Western and southern flanks Volcán Atacazo	Pichincha	2,000 – 3,400	**	<ul style="list-style-type: none"> <li>Plan and carry out excursions in search of Black-breasted Puffleg (3.2).</li> <li>Plan and implement long-term monitoring (3.9) and other conservation measures if species is found.</li> </ul>
Páramo Volcán Atacazo	Pichincha	above 3,400	**	<ul style="list-style-type: none"> <li>Develop and implement a program for restoration of woody vegetation in at least 30% of grass páramo (4.2).</li> </ul>
High-Andean mountain forest on west slope Culagá-Cayapachupa area (RECC)	Esmeraldas	2,700 – 3,400	***	<ul style="list-style-type: none"> <li>Implement effective surveillance system for the prevention of invasions, fires, and hunting in coordination with private landowners and neighboring communities (1.1.2, 4.1).</li> <li>Continue with habitat preservation (1.1).</li> <li>Plan and implement long-term monitoring program (3.9).</li> </ul>
Páramo Piñán – Cuicocha (RECC)	Esmeraldas & Imbabura	3,400 – 4,350	***	<ul style="list-style-type: none"> <li>Plan and implement awareness campaign for MAE park rangers, communities (particularly Piñán and Guamanín), and private landowners (2.2).</li> <li>Mark the limits of the RECC with signs and boundary stones (4.1).</li> <li>Implement effective surveillance system for the prevention of invasions, fires, and hunting in coordination with private landowners and neighboring communities (1.1.2, 4.1).</li> <li>Elaborate an ecological and socio-economic zoning with a Geographic Information System, facilitating the planning of land use strategies (1.4.1, 3.4).</li> <li>Promote participative resource stewardship in communities and private lands through land use zoning, ranch management plans, and capacity building in alternative activities (1.3.2).</li> <li>Develop and implement conservation and development projects, promoting a participative resource stewardship and generating conservation incentives (1.3.3).</li> <li>Develop and implement a program for restoration of woody vegetation in at least 30% of grass páramo (4.2).</li> </ul>
West slope main massif Cordillera de Toisán (RECC)	Esmeraldas	2,000 – 3,500?	***	<ul style="list-style-type: none"> <li>Establish legal mechanisms, prohibiting mining within private, community, and governmental reserves (1.2.1.2, 1.2.2.2).</li> <li>Mark the limits of the RECC with signs and boundary stones (4.1).</li> <li>Continue with habitat preservation (4.1).</li> <li>Plan and carry out excursions in search of Black-breasted Puffleg (3.2, 3.9).</li> <li>Plan and implement long-term monitoring (3.9) and other conservation measures if species is found.</li> </ul>

**APPENDIX 3A. SPECIES CONSERVATION ACTION PLAN FOR BLACK-BREADED PUFFLEG: PROPOSED SITE-BASED CONSERVATION ACTION AND CONSERVATION PRIORITY OF EACH SITE IN THE KNOWN AND PRESUMED RANGE OF BLACK-BREADED PUFFLEG.**

LOCALITY	PROVINCE	ALTITUDE (M)	CONSERVATION PRIORITY	PROPOSED CONSERVATION ACTION (SEE CORRESPONDING CHAPTER/S FOR DETAILS)
East slope main massif Cordillera de Toisán	Imbabura	2,000 – 3,500?	***	<ul style="list-style-type: none"> <li>• Establish legal mechanisms, prohibiting mining within private, community, and governmental reserves (1.2.1.2, 1.2.2.2).</li> <li>• Plan and carry out excursions in search of Black-breasted Puffleg (3.2, 3.9).</li> <li>• Plan and implement long-term monitoring (3.9) and other conservation measures if species is found.</li> </ul>
Upper Íntag valley	Imbabura	2,500 – 3,200	***	<ul style="list-style-type: none"> <li>• Establish legal mechanisms, prohibiting mining within private, community, and governmental reserves (1.2.1.2, 1.2.2.2).</li> <li>• Develop and implement awareness campaign about the species and its habitat (2.2).</li> <li>• Elaborate an ecological and socio-economic zoning through a Geographic Information System, facilitating the planning of land use strategies (1.4.1, 3.4).</li> <li>• Promote participative resource stewardship in communities and private lands through land use zoning, ranch management plans, and capacity building in alternative activities (1.3.2).</li> <li>• Develop and implement conservation and development projects, promoting a participative resource stewardship and generating conservation incentives (1.3.3).</li> <li>• Implement mechanisms for an efficient and/or sustainable production of charcoal and timber as well as for governmental and social controls (1.2.1.3, 1.2.2.3).</li> <li>• Promote partial reforestation and establishment of corridors between forest fragments with native species (4.2, 4.3).</li> <li>• Develop an agroforestry program (restoration of vegetation using native and certain introduced species), generating economic benefit for communities and landowners (1.3.3).</li> <li>• Identify key sites for new private and community reserves (4.4.2).</li> <li>• Plan and carry out excursions in search of Black-breasted Puffleg (3.2, 3.9).</li> <li>• Plan and implement long-term monitoring program (3.9).</li> </ul>

**APÉNDICE 3B. PLAN DE ACCIÓN PARA LA CONSERVACIÓN DEL ZAMARRITO PECHINEGRO: ACCIONES DE CONSERVACIÓN PROPUESTAS EN BASE A LOS SITIOS Y PRIORIDADES DE CONSERVACIÓN PARA CADA SITIO DENTRO DEL RANGO DE DISTRIBUCIÓN CONOCIDO O SUPUESTO DEL ZAMARRITO PECHINEGRO.**

Prioridad de Conservación: \* = baja, \*\* = media, \*\*\* = alta. Abreviaturas: RECC= Reserva Ecológica Cotacachi-Cayapas. Ver capítulos correspondientes y Apéndice 2B para detalles sobre las acciones de conservación propuestas. Ver Appendix 3A para la versión en inglés.

LOCALIDAD	PROVINCIA	ALTITUD (M)	PRIORIDAD DE CONSERVACION	ACCIONES DE CONSERVACION PROPUESTAS (PARA DETALLES VER LOS RESPECTIVOS CAPITULO/S)
Comunidades de: Yanacocha - Nono - Alambi  (áreas severamente degradadas)	Pichincha	2,700 - 3,200	*	<ul style="list-style-type: none"> <li>• Desarrollar e implementar una campaña de concienciación sobre la especie y el hábitat (2.2).</li> <li>• Elaborar una zonificación ecológica y socio-económica mediante un Sistema de Información Geográfica que permita planificar estrategias para los usos del suelo (1.4.1, 3.4).</li> <li>• Promover la gestión participativa de los recursos naturales en comunidades y tierras privadas a través de la zonificación del uso de suelo, manejo de fincas y asesoramiento técnico en actividades alternativas (1.3.2).</li> <li>• Elaborar e implementar proyectos integrados de conservación y desarrollo, que promuevan la gestión participativa y generen incentivos para la conservación (1.3.3).</li> <li>• Implementar mecanismos para la producción eficiente y/o sostenible de carbón y madera, así como mecanismos de control tanto gubernamental como social (1.2.1.3, 1.2.2.3).</li> <li>• Promover actividades de reforestación y el establecimiento de corredores entre fragmentos de bosque con especies nativas (4.2, 4.3).</li> <li>• Desarrollar un programa agro-forestal (revegetación mixta con especies nativas e introducidas) que proporcionará beneficios para las comunidades y propietarios de fincas (1.3.3).</li> <li>• Informar a las comunidades locales sobre el alcance e implementación del plan de contingencia de accidentes del oleoducto OCP (2.2).</li> </ul>
La Sierra (Loma la Esperanza, Guarumos, Loma La Bola) - Alaspungo (Cerro Chiquilpe)  (áreas levemente degradadas)	Pichincha	2,800 - 3,150	***	<ul style="list-style-type: none"> <li>• Desarrollar e implementar una campaña de concienciación sobre la especie y el hábitat (2.2).</li> <li>• Elaborar una zonificación ecológica y socio-económica mediante un Sistema de Información Geográfica que permita planificar estrategias para los usos del suelo (1.4.1, 3.4).</li> <li>• Promover la gestión participativa de los recursos naturales en comunidades y tierras privadas a través de la zonificación del uso de suelo, planes de manejo de fincas y asesoramiento técnico en actividades alternativas (1.3.2).</li> <li>• Elaborar e implementar proyectos integrados de conservación y desarrollo, que promuevan la gestión participativa y generen incentivos para la conservación (1.3.3).</li> <li>• Implementar mecanismos para la producción eficiente y/o sostenible de carbón y madera, así como mecanismos de control tanto gubernamental como social (1.2.1.3, 1.2.2.3).</li> <li>• Promover actividades de reforestación y el establecimiento de corredores entre fragmentos de bosque con especies nativas (4.2, 4.3).</li> <li>• Desarrollar un programa agro-forestal (revegetación mixta con especies nativas e introducidas) que proporcionará beneficios para las comunidades y propietarios de fincas (1.3.3).</li> <li>• Identificar sitios clave para la creación de nuevas reservas privadas o comunitarias (4.4.2).</li> <li>• Planificar e implementar un programa de monitoreo de largo plazo (3.9).</li> <li>• Informar a las comunidades locales sobre el alcance e implementación del plan de contingencia de accidentes del oleoducto OCP (2.2).</li> </ul>



<p><b>APÉNDICE 3B. PLAN DE ACCIÓN PARA LA CONSERVACIÓN DEL ZAMARRITO PECHINEGRO: ACCIONES DE CONSERVACIÓN PROPUESTAS EN BASE A LOS SITIOS Y PRIORIDADES DE CONSERVACIÓN PARA CADA SITIO DENTRO DEL RANGO DE DISTRIBUCIÓN CONOCIDO O SUPUESTO DEL ZAMARRITO PECHINEGRO.</b></p>				
LOCALIDAD	PROVINCIA	ALTITUD (M)	PRIORIDAD DE CONSERVACION	
			ACCIONES DE CONSERVACION PROPUESTAS (PARA DETALLES VER LOS RESPECTIVOS CAPITULO/S)	
Comunidades de: Yanacocha – Nono – Alambi (áreas severamente degradadas)	Pichincha	2,700 – 3,200	*	<ul style="list-style-type: none"> <li>• Desarrollar e implementar una campaña de concienciación sobre la especie y el hábitat (2.2).</li> <li>• Elaborar una zonificación ecológica y socio-económica mediante un Sistema de Información Geográfica que permita planificar estrategias para los usos del suelo (1.4.1, 3.4).</li> <li>• Promover la gestión participativa de los recursos naturales en comunidades y tierras privadas a través de la zonificación del uso de suelo, manejo de fincas y asesoramiento técnico en actividades alternativas (1.3.2).</li> <li>• Elaborar e implementar proyectos integrados de conservación y desarrollo, que promuevan la gestión participativa y generen incentivos para la conservación (1.3.3).</li> <li>• Implementar mecanismos para la producción eficiente y/o sostenible de carbón y madera, así como mecanismos de control tanto gubernamental como social (1.2.1.3, 1.2.2.3).</li> <li>• Promover actividades de reforestación y el establecimiento de corredores entre fragmentos de bosque con especies nativas (4.2, 4.3).</li> <li>• Desarrollar un programa agro-forestal (revegetación mixta con especies nativas e introducidas) que proporcionará beneficios para las comunidades y propietarios de fincas (1.3.3).</li> <li>• Informar a las comunidades locales sobre el alcance e implementación del plan de contingencia de accidentes del oleoducto OCP (2.2).</li> </ul>
Hacienda Verdecocha (Loma Monte Bravo, Cerro Pugi, Loma Frutillas)	Pichincha	2,700–3,400	***	<ul style="list-style-type: none"> <li>• Continuar la protección del hábitat (4.1).</li> <li>• Seguir con la restauración de vegetación nativa (4.2, 4.3).</li> <li>• Mejorar el plan de manejo ya existente y elaborar e implementar un plan de contingencia para el control de incendios forestales y quemas, en coordinación con entidades públicas, acciones de educación ambiental y vigilancia por guardaparques (1.1.1, 1.1.2, 4.1).</li> <li>• Colaborar con el MAE en la vigilancia de los límites comunes entre la Hacienda Verdecocha y el Bosque Protector Mindo-Nambillo (1.1.2, 4.1).</li> <li>• Formalizar el estado de protección de la reserva (1.2.1.2).</li> <li>• Involucrar a las comunidades en actividades dentro de la reserva que les brinden beneficios (1.3.3).</li> <li>• Planificar e implementar un programa de monitoreo de largo plazo (3.9).</li> </ul>
Reserva Yanacocha (Ver arriba.)	Pichincha	c.3,400	***	<ul style="list-style-type: none"> <li>• Continuar la protección del hábitat (4.1).</li> <li>• Desarrollar un plan de manejo (1.1.1).</li> <li>• Controlar el acceso a la ladera occidental del Volcán Pichincha y colaborar con el MAE en la vigilancia de los límites comunes entre la Reserva Yanacocha y el Bosque Protector Mindo-Nambillo (1.1.2, 4.1).</li> <li>• Desarrollar e implementar un programa de restauración de la vegetación leñosa en áreas degradadas y de páramo de pajonal (herbáceo) con especies nativas (4.2, 4.3).</li> <li>• Expandir la reserva (4.4.4).</li> <li>• Involucrar a las comunidades en actividades dentro de la reserva que les brinden beneficios (1.3.3).</li> <li>• Establecer un centro de educación ambiental (2.2).</li> <li>• Planificar e implementar un programa de monitoreo de largo plazo (3.9).</li> </ul>

<p>APÉNDICE 3B. PLAN DE ACCIÓN PARA LA CONSERVACIÓN DEL ZAMARRITO PECHINEGRO: ACCIONES DE CONSERVACIÓN PROPUESTAS EN BASE A LOS SITIOS Y PRIORIDADES DE CONSERVACIÓN PARA CADA SITIO DENTRO DEL RANGO DE DISTRIBUCIÓN CONOCIDO O SUPUESTO DEL ZAMARRITO PECHINEGRO.</p>				
LOCALIDAD	PROVINCIA	ALTITUD (M)	PRIORIDAD DE CONSERVACION	ACCIONES DE CONSERVACION PROPUESTAS (PARA DETALLES VER LOS RESPECTIVOS CAPITULO/S)
Estribaciones occidentales del Volcán Pichincha (Bosque Protector Mindo-Nambillo)	Pichincha	2,000 – 3,400	***	<ul style="list-style-type: none"> <li>Implementar un sistema efectivo de vigilancia para la prevención de invasiones, incendios y cacería en coordinación con propietarios privados y comunidades aledañas (1.1.2, 4.1).</li> <li>Desarrollar e implementar una campaña de concienciación para guardaparques (2.2).</li> <li>Señalizar los límites de la reserva con letreros e hitos (4.1).</li> <li>Elaborar e implementar un plan de contingencia para el control de incendios forestales y quemas, en coordinación con entidades públicas, acciones de educación ambiental y vigilancia por guardaparques (1.1.1, 1.1.2, 2.2, 4.1).</li> <li>Elaborar una zonificación ecológica y socio-económica mediante un Sistema de Información Geográfica que permita planificar estrategias para los usos del suelo (1.4.1, 3.4).</li> <li>Promover la gestión participativa de los recursos naturales en comunidades y tierras privadas a través de la zonificación del uso de suelo, planes de manejo de fincas y asesoramiento técnico en actividades alternativas (1.3.2).</li> <li>Elaborar e implementar proyectos integrados de conservación y desarrollo en conjunto con los propietarios privados dentro de la reserva, que promuevan la gestión participativa y generen incentivos para la conservación (1.3.3).</li> <li>Planificar y llevar a cabo expediciones de búsqueda del Zamarrito Pechinegro (3.2, 3.9).</li> <li>Identificar sitios clave para la creación de nuevas reservas privadas dentro del Bosque Protector y establecerlas mediante la compra de tierra o pagos por servicios ambientales (4.4.2).</li> <li>Planificar e implementar un programa de monitoreo de largo plazo (3.9).</li> </ul>
Páramo del Volcán Pichincha		arriba de 3,400	***	<ul style="list-style-type: none"> <li>Implementar un plan de contingencia y un sistema efectivo de vigilancia para la prevención de incendios (4.1).</li> <li>Elaborar una zonificación ecológica y socio-económica mediante un Sistema de Información Geográfica que permita planificar estrategias para los usos del suelo (1.4.1, 3.4).</li> <li>Desarrollar e implementar un programa de restauración de la vegetación leñosa en al menos 30% del páramo herbáceo (4.2).</li> <li>Establecer un plan de desarrollo turístico de la zona (1.3.3).</li> </ul>
Estribaciones Occidentales y del Sur del Volcán Atacazo	Pichincha	2,000 – 3,400	**	<ul style="list-style-type: none"> <li>Planificar y llevar a cabo expediciones de búsqueda del Zamarrito Pechinegro (3.2).</li> <li>Planificar e implementar un monitoreo a largo plazo (3.9) además de otras medidas de conservación si la especie es encontrada.</li> </ul>
Páramo Volcán Atacazo	Pichincha	arriba de 3,400	**	<ul style="list-style-type: none"> <li>Desarrollar e implementar un programa de restauración de la vegetación leñosa en al menos 30% del páramo herbáceo (4.2).</li> </ul>
Bosque Alto Andino de la estribación occidental del área de Culagá-Cayapachupa (RECC)	Esmeraldas	2,000 – 3,400	***	<ul style="list-style-type: none"> <li>Implementar un sistema efectivo de vigilancia para la prevención de invasiones, incendios y cacería en coordinación con propietarios privados y comunidades aledañas (1.1.2, 4.1).</li> <li>Continuar con la protección del hábitat (1.1).</li> <li>Planificar e implementar un programa de monitoreo de largo plazo (3.9).</li> </ul>

<b>APÉNDICE 3B. PLAN DE ACCIÓN PARA LA CONSERVACIÓN DEL ZAMARRITO PECHINEGRO: ACCIONES DE CONSERVACIÓN PROPUESTAS EN BASE A LOS SITIOS Y PRIORIDADES DE CONSERVACIÓN PARA CADA SITIO DENTRO DEL RANGO DE DISTRIBUCIÓN CONOCIDO O SUPUESTO DEL ZAMARRITO PECHINEGRO.</b>				
LOCALIDAD	PROVINCIA	ALTITUD (M)	PRIORIDAD DE CONSERVACION	ACCIONES DE CONSERVACION PROPUESTAS (PARA DETALLES VER LOS RESPECTIVOS CAPITULO/S)
Páramo de Piñán-Cuicocha (RECC) (Ver página anterior.)	Esmeraldas & Imbabura	arriba de 3,400	***	<ul style="list-style-type: none"> <li>• Desarrollar e implementar una campaña de concienciación para guardaparques del MAE, las comunidades (particularmente Piñán y Guamanín) y los propietarios privados (2.2).</li> <li>• Marcar los límites de la RECC con letreros e hitos (4.1).</li> <li>• Implementar un sistema efectivo de vigilancia para la prevención de invasiones, incendios y cacería en coordinación con propietarios privados y comunidades aledañas (1.1.2, 4.1).</li> <li>• Elaborar una zonificación ecológica y socio-económica mediante un Sistema de Información Geográfica que permita planificar estrategias para los usos del suelo (1.4.1, 3.4).</li> <li>• Promover la gestión participativa de los recursos naturales en comunidades y tierras privadas a través de la zonificación del uso de suelo, planes de manejo de fincas y asesoramiento técnico en actividades alternativas (1.3.2).</li> <li>• Elaborar e implementar proyectos integrados de conservación y desarrollo, que promuevan la gestión participativa y generen incentivos para la conservación (1.3.3).</li> <li>• Desarrollar e implementar un programa de restauración de la vegetación leñosa en al menos 30% del páramo herbáceo (4.2).</li> </ul>
Estribación occidental del macizo principal de la Cordillera de Toisán (RECC)	Esmeraldas	2,000 – 3,500	***	<ul style="list-style-type: none"> <li>• Establecer mecanismos legales que prohíban cualquier actividad minera dentro de reservas gubernamentales, comunitarias y privadas (1.2.1.2, 1.2.2.2).</li> <li>• Marcar con señales e hitos los límites de la RECC (4.1).</li> <li>• Continuar con la protección del hábitat (4.1).</li> <li>• Planificar y llevar a cabo expediciones de búsqueda del Zamarrito Pechinegro (3.2, 3.9).</li> <li>• Planificar e implementar un monitoreo de largo plazo (3.9) además de otras medidas de conservación si la especie es encontrada.</li> </ul>
Estribación oriental del macizo principal de la Cordillera de Toisán	Imbabura	2,000 - 3,500	***	<ul style="list-style-type: none"> <li>• Establecer mecanismos legales que prohíban cualquier actividad minera dentro de reservas gubernamentales, comunitarias y privadas (1.2.1.2, 1.2.2.2).</li> <li>• Planificar y llevar a cabo expediciones de búsqueda del Zamarrito Pechinegro (3.2, 3.9).</li> <li>• Planificar e implementar un monitoreo de largo plazo (3.9) además de otras medidas de conservación si la especie es encontrada.</li> </ul>
Valle Alto de Intag (Ver página anterior.)	Imbabura	2,500 - 3,200	***	<ul style="list-style-type: none"> <li>• Establecer mecanismos legales que prohíban cualquier actividad minera dentro de reservas gubernamentales, comunitarias y privadas (1.2.1.2, 1.2.2.2).</li> <li>• Desarrollar e implementar una campaña de concienciación sobre la especie y el hábitat (2.2).</li> <li>• Elaborar una zonificación ecológica y socio-económica mediante un Sistema de Información Geográfica que permita planificar estrategias para los usos del suelo (1.4.1, 3.4).</li> <li>• Promover la gestión participativa de los recursos naturales en comunidades y tierras privadas a través de la zonificación del uso de suelo, planes de manejo de fincas y asesoramiento técnico en actividades alternativas (1.3.2).</li> <li>• Elaborar e implementar proyectos integrados de conservación y desarrollo, que promuevan la gestión participativa y generen incentivos para la conservación (1.3.3).</li> <li>• Implementar mecanismos para la producción eficiente y/o sostenible de carbón y madera, así como mecanismos de control tanto gubernamental como social (1.2.1.2, 1.2.1.3).</li> <li>• Promover actividades de reforestación y el establecimiento de corredores entre fragmentos de bosque con especies nativas (4.2 y 4.3).</li> <li>• Desarrollar un programa agro-forestal (revegetación mixta con especies nativas e introducidas) que proporcionará beneficios para las comunidades y propietarios de fincas (1.3.3).</li> <li>• Identificar sitios clave para la creación de nuevas reservas privadas o comunitarias (4.4.2).</li> <li>• Planificar y llevar a cabo expediciones de búsqueda del Zamarrito Pechinegro (3.2, 3.9).</li> <li>• Planificar e implementar un programa de monitoreo de largo plazo (3.9).</li> </ul>

#### APPENDIX 4. ESTIMATED COSTS OF SELECTED ACTIVITIES.

Cost estimates are provided only for those activities for which realistic information is available. The remaining proposed conservation actions (Appendices 2A and 3A) are at an early stage of planning, and their costs cannot yet be estimated within a reasonable margin of error.

CONSERVATION ACTION (SEE CHAPTER NO. FOR DETAILS)	COSTS PER UNIT (US-\$)	TYPE OF UNIT	FREQUENCY	REMARKS
Updating of Species Action Plan	10,000	Activity.	Every five years.	
Cadastral study on land-ownership (1.4).	50,000	Activity.	Once.	
Elaboration of corresponding GIS database on land-ownership and additional socio-economic and political information (1.4).	15,000	Activity.	Once.	
Updating of GIS database on land-ownership and additional socio-economic and political information (1.4).	7,500	Activity.	Every five years.	
Elaboration of GIS database on habitat status and change.	20,000	Activity.	Once.	
Updating of GIS database on habitat status and change.	10,000	Activity.	Every five years.	
Development of new management plans for private and community reserves (<500 ha).	2,000	Activity per reserve.	Once.	
Updating of existing management plans for private and community reserves (<500 ha).	1,000	Activity per reserve.	Every five years.	
Development of new management plans for private and community reserves (500–2,500 ha).	56,000	Activity per reserve.	Once.	The costs of the development of new management plans for reserves >2,500 ha can be estimated at \$2.0 per hectare.
Updating of existing management plans for private and community reserves (500–2,500 ha).	2,500	Activity per reserve.	Every five years.	The costs of the update of existing management plans for reserves >2,500 ha can be estimated at \$1.0 per hectare.
Land purchase for the establishment of private and community reserves.	400-1,000	Per hectare.	According to the availability of funds.	New owner has to pay for maintenance of the reserve, e.g., infrastructure, park rangers, etc.
Endowment fund seed money for conservation easements aimed at the protection of habitat and wildlife in private and community lands.	500	Per hectare.	According to the availability of funds.	Original owner maintains land title but guarantees the conservation of the habitat and wildlife. For this environmental service he receives payments generated by the trust fund. The compliance of the contract is confirmed through monitoring studies of habitat status (satellite images) and populations of birds and mammals.



APPENDIX 4. ESTIMATED COSTS OF SELECTED ACTIVITIES.					
CONSERVATION ACTION (SEE CHAPTER NO. FOR DETAILS)	COSTS PER UNIT (US-\$)	TYPE OF UNIT	FREQUENCY	REMARKS	
Park ranger.	4,000	Per year.	Continuous.	For reserves <1,000 ha at least 2 park rangers are needed. For reserves between 1,000 and 10,000 ha at least 1 park ranger per 1,000 ha should be employed.	
Restoration of native woody vegetation on pastures and páramo grasslands.	2,000	Per hectare.	Continuous.	Includes tree nursery and minimum payments for workers.	
Field course on Transect Mapping techniques.	5,000 - 8,000	Ten-day event.	Two per year.	For 6–16 participants. Includes 3 days of lectures on the theory of the method, which can be held in a classroom.	
Field expeditions to remote sites in the search of Black-breasted Puffleg.	5,000 - 8,000	Per fieldtrip (duration: about 21 days).	Two to four expeditions per year.	Includes transport; materials; food; payments for field assistants and researchers; and surveys of two transects according to the MTW monitoring protocol. True costs depend on various factors, e.g., remoteness of study areas, fee for field assistants, experience of biologist, etc.	
Digitalization and analysis of expedition data.	2,500	Per two transects (duration: about four weeks).	Every five years. Two to four times per year.	Includes payments for assistants, database administrator and researchers.	
Monitoring of transects in long-term study.	2,500 - 4,000	Per transect and monitoring survey (duration: about 10 days).	Two monitoring surveys per year and transect.	Includes transport, materials, food, and payments for field assistants and researchers.	
Digitalization and analysis of monitoring data.	1,250	Per transect and monitoring survey (duration: about two weeks).	Two times per year and transect.	Includes payments for assistants, database administrator and researchers.	
Production of a booklet for environmental education purposes.	3,000	1,000 copies	Every three years.		
Production of a poster for environmental education purposes.	2,000	1,000 copies	Every three years.		

**APPENDIX 5. DESIGN OF A POPULATION MONITORING PROGRAM FOR BLACK-BREASTED PUFFLEG, USING THE MTW TRANSECT MAPPING PROTOCOL (JAHN IN PRESS A).**

To use the funds for this program as efficiently as possible all bird species and certain mammal species will be surveyed in the proposed study.

**Conservation training and education:** Trainees and participants will be recruited from a wide spectrum of organizations (e.g., Museo Ecuatoriano de Ciencias Naturales, universities, NGOs, bird guides, as well as biologist, and independent amateurs). A questionnaire will help to assess the experience of those interested in the program, regarding their identification skills, experience with audio-visual survey techniques, and academic formation. An appropriate number of basic and advanced courses on theory and data analysis will be offered. The most experienced candidates will be trained first in order to get the monitoring study going.

**Principal design of the monitoring study:** On the basis of the known altitudinal range of Black-breasted Puffleg, we will divide the study area in two zones: between 2,400 and 3,000 m (Montane Cloud Forest) and between 3,000 and 3,600 m (High Andean Evergreen Forest). In each of these altitudinal ranges we will establish a set of eight transects, that is 16 transects in total. The number of transects will be divided evenly between two political areas in the species' range of distribution (Tab. 3-7): Pichincha province (Volcán Pichincha and Volcán Atacazo) and Imbabura province (Cordillera de Toisán and upper Íntag valley). The transects will be established in legally protected areas, as well as in private and community reserves to guarantee that they can be surveyed for many years.

**Implementation:** The long-term monitoring will be implemented in three years, according to the availability of funds and sufficiently well trained observers. We plan to survey four transects in the first, six transect in the second, and subsequently eight transects per year. At least sixteen transects should be monitored in total (Tab. 3-7). That is, each transect will be surveyed only every second year.

**Transect establishment:** The transects of a lengths of 1200 meters will be established inside forest and at least 500 meters apart from each other. They will be marked with conspicuous distance markers, each 25 m apart,

on both sides of the path. Their orientation and altitude will be measured and the geographic coordinates of the initial and final points determined with a Ground Positioning Satellite (GPS) equipment.

**Long-term monitoring:** Each transect will be surveyed two times per monitoring year according to the "Multi Time-Window Transect Mapping" (MTW) protocol for monitoring studies (Jahn in press a). One survey should be carried out in the dry season and another in the rainy season. One complete survey consists of a set of 24 samples, which can be carried out within six days under optimal climatic conditions. Using the MTW monitoring protocol, a well-trained observer might record *c.* 70 % of the total bird species richness and 80-90 % of all breeding residents present in the transect area with a single complete survey, including most of the endemic and threatened species. Certain mammals (e.g., squirrels) are simultaneously recorded. One of the most remarkable advantages of the MTW monitoring protocol is that estimates of abundance indices, absolute population densities, and biomass densities for a transect of up to 1200 m, can be obtained after only one complete survey.

**Data analysis:** Absolute population densities will be determined for each species recorded in the monitoring surveys. Changes in absolute density can be tested between years using pair-wise (Mann-Whitney) U-tests with a minimum of four transects, and with the Wilcoxon's test for matched pairs with a minimum of six transects. After seven years of continued monitoring, population trends can be analyzed with the Spearman Rank Correlation Coefficient.

**Estimated costs:** The costs per surveyed transect should be estimated at \$ 8,000 per year. This includes two surveys of the same transect and the analysis of the corresponding data, given that the analysis is carried out with a computerized system, including a GIS based plotting of maps that show the records of each species. The maintenance of the database and the computer program for data analysis are between \$ 10,000 and \$ 20,000 per year. Thus, the total costs of the monitoring study outlined her are about \$80.000 per year. However, this number does not include the costs for capacity building workshops.

#### Proposed program for population-monitoring of Black-breasted Puffleg.

LOCALITY	NUMBER OF TRANSECTS				
	YEAR 1	YEAR 2	YEAR 3	YEAR 4	YEAR 5
NW slope of Volcán Pichincha, >3,000 m	2		2		2
NW slope of Volcán Pichincha, <3,000 m	2		2		2
W slope of Volcán Pichincha, >3,000 m			1		1
W slope of Volcán Pichincha, <3,000 m			1		1
Volcán Atacazo, >3,000 m			1		1
Volcán Atacazo, <3,000 m			1		1
Cayapachupa, Cordillera de Toisán, >3,000 m		2		2	
Cayapachupa, Cordillera de Toisán, <3,000 m		2		2	
Main massif Cordillera de Toisán, >3,000 m		1		2	
Main massif Cordillera de Toisán, <3,000 m		1		2	
<b>Total</b>	<b>4</b>	<b>6</b>	<b>8</b>	<b>8</b>	<b>8</b>

## APPENDIX 6. MEETINGS AND WORKSHOPS WITH STAKEHOLDERS

In order to obtain broad support for, and participation in, the outlined conservation activities, the action plan was discussed with a wide spectrum of stakeholders during the following events: (1) meeting at Jocotoco Foundation, (2) stakeholder workshop at Fundación Natura, Quito; (3) stakeholder workshop in Nono; (4) community workshop in La Sierra, (5) community workshop in Alaspungo, (6) community workshop in Alambi, (7) stakeholder workshop Nono, (8) workshop with landowners at FLACSO, Quito.

EVENT	DATE	LOCALITY	ORGANIZATION	PARTICIPANTS	PHONE	E-MAIL
1	15.12.2006	Quito	World Land Trust and Jocotoco Foundation	Robert Ridgely	27272013	rridgely@earthlink.net
1	15.12.2006	Quito	Jocotoco Foundation	Francisco Sornoza Molina	27272013	fsornoza@pi.pro.ec
1	15.12.2006	Quito	Aves & Conservación	Tatiana Santander	2507238 2249968	tsantander@avesconservacion.org
1	15.12.2006	Quito	Aves & Conservación	Olaf Jahn	2271800 2249968	O.Jahn@andinanet.net
2	22.01.2007	Quito	Nubesierra Foundation	Ricardo Maldonado	2507238, 2551508	ricky@verdecocha.com
2	22.01.2007	Quito	Jocotoco Foundation	Francisco Sornoza Molina	2272013	fsornoza@pi.pro.ec
2	22.01.2007	Quito	Museo Ecuatoriano de Ciencias Naturales	Patricio Mena	2449824	p.mena@mecn.gov.ec
2	22.01.2007	Quito	Ministerio del Ambiente	Gabriela Montoya	097531454	gmontoya@ambiente.gov.ec
2	22.01.2007	Quito	Ministerio de Ambiente, Dirección Forestal y Bosques Protectores	Camilo González	097781245, 2563542	cgonzalez@ambiente.gov.ec
2	22.01.2007	Quito	Ministerio de Turismo, Proyecto Ecoruta	Iván Hidalgo	084232161	ihidalgo@turismo.gov.ec
2	22.01.2007	Quito	Ministerio de Turismo	Paola González	084940166	cpalaygonzalez@hotmail.com
2	22.01.2007	Quito	Fundación Alambi	Wilma Peñaherrera	2116327	
2	22.01.2007	Quito	Ecoruta, Tandayapa	Fausto Valencia	2374356	truchafav@punto.net.ec
2	22.01.2007	Quito	Corporación Ecoruta, Presidenta	Grecia Flores	096000063	gfloresflores@hotmail.com
2	22.01.2007	Quito	Alaspungo, Presidente	Emiliano Ramos	092460782	
2	22.01.2007	Quito	Yanacocha, Presidente	Jose Luis Hipo	091226320	
2	22.01.2007	Quito	Yanacocha	Nelson Hipo	091822813	
2	22.01.2007	Quito	La Sierra, Presidente	Rosendo Albarracín		
2	22.01.2007	Quito	Alambi, Presidente	Rolando Hipo	091689219	
2	22.01.2007	Quito	Junta Parroquial Nono	Margiory Donoso Chacón	099222117	mdonosos@maxigraf.com
2	22.01.2007	Quito	Mindo Cloud Forest Foundation	Paul Greenfield	2464068 0865399360	paulg@uio.satnet.net
2	22.01.2007	Quito	Dirección Metropolitana de Medio Ambiente	Daniela Valarezo	2430588 ext. 107	cdanibb7@yahoo.com
2	22.01.2007	Quito	Maquipucuna Foundation	Bernardo Castro	2507202/203	bernardo@maquipucuna.org
2	22.01.2007	Quito	Maquipucuna Foundation	Manuel Sánchez	2507198	jazzmanu@gmail.com
2	22.01.2007	Quito	Consejo Provincial de Pichincha	Vicente Guadalupe	2562776 ext. 112	vguadalupe@pichincha.gov.ec
2	22.01.2007	Quito	Jatun Sacha Foundation	Loly Sánchez	2432240	sloly@jatunsacha.org
2	22.01.2007	Quito	Ecociencia Foundation	Verónica Benítez	2522999	verobenitezj@yahoo.es
2	22.01.2007	Quito	Unidad de Protección del Medio Ambiente de la Policía	Marcelo Valladolid		marcelovalladolid@yahoo.com

APPENDIX 6. MEETINGS AND WORKSHOPS WITH STAKEHOLDERS						
EVENT	DATE	LOCALITY	ORGANIZATION	PARTICIPANTS	PHONE	E-MAIL
2	22.01.2007	Quito	EcoFondo/FAN	Cecilia Pacheco	2246 116 2262 605	arasari@andinanet.net
2	22.01.2007	Quito	Hacienda La Merced de Nono	Guido Rosero	2786047	
2	22.01.2007	Quito	Hacienda La Merced de Nono	Fanny Rosero de Yépez	2268176	
2	22.01.2007	Quito	Municipio de Quito	Juan Manuel Carrión	2892784	tangara@interactive.net.ec
2	22.01.2007	Quito	Municipio de Quito, Presidenta Comisión de Medio Ambiente	Carmen Elena de Janón	095675520	cjanon@quito.gov.ec
2	22.01.2007	Quito	CORPEI	Geovanna Robayo	094620695	aviturismo_corpei@yahoo.com
2	22.01.2007	Quito	Guarumos	Jaime Villalba	093099989	
2	22.01.2007	Quito	Hacienda La Merced de Nono	Fanny Rosero de Yépez	2268176	
3	27.02.2007	Nono	Comunidad Alambi	Rolando Hipo	091689219	
3	27.02.2007	Nono	Parroquia Nono guías de turismo.	Bayron Quishpe	022498224 092918704	
3	27.02.2007	Nono	La Sierra / Guarumos / Los Cedros	Daniel Rosero Albarracín	099610564 (Sra. Nancy Albarracín)	
3	27.02.2007	Nono	Guarumos	Jaime Villalba	093099989	
3	27.02.2007	Nono	Asociación Agrícola Yanacocha	Juan Manuel Chicaiza	091822813 (Nelson Hipo)	
3	27.02.2007	Nono	Asociación Agrícola Yanacocha	Nelson Hipo	091822813	
3	27.02.2007	Nono	Parroquia Nono	Cristina Cumba	022786055	
3	27.02.2007	Nono	Presidente Comunidad Alaspungo	Segundo Emiliano Ramos	092460782	
3	27.02.2007	Nono	Nono	Aníbal Rivera	2786130	
3	27.02.2007	Nono	Nono	Rigoberto Ruiz	2786270	
4	17.03.2007	La Sierra	La Sierra Community	Javier Albarracín		
4	17.03.2007	La Sierra	La Sierra Community	Marlene Barreiros		
4	17.03.2007	La Sierra	La Sierra Community	Juan Barreiros		
4	17.03.2007	La Sierra	La Sierra Community	Gonzalo Correa		
4	17.03.2007	La Sierra	La Sierra Community	Victoriana Vergara		
4	17.03.2007	La Sierra	La Sierra Community	Inés Vergara		
4	17.03.2007	La Sierra	La Sierra Community	Ester Villalba		
4	17.03.2007	La Sierra	La Sierra Community	Carmen Barreiros		
4	17.03.2007	La Sierra	La Sierra Community	Francisco Villalba		
4	17.03.2007	La Sierra	La Sierra Community	Rosa Villalba		
4	17.03.2007	La Sierra	La Sierra Community	Emiliano Ramos	092460780	
4	17.03.2007	La Sierra	La Sierra Community	Yolanda Villalba		
4	17.03.2007	La Sierra	La Sierra Community	Mario Correa		
4	17.03.2007	La Sierra	La Sierra Community	Humberto Villalba		
4	17.03.2007	La Sierra	La Sierra Community	Alicia Hipo		
4	17.03.2007	La Sierra	La Sierra Community La Sierra Community	Miguel Morales		
4	17.03.2007	La Sierra	La Sierra Community	Daniel Albarracín		
4	17.03.2007	La Sierra	La Sierra Community	Gloria Chicaiza		
4	17.03.2007	La Sierra	La Sierra Community	Enma Chicaiza	088102719	
4	17.03.2007	La Sierra	La Sierra Community	Manuel Bareiro		
4	17.03.2007	La Sierra	La Sierra Community	Edison Albarracín	088953796	



APPENDIX 6. MEETINGS AND WORKSHOPS WITH STAKEHOLDERS						
EVENT	DATE	LOCALITY	ORGANIZATION	PARTICIPANTS	PHONE	E-MAIL
4	17.03.2007	La Sierra	La Sierra Community	Rosendo Barreiros	091466394	
4	17.03.2007	La Sierra	La Sierra Community	Erik Bazán	091897302	
4	17.03.2007	La Sierra	La Sierra Community	Javier Larco		
4	17.03.2007	La Sierra	La Sierra Community	Nelly Albarracín		
4	17.03.2007	La Sierra	La Sierra Community	Miguel Morales		
4	17.03.2007	La Sierra	Alambi community	Rolando Hipo	091689219	
4	17.03.2007	La Sierra	Guarumos community	Carlos Villalba		
4	17.03.2007	La Sierra	La Sierra Community	Jaime Villalba	093099989	
4	17.03.2007	La Sierra	La Sierra School Principal	Wilson Gualpa	022593005	
4	17.03.2007	La Sierra	La Sierra Community	Edison Manuel Pullataxi		
5	12.04.2007	Alaspungo	Alaspungo Community	Enrique Calderón		
5	12.04.2007	Alaspungo	Alaspungo Community	Ángel Albán		
5	12.04.2007	Alaspungo	Alaspungo Community	Honorio Calderón		
5	12.04.2007	Alaspungo	Alaspungo Community	Alfredo Quingalamba		
5	12.04.2007	Alaspungo	Alaspungo Community	Gerardo Pailiacho		
5	12.04.2007	Alaspungo	Alaspungo Community	Vicente Vinueza		
5	12.04.2007	Alaspungo	Alaspungo Community	Elias Tatayo		
5	12.04.2007	Alaspungo	Alaspungo Community	Luis Tatayo		
5	12.04.2007	Alaspungo	Alaspungo Community	Elias Pailiacho		
5	12.04.2007	Alaspungo	Alaspungo Community	Moisés Romo		
5	12.04.2007	Alaspungo	Alaspungo Community	Cecilia Olmedo		
5	12.04.2007	Alaspungo	Alaspungo Community	Mónica Quishpe		
5	12.04.2007	Alaspungo	Alaspungo Community	Alexandra Ramos		
5	12.04.2007	Alaspungo	Alaspungo Community	Eduardo Ramos		
5	12.04.2007	Alaspungo	Alaspungo Community	Cristian Cañar		
5	12.04.2007	Alaspungo	Alaspungo Community	Jhovany Tatayo		
5	12.04.2007	Alaspungo	Alaspungo Community	Jessica Tatayo		
5	12.04.2007	Alaspungo	Alaspungo Community	María Tatayo		
5	12.04.2007	Alaspungo	Alaspungo Community	Galo Ramos		
5	12.04.2007	Alaspungo	Alaspungo Community	Luis Quishpe		
5	12.04.2007	Alaspungo	Alaspungo Community	María Gualco		
5	12.04.2007	Alaspungo	Alaspungo Community	Alcira Calderón		
5	12.04.2007	Alaspungo	Alaspungo Community	Luz Querembas		

APPENDIX 6. MEETINGS AND WORKSHOPS WITH STAKEHOLDERS						
EVENT	DATE	LOCALITY	ORGANIZATION	PARTICIPANTS	PHONE	E-MAIL
5	12.04.2007	Alaspungo	Alaspungo Community	Martha Quishpe		
5	12.04.2007	Alaspungo	Alaspungo Community	Rosa Guamán		
5	12.04.2007	Alaspungo	Alaspungo Community	Tránsito Albán		
5	12.04.2007	Alaspungo	Alaspungo Community	Leticia Payliacho		
5	12.04.2007	Alaspungo	Alaspungo Community	Edelmira Oñate		
5	12.04.2007	Alaspungo	Alaspungo Community	Susana Quishpe		
5	12.04.2007	Alaspungo	Alaspungo Community	Jorge Calderón		
5	12.04.2007	Alaspungo	Alaspungo Community	Gustavo Romo		
5	12.04.2007	Alaspungo	Alaspungo Community	Olimpio Romo		
5	12.04.2007	Alaspungo	Alaspungo Community	Segundo Gualpo		
5	12.04.2007	Alaspungo	Alaspungo Community	Segundo Ramos		
5	12.04.2007	Alaspungo	Alaspungo Community	Mario Cañar		
5	12.04.2007	Alaspungo	Alaspungo Community	Alonso Calderón		
5	12.04.2007	Alaspungo	Alaspungo Community	Camilo Ramos		
5	12.04.2007	Alaspungo	Alaspungo Community	Emiliano Ramos		
5	12.04.2007	Alaspungo	Alaspungo Community	Fernando Ramos		
5	12.04.2007	Alaspungo	Alaspungo Community	Teresa Ramos		
6	21.04.2007	Alambi	Alambi Community	Roxana Morales		
6	21.04.2007	Alambi	Alambi Community	Joselin Morales		
6	21.04.2007	Alambi	Alambi Community	Mayra Villalba		
6	21.04.2007	Alambi	Alambi Community	Susana Morales		
6	21.04.2007	Alambi	Alambi Community	Manuel Santos		
6	21.04.2007	Alambi	Alambi Community	Alicia Hipo	093099989	
6	21.04.2007	Alambi	Alambi Community	Julia María Santos		
6	21.04.2007	Alambi	Alambi Community	Patricia Hipo		
6	21.04.2007	Alambi	Alambi Community	Yadira Hipo		
6	21.04.2007	Alambi	Alambi Community	Marina Santos		
6	21.04.2007	Alambi	Alambi Community	Juan Carlos Toasa		
6	21.04.2007	Alambi	Alambi Community	Ana María Cañar		
6	21.04.2007	Alambi	Alambi Community	Cristian Toaza		
6	21.04.2007	Alambi	Alambi Community	Patricio Toaza		
6	21.04.2007	Alambi	Alambi Community	José Antonio Hipo		
6	21.04.2007	Alambi	Alambi Community	María Amanda Santos		
6	21.04.2007	Alambi	Alambi Community	Lucila Chicaiza		
6	21.04.2007	Alambi	Alambi Community	Segundo José Hipo		
6	21.04.2007	Alambi	Alambi Community	Segundo Santos		
6	21.04.2007	Alambi	La Sierra Community	Jaime Villalba		

APPENDIX 6. MEETINGS AND WORKSHOPS WITH STAKEHOLDERS						
EVENT	DATE	LOCALITY	ORGANIZATION	PARTICIPANTS	PHONE	E-MAIL
6	21.04.2007	Alambi	Alambi Community	Carolina Llumiquinga		
6	21.04.2007	Alambi	Alambi Community	Angélica Santos		
6	21.04.2007	Alambi	Alambi Community	Elsa Santos		
6	21.04.2007	Alambi	Alambi Community	Oscar Morales		
6	21.04.2007	Alambi	Alambi Community	Ximena Morales		
6	21.04.2007	Alambi	Alambi Community	María Juana Santos		
6	21.04.2007	Alambi	Alambi Community	Emiliano Ramos		
6	21.04.2007	Alambi	Alambi Community	Manuela Ambas		
6	21.04.2007	Alambi	Alambi Community	Rolando Hipo	091689219	
6	21.04.2007	Alambi	Alambi Community	Manuel Cañar		
6	21.04.2007	Alambi	Alambi Community	Rubén Morales	097878315	
6	21.04.2007	Alambi	Alambi Community	Gloria Santos		
6	21.04.2007	Alambi	Alambi Community	Segunda Santos		
6	21.04.2007	Alambi	Alambi Community	José Manuel Hipo Flores		
6	21.04.2007	Alambi	Alambi Community	José Julio Santos		
6	21.04.2007	Alambi	Alambi Community	Alberto Cañar		
6	21.04.2007	Alambi	Alambi Community	Wilmer Hipo	086350367	
6	21.04.2007	Alambi	Alambi Community	Pedro Santos		
6	21.04.2007	Alambi	Alambi Community	Freddy Hipo	086482793	
7	21.07.2007	Nono	Alambi Community	Rolando Hipo	091689219	
7	21.07.2007	Nono	Alaspungo Community President	Eduardo Ramos	092460782	
7	21.07.2007	Nono	Alambi Community Vice-president	Alberto Cañar		
7	21.07.2007	Nono	Alaspungo Community	Gerardo Pailacho		
7	21.07.2007	Nono	Alanpungo Community Vice-president	Segundo Gualeo		
7	21.07.2007	Nono	Alaspungo Community	William Calderón		
7	21.07.2007	Nono	Alaspungo Community	Enrique Calderón		
7	21.07.2007	Nono	Alaspungo Community secretary	Jorge Calderón		
7	21.07.2007	Nono	Nono Community	Santiago Enríquez	091503229	
7	21.07.2007	Nono	Nono Community	Norberto Vallejo	091235353	
7	21.07.2007	Nono	Nono Community	Romelia Mosquera	094313799	
8	12.09.2007	Mindo	Tandayapa Community	Fausto Valencia	2374356 084974643	
8	12.09.2007	Nono	Hacienda La Merced	Mireya de Rosero	2786047	
8	12.09.2007	Guarumos	Hacienda La Esperanza	Marcelo Franco	2432697	
8	12.09.2007	Nono	Hacienda San Martín	Belén Sandoval	2456051	
8	12.09.2007	Verdecocha	Foundation Jocotoco	Mery Juiña	2272013	
8	12.09.2007	Tandayapa	Tamboquinde	Juan Manuel Carrión	2892784	
8	12.09.2007	Verdecocha	Verdecocha Community	Ricardo Maldonado	091473948	
8	12.09.2007	Nono	Hacienda Anita Lucía	Luis Pozo	2533020	
8	12.09.2007	Mindo	Mindo Community	Eduardo Goetschel	2456474	

APPENDIX 6. MEETINGS AND WORKSHOPS WITH STAKEHOLDERS						
EVENT	DATE	LOCALITY	ORGANIZATION	PARTICIPANTS	PHONE	E-MAIL
8	12.09.2007	Mindo	Mindo Community	Carlos Fiallo	094919895	
8	12.09.2007	Mindo	Mindo Community	Jorge Goetschel	2456474	
8	12.09.2007	Mindo	Hacienda San Tadeo	Rolando García	091919928	
8	12.09.2007	Nono	Nono Community	Guido Rosero	2786047	
8	12.09.2007	Mindo	Mindo Commulity	Sonia Saltos	097863172	



SPECIES ACTION PLAN  
BLACK-BREASTED PUFFLEG  
ERIOCNEMIS NIGRIVESTIS

A PUBLICATION OF:

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