

Conservation status in Bolivia of timberline habitats, elfin forest and their birds

Michael Kessler and Sebastian K. Herzog

La línea superior de bosques en los Andes bolivianos ha sido fuertemente modificada por quema y pastoreo durante miles de años. Por lo tanto, la transición gradual natural ha sido ampliamente reemplazada por un ecotono abrupto de bosque a pastizales adaptados al fuego. Menos del 5% de la línea de bosque en Bolivia permanece en estado natural. Tanto especies de aves dependientes en el ecotono bosque/pastizal como aquellas restringidas al bosque enano encima de los 3.000 m han visto su hábitat reducido en por lo menos 50%, una tendencia que continúa y pone en peligro varias especies de aves no adaptables a hábitats modificados.

Introduction

Andean forests are widely recognised as containing some of the most diverse and threatened biotic communities worldwide. No fewer than 84 (31%) of South America's threatened bird species are largely confined to Andean forests^{3,12}. Much attention has recently focused on the plight of high-Andean *Polylepis*⁵ and Andean foothill forests⁷, both of which are being destroyed at alarming rates. In contrast, the large-scale destruction of humid elfin forest and timberline habitats has been largely neglected¹², possibly because much of this destruction took place long before the arrival of Europeans in the Americas and is therefore less obvious. Here we assess the conservation status of these habitats and their bird communities in Bolivia.

Natural versus disturbed timberline habitats

Few botanists and even fewer ornithologists are aware of the natural appearance of undisturbed timberline habitats, principally because there are very few such areas left anywhere in the Andes. It is believed that the destruction of high-Andean forests commenced with the first human arrivals in the Andes¹⁰. Since then, fire has been the main destructive factor¹¹, initially being used mainly as a hunting tool⁸ (intensive hunting contributed to the extinction of the Pleistocene megafauna—*Glyptodon*, *Megatherium* etc.). The large human population in pre-Colombian times (several tens of millions of inhabitants in the central Andes alone is comparable to modern-day levels) probably led to the large-scale degradation of Andean habitats, subsequently forcing the development of social-security networks and environmental laws: the Andean cultures were born¹.

On their arrival the Spaniards encountered well-functioning, sustainable agricultural systems with irrigation, terracing schemes and laws to pro-

tect forests¹. Much of this was lost during and after the *conquista* and replaced by unsustainable agricultural methods, many of which persist today⁹. Soil erosion and impoverishment, stream siltation, drying up of natural wells and firewood scarcity are widespread⁵. Uncontrolled burning of large areas remains the major factor responsible for the degradation of high-Andean habitats^{8,10}. Much of this burning is performed to maintain pastures for domestic animals but large areas are often burnt for no apparent reason. Particularly during August and September, visibility in the Bolivian Andes is greatly inhibited due to large-scale burning. While fires are usually started on open, grass-covered slopes they frequently extend to the forest edge, damaging the outermost trees, preventing regeneration and gradually reducing forest cover.

During several years of timberline studies throughout the tropical Andes, MK has found only a handful of extensive pristine timberline areas,



Figure 1. Undisturbed natural timberline at 3,250 m in the Cordillera Colán, northern Peru. Note the gradual transition from forest patches to bushy areas and tall tussock-grass habitat. The transition from closed forest to treeless habitat extends over several hundred altitudinal metres. (T. S. Schulenberg)



Figure 2. Heavily burnt timberline habitat in Carrasco National Park, Cochabamba, Bolivia. Note the abrupt transition from forest to grassland and, in the background, how fires have displaced forest from ridges well below the current timberline altitude. Not visible here are tiny remnant *Polylepis* forest patches just below the peaks in the background, indicating that most of the grass-covered slopes would naturally be forested. (Michael Kessler)

such as in Podocarpus National Park, Ecuador; on the Cordillera Colán, Peru (photos by T. S. Schulenberg, 1978); and on the Cordillera Vilcabamba, Peru². All these sites have several features in common⁹.

- They are located on relatively small isolated mountain ranges away from the main Andean highlands or on very wet, windswept ridges which are difficult to reach.
- The transition from forest to grasslands is gradual, proceeding from progressively lower tree height to a shrub belt and finally tall tussock grassland (Fig. 1).
- Depending on topographic features, the transition zone from closed forest to treeless shrubby or grassy slopes extends over an altitudinal gradient of several hundred metres: steep slopes and flat boggy plains frequently support more open vegetation well within closed forest, creating a habitat mosaic.

Fire-influenced timberlines, on the contrary, have different characteristics.

- They are found on virtually all outer Andean slopes that can be reached from the more arid interior valleys where the human population is concentrated. Many uninhabited timberline habitats are periodically visited and burnt even if they are tens of kilometres from the nearest settlement.
- Closed forest is abruptly replaced by open grassland (Fig. 2). Isolated woods often occur higher

up along streams which fires cannot reach. Occasionally, relict stands of *Polylepis* trees are found, whose adult trees (but not young trees!) are protected against fire by their thick, peeling bark. Under natural conditions there is a gradual transition from humid elfin forest to *Polylepis* forest.

- While the grassland in undisturbed timberlines consists of tall tussock-grass, that of burnt treelines is made up of hard, fire-resistant bunchgrass.

Conservation status of Bolivian timberline habitats

Using the above characteristics we assessed the conservation status of Bolivian timberline habitats (Fig. 3). This assessment is mainly based on personal observations made while exploring most of the roads on the country's east Andean slope and from commercial flights. Additionally, we consulted commercially available and private photographs from areas not seen by us, totalling c.80% of the total timberline area.

According to our knowledge, only one relatively extensive area of undisturbed elfin forest and timberline habitat remains in Bolivia—at the north-eastern tip of the Cordillera Cocapata, dpto. Cochabamba (Fig. 3). Much smaller patches of only a few km² have been located on an isolated mountain further east in Cochabamba and just south-west of Parque Nacional Cotapata, dpto. La Paz. While it is likely that more such small areas exist, the amount of undisturbed timberline habitat can be reliably estimated at no more than 5% of the total timberline area. By far the largest area is moderately to severely disturbed. On average, we estimate that the natural timberline has been lowered by c.500 m.

Implications for bird communities

To assess the effect of timberline forest destruction on bird communities we distinguished between edge species inhabiting the timberline ecotone and those inhabiting the interior of elfin forest.

In Bolivia, the first group includes species such as Huayco Tinamou *Rhynchotus (rufescens) maculicollis*, Swallow-tailed Nightjar *Uropsalis segmentata*, Black-hooded Sunbeam *Aglaeactis pamela*, Scaled Metaltail *Metallura aeneocauda*, Black-throated Thistletail *Schizoeaca harterti*, Line-fronted Canastero *Asthenes urubambensis*, Andean Tapaculo *Scytalopus (magellanicus) simonsi*, Brown-backed Chat-tyrant *Ochthoeca fumicolor*, Red-rumped Bush-tyrant *Cnemarcus erythropygius*, Blue-backed Conebill *Conirostrum*

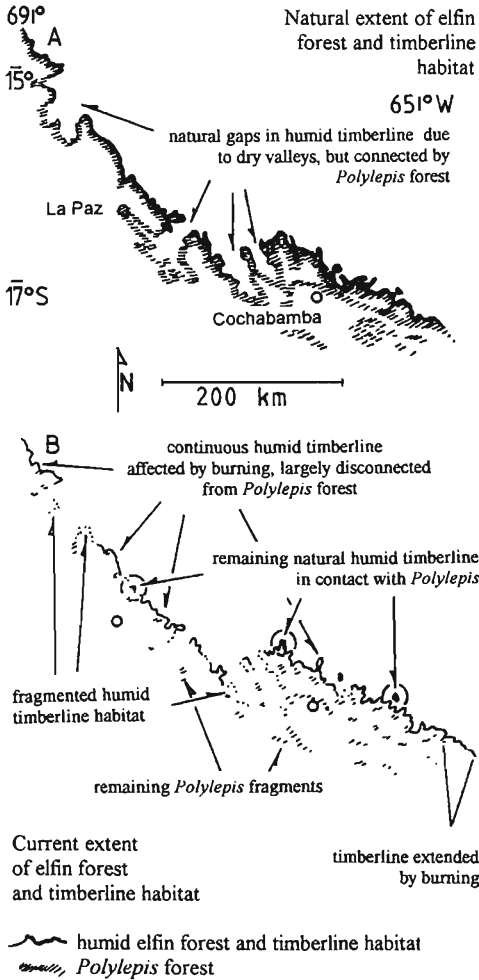


Figure 3. Natural (top) and current (bottom) extent of humid timberline habitat in the northern Bolivian Andes. Areas south of 18°S have been excluded because they belong to a different biogeographic region and are absolutely devoid of natural timberline habitats. (Michael Kessler)

sitticolor and Grey-bellied Flowerpiercer *Diglossa carbonaria*⁶. Threatened species of humid *Polylepis* forests such as Ash-breasted Tit-tyrant *Anairetes alpinus* and Royal Cinclodes *Cinclodes aricomae* may also occur at humid timberlines formed by other tree species (J. Fjeldså pers. comm.).

Under natural conditions these ecotone species inhabit a habitat mosaic covering several hundred altitudinal metres. At disturbed timberlines the habitat will be reduced to a narrow band, supporting only one or at most a few pairs of each species at any one locality (Fig. 4). Thus, even if most of

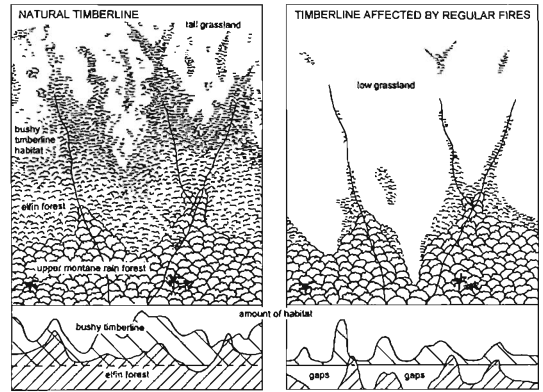


Figure 4. Schematic comparison of natural (left) and burnt (right) humid timberline habitats (top) and the amount of bushy timberline and elfin forest habitat (bottom). (Michael Kessler)

the above species are quite common in their habitat, their populations must be greatly reduced as compared to natural conditions. On the other hand, some adaptable species such as *M. aeneocauda*, *S. harterti* and *D. carbonaria* also occupy man-made edge habitats and may benefit from the human alteration of elfin forest. However, species such as *A. urubambensis*, *C. erythropygius*, Scribble-tailed Canastero *Asthenes maculicauda* and Grass Wren *Cistothorus platensis* appear to require reasonably undisturbed timberline habitat and perhaps tall tussock grassland for their survival. The latter two species are very local in the Bolivian Andes⁶.

In other Andean countries such rare or threatened species as Taczanowski's Tinamou *Nothoprocta taczanowskii*, Violet-throated Metallura *baroni* and Neblina Metaltails *M. odomae* as well as Bay-vented *Doliornis sclateri* and Chestnut-bellied Cotingas *D. remseni* could be added to the list of species that require an undisturbed timberline ecotone and are endangered by its destruction.

Elfin forests most affected by timberline lowering are those restricted to the uppermost altitudes. Bolivian elfin forest specialists occurring mostly above 3,000 m include Diademed Tapaculo *Scytalopus schulenbergi*, Pale-footed Swallow *Notiochelidon flavipes*, Orange-browed Hemispingus *Hemispingus calophrys*, Golden-collared Tanager *Iridosornis jelskii* and White-browed Conebill *Conirostrum ferrugineiventris*⁶. While their natural range would extend to 3,500 m or even higher, today they are frequently limited to a narrow altitudinal belt of only 100–200 m, resulting in greatly reduced populations.



5



8



6



9



7

Figures 5–9. Some bird species affected by the modification of their timberline and elfin forest habitat:

5. Swallow-tailed Nightjar *Uropsalis segmentata* (Michael Kessler)
6. Andean Tapaculo *Scytalopus (magellanicus) simonsi* (Michael Kessler)
7. Juvenile Black-throated Thistletail *Schizoeaca harterti* (Sebastian K. Herzog)
8. Orange-browed Hemispingus *Hemispingus calophrys* (Michael Kessler)
9. Grey-bellied Flowerpiercer *Diglossa carbonaria* (Michael Kessler).

Conclusions

The widespread degradation and lowering of the humid montane timberline in Bolivia and other tropical Andean countries has led to a considerable reduction in the population sizes of many bird species restricted to this ecotone. Species formerly occupying more extensive elevational belts are now restricted to more or less linear distributions. Wherever the timberline is lowered below the lower altitudinal limit of a particular species, its range will be fragmented, resulting in reduced gene flow between populations, inbreeding and possible local extinction⁷. While only a few species are currently classified as threatened and several taxa (e.g. *Metallura* and *Schizoeaca*) appear to adapt well to such habitat alteration, many species are certainly much rarer than they used to be.

If the alteration of Andean timberline habitats was a more recent phenomenon and had not taken place over perhaps thousands of years, the fate of many timberline specialists would be a source of extreme concern. Considering that most species mentioned in this paper have had their habitat occupancy reduced by at least 50% (and the problem is ongoing), they may require official classification as threatened or near-threatened. Consequently, more attention should be given to the status of timberline and elfin forest species and every opportunity sought to preserve the precious few remaining areas of intact habitat.

Acknowledgements

Discussions with and comments from Jon Fjeldså greatly influenced and improved this paper. Tom Schulenberg kindly provided photographs of the undisturbed timberline in Cordillera Colán. Our botanical and ornithological studies in Bolivia have been supported by the Schimper Foundation and the German Science Foundation (to MK) as well as the German Society for Tropical Ornithology and the DIVA project under the Danish Environmental Programme (to SKH).

References

1. Ansión, I. (1986) *El árbol y el bosque en la sociedad Andina*. Lima: Instituto Nacional Forestal y Fauna.
2. Baekeland, G. B. (1964) By parachute into Peru's lost world. *Nat. Geographic Mag.* 126: 268–296.
3. Collar, N. J., Gonzaga, L. P., Krabbe, N., Madroño N., A., Naranjo, L. G., Parker, T. A. & Wege, D. C. (1992) *Threatened birds of the Americas: the ICBP / IUCN Red Data Book*. Cambridge, UK: International Council for Bird Preservation.
4. Earls, J. (1991) *Ecología y agronomía en los Andes*. La Paz: Hisbol.
5. Fjeldså, J. & Kessler, M. (1996) *Conserving the biological diversity of Polylepis woodlands of the highlands of Peru and Bolivia*. Copenhagen: Centre for Tropical Biodiversity & Nordic Foundation for Development.
6. Fjeldså, J. & Krabbe, N. (1990) *The birds of the high Andes*. Copenhagen: University of Copenhagen & Svendborg: Apollo Books.
7. Graves, G. R. (1988) Linearity of geographic range and its possible effect on the population structure of Andean birds. *Auk* 105: 47–52.
8. Kessler, M. (1995) Present and potential distribution of *Polylepis* (Rosaceae) forests in Bolivia. In Churchill, S. P., Balslev, H., Forero, E. & Luteyn, J. L. (eds.) *Biodiversity and conservation of Neotropical montane forests*. New York: New York Botanical Garden.
9. Kessler, M. (1995) *Polylepis-Wälder Boliviens: Taxa, Ökologie, Verbreitung und Geschichte. Dissertationes Botanicae* 246.
10. Kessler, M. & Driesch, P. (1993) Causas e historia de la destrucción de bosques altoandinos en Bolivia. *Ecología en Bolivia* 21: 1–18.
11. Læggaard, S. (1992) Influence of fire on the grass páramo vegetation of Ecuador. In Balslev, H. & Luteyn, J. L. (eds.) *Páramo. An Andean ecosystem under human influence*. Aarhus: Botanical Institute, University of Aarhus.
12. Long, A. (1994) The importance of tropical montane cloud forests for endemic and threatened birds. In Hamilton, L. S., Juvik, J. O. & Scatena F. N. (eds.) *Tropical montane cloud forests*. Berlin: Springer.

Michael Kessler

A.-v.-Haller-Institut für Pflanzenwissenschaften,
Untere Karstraße 2, 37073 Göttingen, Germany.

Sebastian K. Herzog

Institut für Vogelforschung, "Vogelwarte Helgoland",
An der Vogelwarte 21, 26386 Wilhelmshaven, Germany.