Methods for the assessment of habitat and species conservation status in data-poor countries - case study of the Pleurothallidinae (Orchidaceae) of the Andean rain forests of Bolivia

Métodos para la evaluación del estado de conservación de hábitats y especies en países poco investigados – estudio de caso de las Pleurothallidinae (Orchidaceae) de los bosques húmedos andinos de Bolivia

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Abstract
Assessments of habitat and species conservation status, commonly called "red lists", are political instruments that can further the cause of conservation. They represent an important input of scientific-conservationist work and key tools for making political decisions. Unfortunately, in many biodiverse tropical countries which often are developing countries with large unexplored or even inaccessible areas, existing red lists tend range from highly subjective to erroneous. For this reason, the authors of this present work attempt to develop two recently proposed methods for a more objective evaluation of conservation status. The new integrative methodology is based on the use of existing biological and socioeconomic data that permit the extrapolation modeling with Geographical Information Systems (GIS). Three steps lead to the evaluation of species conservation status: 1. Extrapolation of species range using distribution data and abiotic factors describing the probability of the occurrence of taxa, 2. analysis of the current conservation status of habitats, the future threats and the resulting predicted future conservation status using socioeconomic proxy-indicators (road access, population density, etc.) and development scenarios, and 3. the integration of the results of the first two steps, species ranges and future conservation status. The integration of range size and conservation quality of the ranges leads to a more objective threat assessment of the taxa. In the current study a subgroup of the very diverse and highly endemic orchid family is used for illustrating the application of the proposed models: the subtribe Pleurothallidinae that is practically restricted to the humid Andean forests. In a previous published exercise which analyzes the conservation status of this group, an important percentage of the species turned out to be threatened. Now, taking into account extrapolated ranges and habitat conservation status, less species are classified as vulnerable or endangered. It is supposed that this result reflects reality better than the first study. Implications are discussed critically.

Resumen
Análisis del estado de conservación de hábitats y especies, comúnmente llamados "listas rojas" son herramientas políticas que pueden promover la conservación. Representan un insumo importante del trabajo conservacionista científico e instrumentos claves para tomar decisiones. Lamentablemente, en muchos países tropicales, que en muchos casos también son países en vía de desarrollo caracterizados por grandes áreas no investigadas o hasta inaccesibles, las listas rojas existentes tienden a ser altamente subjetivas hasta erróneas. Por

esta razón, los autores del presente estudio tratan de desarrollar aún más dos métodos recientemente propuestos para una evaluación más objetiva del estado de conservación. La nueva metodología integral, se basa en el uso de datos biológicos y socioeconómicos existentes que permiten la elaboración de modelos extrapolativos a través de Sistemas de Información Geográfica (SIG). Son tres pasos que llevan a la evaluación del estado de conservación de especies: 1) Extrapolación de rangos de especies utilizando datos de distribución y factores abióticos que describen la probabilidad de existencia de taxa en un cierto espacio, 2) análisis del actual estado de conservación de hábitats, de las amenazas futuras, y del futuro estado de conservación aprovechando indicadores proxi (acceso por caminos, densidad de población humana, etc.) y escenarios de desarrollo, 3) la integración de los productos de los primeros dos pasos, rango de distribución de especies y el futuro estado de conservación de los hábitats. Esta integración del rango y la calidad de conservación del hábitat lleva a una evaluación más objetiva del peligro en el cual se encuentran las especies. En el presente estudio un subgrupo de la familia muy diversa y endémica de las Orchidaceae está utilizado para ilustrar la aplicación del modelo propuesto. En un previo ejercicio publicado se analizó el mismo grupo y resultó un porcentaje importante como amenazado. Ahora, teniendo en cuenta los rangos extrapolados y el estado de conservación de los hábitats, menos especies parecen estar vulnerables o amenazadas. Se supone que estos resultados reflejan la realidad de una mejor manera que en el primer estudio. Las implicaciones están discutidas críticamente.

Introduction

Especially, in so-called developed countries the red lists of endangered plants and animals have become an important standard tool of conservation science, policy and action. Although it is well known that many species can survive only if their habitats are kept more or less intact it is a valuable and justified approach to focus on the species level: the sensitive species indicate if the habitat is healthy and in conditions to maintain viable populations; additionally, ecosystems can be restored to a certain degree but species not – extinction is irreversible. Therefore, we need monitoring and warning systems that 'ring' whenever species are threatened. It is rather easy to monitor species and populations in many developed countries. Generally, there are lower species numbers, the species inventory is well advanced, the ecological requirements of the species are more or less known, and the observation of populations is easy thanks to good access to most sites. The resulting red lists are fairly precise and allow political attention to be drawn to especially endangered taxa and critical habitats.

What is the situation in many biodiverse developing countries in the tropics? Most of them experience an ongoing degradation of their ecosystems while the species inventory is far from being completed, and a majority of the recorded species is known from few sites only. Obviously, red lists would be useful to prioritize and guide necessary conservation efforts – but is it possible – in those data-poor countries - to elaborate species red lists that are scientifically sound?

Some years ago, a worldwide red data book for plants was presented by WCMC (Walter & Gillett 1998), and it has had an important echo in the public or at least in the scientific community. This species list had been based mainly on on endemism data. Recently, the first plant red data book of a tropical country has been presented for Ecuador (Valencia et al. 2000) where the first comprehensive plant inventory has been completed. This book is a complete list of all endemic species of the country. In most cases, the conservation status of the species has been concluded from the number and age of the collection records. Of the more than 4,000 endemic species 83% are believed to belong to some of the IUCN threat categories. At this moment, we cannot judge the Ecuador results, but some doubts arise related to the assumption that endemism and few records automatically mean species conservation problems.

On the one hand, floristic exploration is quite deficient and mainly restricted to areas with road access. Naturally, here, the conservation status of habitats tends to be problematic. Many species are simply not well sampled, especially at intact and inaccessible habitats. On the other hand, and even more important, many tropical, locally or regionally endemic species are not as sensitive to anthropogenic habitat conversion as is generally assumed. For example, in the Neotropics, a high percentage of endemic bromeliads is confined to open and rocky habitats; many of them are benefited by deforestation rather than endangered (Ibisch 1998, Ibisch et al. 2001). However, many of those species (e.g. *Puya* spp.) appear as vulnerable or threatened in the worldwide red data book (Walter & Gillett 1998) or in the red list of Ecuador (that already, for several species, suggested lower threat categories than Walter & Gillett 1998, Manzanares 2000).

Including a large amount of species in red lists even though they are not vulnerable or endangered is not useful for conservation, and can even be harmful. In recent years the credibility of conservationists has suffered a lot– partially due to exaggerated warnings and negative scenarios (e.g., maps that predicted dramatic rain forest loss by 2000 with only the Amazon rain forest surviving in the north of Brazil, Mannion 1991) that have not become true. The IUCN system for classifying and categorizing endangered species is rather complete and allows for a good evaluation when exact data are available. In the case of tropical species most specialists are basing their results exclusively on the restricted distribution (often referring only to the known collecting points) when assigning a threat category. Often this categorization is subjective and might tend to be too pessimistic.

In order to achieve a more objective and quantifying categorization, we have attempted to develop a method for the objective evaluation of species, by defining a National Conservation Value (Ibisch 1998). The idea was inspired by several authors who tried to propose a numerical system for conservation evaluation of species (Helliwell 1973, cited in Spellerberg 1992, Perring & Ferrell 1977, Goodrich 1987, Guarino 1995). The National Conservation Value is the sum of several numbers (e.g., 0, 2, 4, 8, 16), that correspond to different categories of distribution, abundance in habitat, specific use/exploitation, response to conservation status of the habitat (considering that some weedy, pioneer or rock species can be benefited by land-use change), and existing ex situ conservation efforts. We have applied this approach to the genus *Puya* (Ibisch 1998), epiphytic cacti (Ibisch et al. 2000) and the orchid subtribe Pleurothallidinae (Vásquez & Ibisch 2000). A numerical scoring approach has also been recently developed and applied by Dunn et al. (1999) for ranking and prioritizing the endangered land-birds of Canada.

In the case of the Pleurothallidinae, the largest data set with about 380 species, about one fourth of the species turned out to be vulnerable (mainly because of restricted distribution) and more than 20% at least endangered. It was acknowledged that the conservation status was highly affected by the lack of knowledge about species distribution. Obviously, even the numerical method has severe restrictions with regard to objectivity when species have been found only once at the edge of a road which was then deforested after the collection. Although it is highly improbable that a species is restricted to the road site in these cases the species, in the conservation evaluation, turned out to be critically endangered.

In seeking more objective findings we have tried to develop the evaluation of species conservation status involving and integrating two recently proposed methods based on Geographical Information Systems (GIS) that 1. facilitate the evaluation of the habitat’s conservation status and 2. predict the distribution of species. In the following, we use the Pleurothallidinae because of the well developed data set and because it is one of the few Bolivian plant groups that have been evaluated with regard to their conservation status. This group is used also as a model group in another paper that compares the general results of taxon-based and inventory-based mapping approaches (publication in prep.).

Methods

For the processing of the spatial data we used ArcView-GIS (3.2) and extensions. All maps were generated using a 5’ grid; each square has a side-length of approximately 9 km (i.e., about 81 km2).

The study area is the rain forests of the northeastern slopes of the Andes, including some semihumid and dry forests (Fig. 1). It covers only 11% of the Bolivian territory (Araujo & Ibisch 2000). Possibly more than 90% of the endemic plant and animal taxa of the country are found here (Ibisch et al. 2001). The area, located between the protected areas of the Madidi National Park on the Peruvian border and the Amboró National Park near Santa Cruz de la Sierra, is geographically and ecologically complex and extends from lowland Amazonian pre-Andean forests below 1,000 m (38% of the area) to sub-Andean rain forests and high-Andean cloud forests above 3,000 m (together 62%). More than 70% of the area is practically unstudied without any botanical voucher collected (Ibisch et al. 2001). About 35% is legally protected.

GIS-BASED EVALUATION OF THE CONSERVATION STATUS OF HABITATS

This method was developed during recent years, first approaching the large-scale conservation status of the Bolivian Amazon (Ibisch et al. 2000), and afterwards, for analyzing a specific region, including the Andean, sub-Andean and pre-Andean forests of the Bolivian Amazon basin (Araujo & Ibisch 2000). The general idea of the method is based upon the ideas that 1. empirical knowledge on the conservation status of the habitats in those vast and inaccessible areas is poor, 2. remote sensing evaluation may neglect impacts not visible on satellite images, and 3. the assumption that some socioeconomic data may be good proxy indicators for the conservation status.

Eight socioeconomic factors were identified as being relevant with regard to their impact on biodiversity conservation status: human population density, inter-census population growth, migration, percentage of lowland indigenous population, road infrastructure, access along larger rivers, oil and gas production and mining. Sources were INE (1978, 1993, 1999), IGM (1993), Martínez (2000), YPFB (2000), SETMIN (1999), Programa Indígena-PNUD (1996), MDH (1995). For each of those factors a value was assigned to the 5’-grid cells. If several polygons were found within one grid cell representing different values the final value of the grid cell was calculated taking into account the proportion of each polygon:

$$\mathbf{F}\ grid\ value = value\ 1 \times \frac{participation\ 1}{100} + value\ 2\ \frac{participation\ 2}{100} + ... + value\ N \times \frac{participation\ N}{100}$$

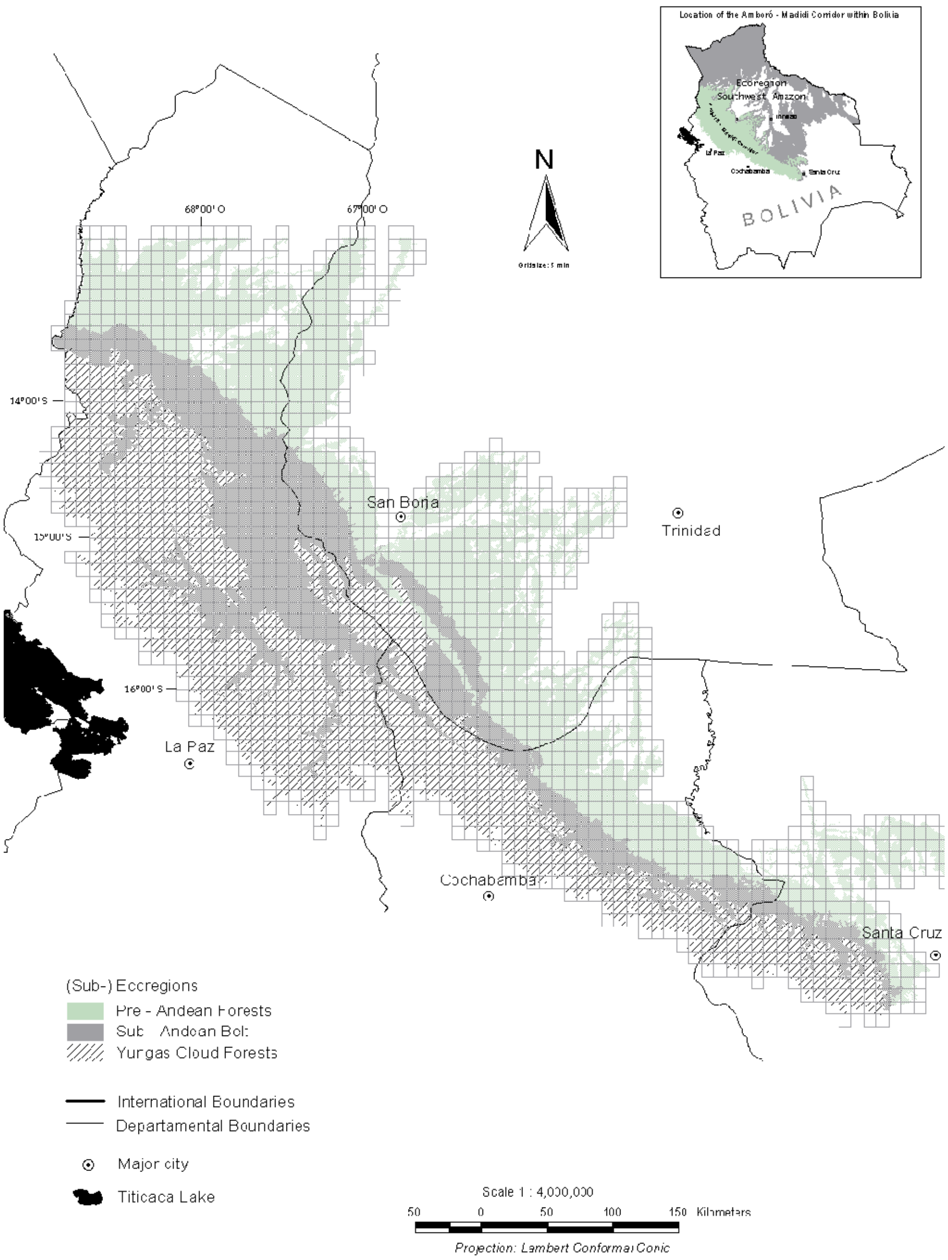

Fig. 1: Study area.

The data resolution was partially improved using GIS; e.g. population density was available for municipal territories only. In this case the grid cells' values were obtained considering obvious population-free areas without villages and roads (centers of confirmed population-free protected areas, areas at a distance of >15 km from roads), redistributing the inhabitants of the municipality in the populated area and recalculating population density. A similar spatial correction was applied in the case of population growth and migration.

The map of road infrastructure (Fig. 2) was obtained by using existing road maps (IGM 1993, NIMA 1997, INE 1999). Additionally, the existence and quality of many roads was verified in the field. Roads, in the GIS, were categorized according to width, traffic and conditions (7 categories; from principal road with asphalt and permanent, important traffic throughout the year to small track not passable for cars, see Table 1). To illustrate the impact of the roads

(Fig. 3) we created buffers from 0.5 km to 4 km, according to the category; afterwards, the impact on biodiversity within the buffers was quantified.
The access along rivers was mapped taking into account the large navigable rivers for large (highest value) and small boats and all rivers of the lowlands that permit at least access by foot (e.g. relevant for hunters; lowest value). In the case of oil and gas production sites we differentiated those far (> 35 km) from main roads and those nearby; we also took into account if they were used for exploration or exploitation. Mining activities were identified by concessions – exploited and not exploited mines were differentiated.

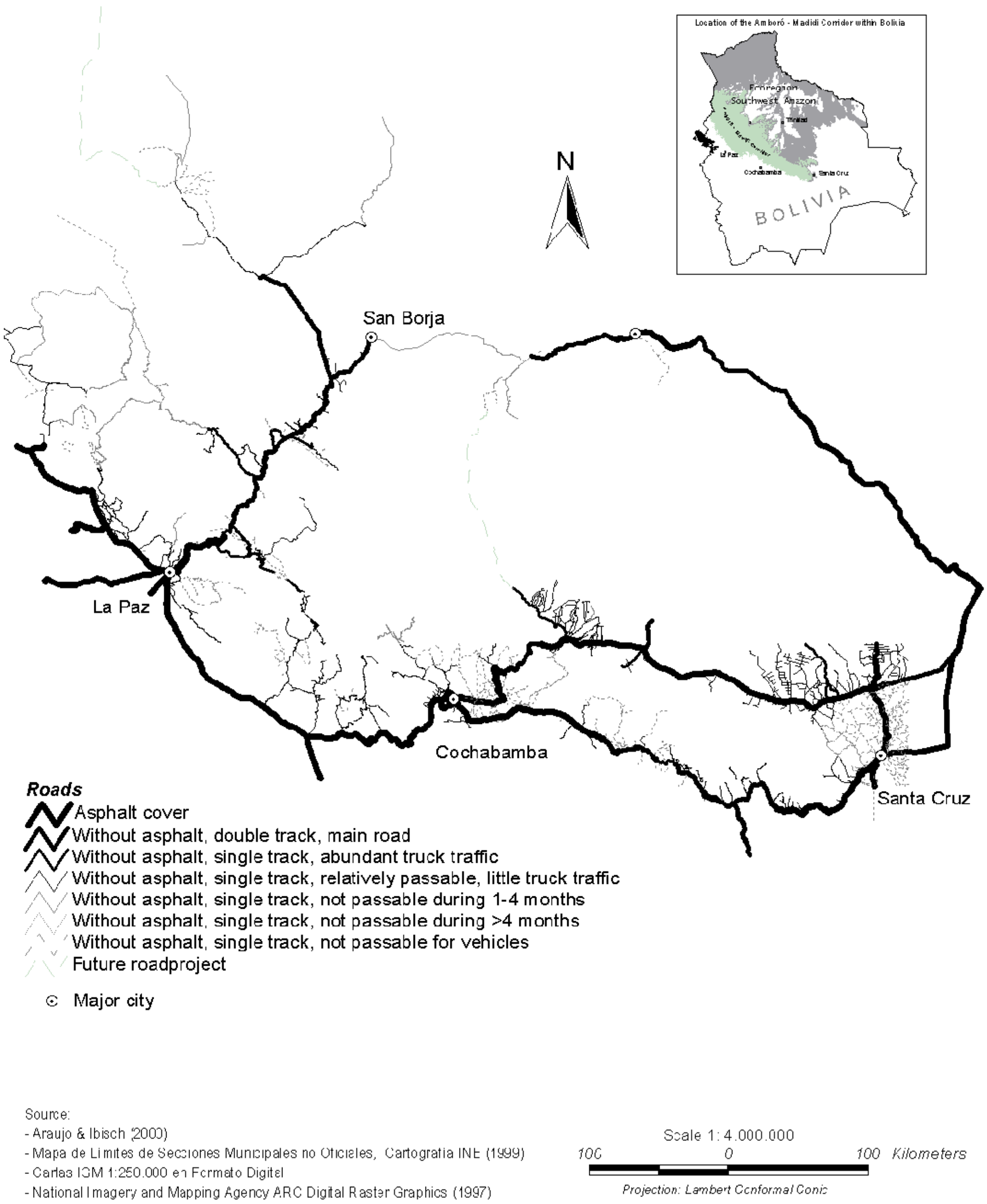

Fig. 2: Categorization of the existing roads.

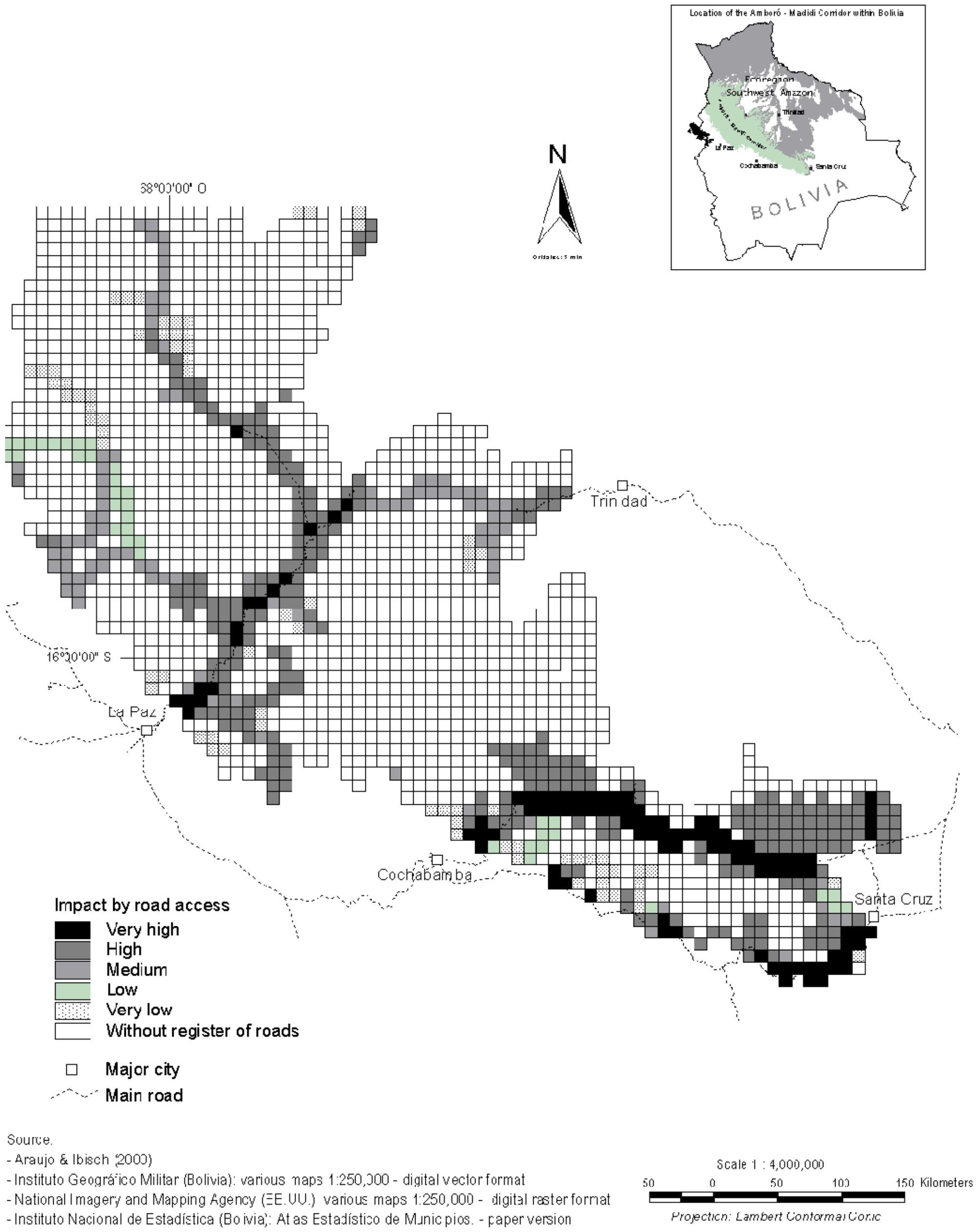

Fig. 3: Analysis of road impacts on biodiversity.

The final sums of the 8 indicator grid values were grouped into five ranges that indicate the current conservation status (Fig. 4): very good, good, regular, critical, very critical. Additionally, we predicted future threats (Fig. 5) which might occur within the next 10 Years assigning numerical values to areas with road projects (considering possible impact categories and buffers; INE 1998; Pacheco 1998, Oberfrank 1998, MDSMA 1998), forest concessions Superintendencia Forestal 2000, MDSMA 1997), oil concessions (YPFB 2000) (both are important especially when overlapped with protected areas or far away from main roads), colonization projects (Pacheco 1998, Oberfrank 1998, MDSMA 1998, INE 1993, 1999; important especially when not nearby existing colonization areas) and other important infrastructure projects (e.g. hydroelectric dams). Again, the sums were grouped into five ranges reflecting threat intensity. Then, current conservation status and future threats were integrated in order to elaborate the map of the future conservation status (Fig. 6). First, values for the future threats were defined: 0 for very little intensive and little intensive, -1 for regular, -2 for intensive, -3 for very intensive. This means that little intensive future threats do not change the current conservation status. These grid cell values were added to the current conservation status values (1-5). The lowest possible result is –2 and the highest 5. However, the values –2 to 1 all mean a very critical future conservation status; obviously a current conservation status that is already very critical cannot become worse. The value 2 means a critical future conservation status, 3 regular, 4 good and 5 very good.

Table 1: Classification of roads and their impacts

Road class	Description	Impact buffer (km)	Impact intensity (%)
1	Asphalt cover	4	100
2	Without asphalt, double track, main road	3	80
3	Without asphalt, single track, abundant truck traffic	2	70
4	Without asphalt, single track, relatively passable, little truck traffic	1	70
5	Without asphalt, single track, not passable during 1-4 months	0.5	60
6	Without asphalt, single track, not passable during >4 months	0.5	30
7	Without asphalt, single track, not passable for cars	0.5	10

It should be stressed that we propose this method after having traveled for several years in most parts of the study area, and we are sure that the current conservation status as obtained by the integration of the proxy indicators generally reflects reality.

Extrapolation of Pleurothallidinae species ranges

The whole range extrapolation methodology will be explained in detail and discussed critically in another paper (Müller et al. in prep.). Here, we give the most necessary methodological steps. The data on sample points were taken from Vasquez & Ibisch (2000). Samples with very inexact or vague localities were removed from the database. In most cases, coordinates had to be estimated, searching for the indicated localities on political maps. Finally, 331 of more than 380 currently known species were analyzed spatially because their collection sites have been recorded with sufficient exactness.

The essential procedure for taxon-based mapping of biodiversity is the extrapolation of ranges for individual taxa (Guisan & Zimmerman 2000, Jones & Gladkov 1999, Chapman & Busby 1994, Miller 1994, Skov & Borchsenius 1997, Williams 1997). The range extrapolations were based on the species records as well as abiotic and historical factors which both determine the ranges of species:

a) *Abiotic factors* are very important variables in determining potential growth and reproduction of a taxon in an area. In the case of plants they are the most relevant in determining *potential range* of a species (Davis 1990, Davis et al. 1994) that is the area where its ecological requirements are fulfilled. The abiotic requirements of a species can be derived by analyzing the abiotic conditions of all sampling localities. Considering the poor spatial data on these factors of the study area we took into account only those that are supposedly most important for the distribution of epiphytic plants in mountainous areas (Ibisch 1996): *altitude* (as temperature indicator) and *humidity*.

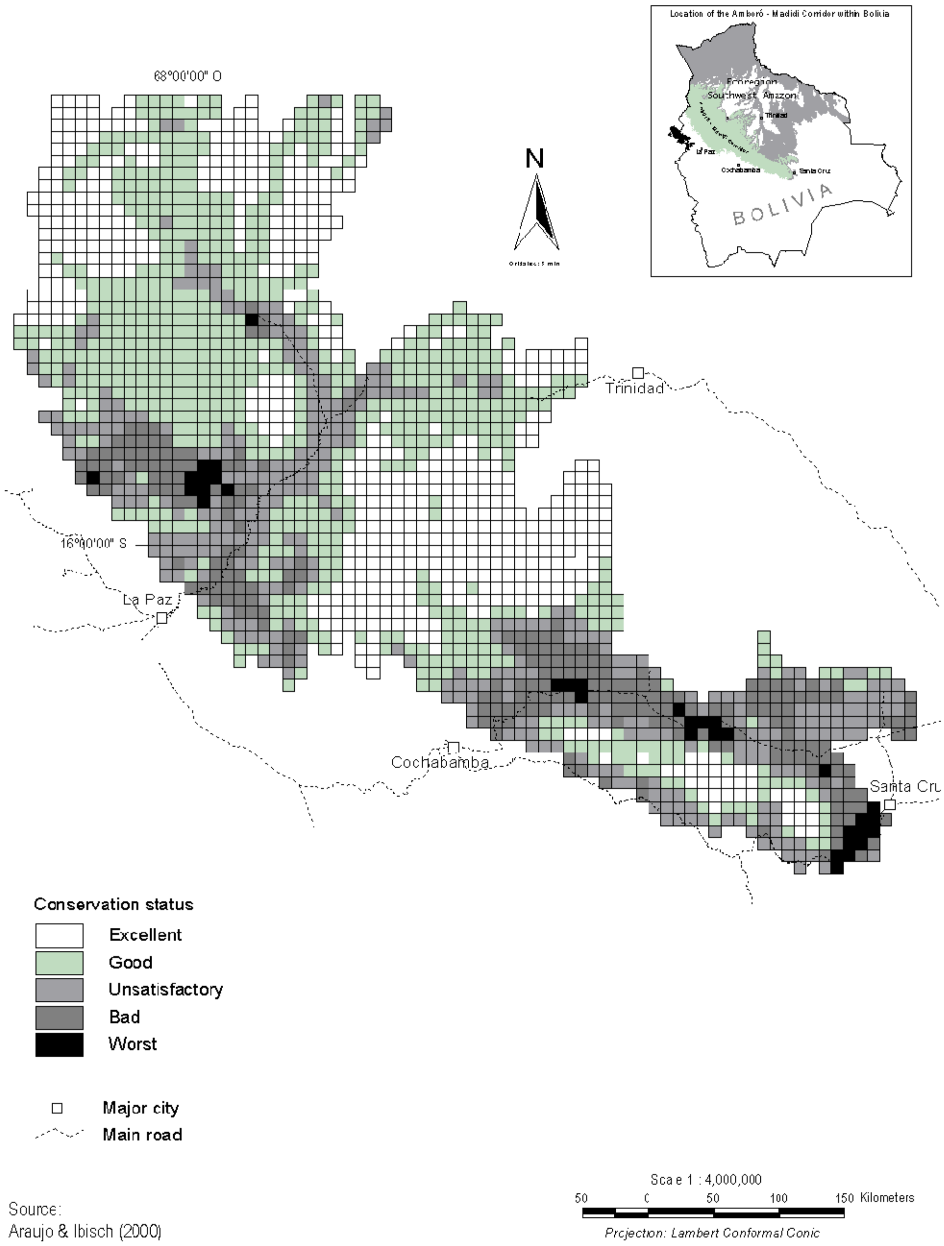

Fig. 4: Current conservation status of the study area.

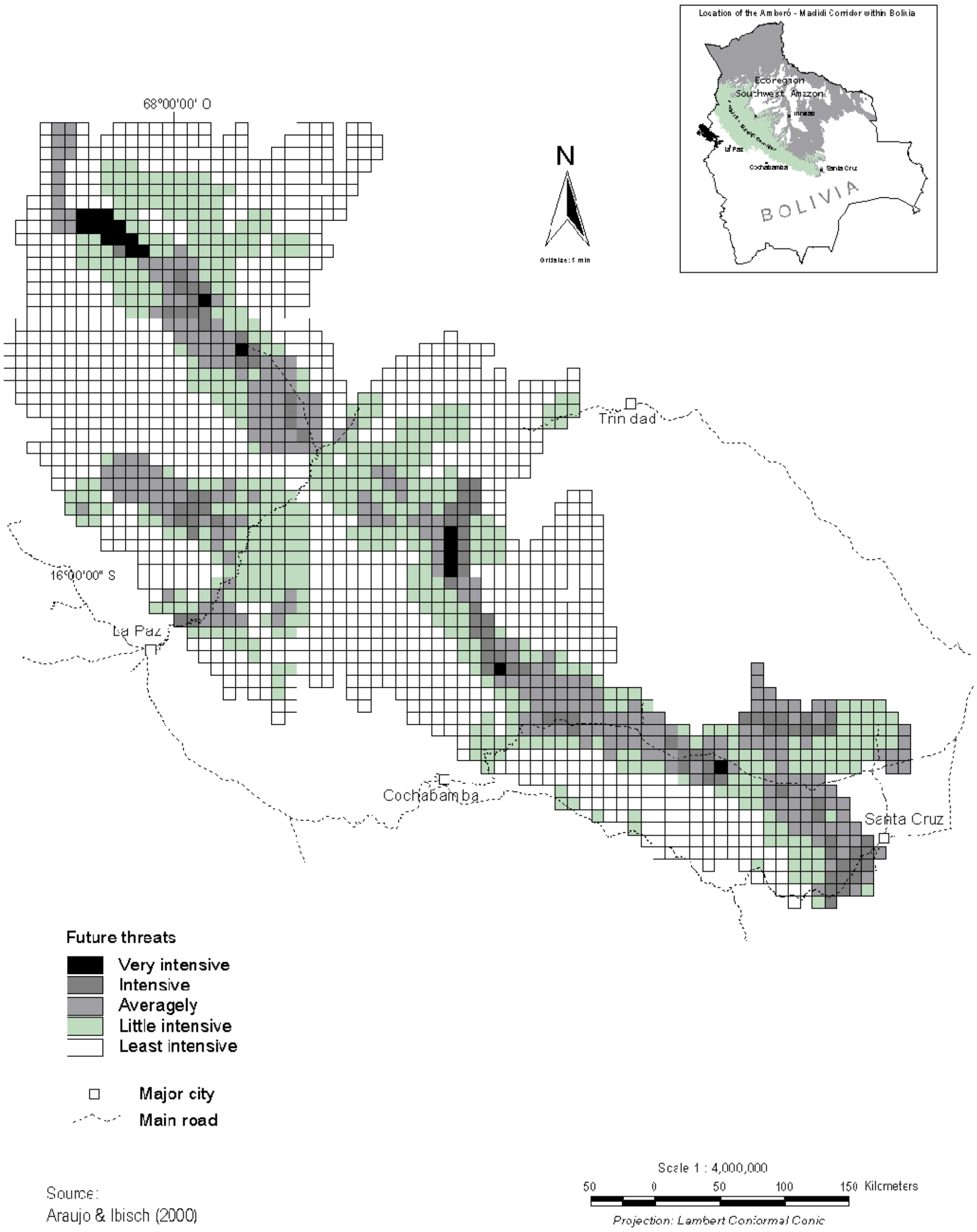

Fig. 5: Location of future threats in the study area.

In order to analyze the altitudinal distribution of the species, we first generated an elevation model based on a 5' grid. For each square the presence of 500 m intervals, from 0-499 m to >4,000 m, was registered digitally according to the physical map of Bolivia (1:1,000,000; IGM 1993). The altitude of the sample localities in most cases was taken directly from the specimens' records; when not available it could be estimated comparing the localities to physical maps (IGM 1993). Because of the relatively small number of samples per species, in most cases theses samples will not represent the full altitudinal range of a species. In fact, Pleurothallidinae species that are represented by a larger number of samples (5) indicate a medium altitudinal range of about 1,500 m. Thus, in the case of species found in only one 500 m-interval both neighboring intervals were automatically considered part of the altitudinal range. When species were recorded exclusively in the 0-499 m interval their altitudinal range was extended to 1,000 m. In the case of two altitudinal records in two neighboring 500 m intervals the altitudinal range was complemented towards a third interval that was nearer to the mean value of both recorded altitudes (example: collection records at 1,350 m and 980 m: mean value 1,165 m; extrapolated altitudinal species range: 500-2,000 m). The potential altitudinal range was determined by identifying all squares of the grid in which the correspondening intervals were present.

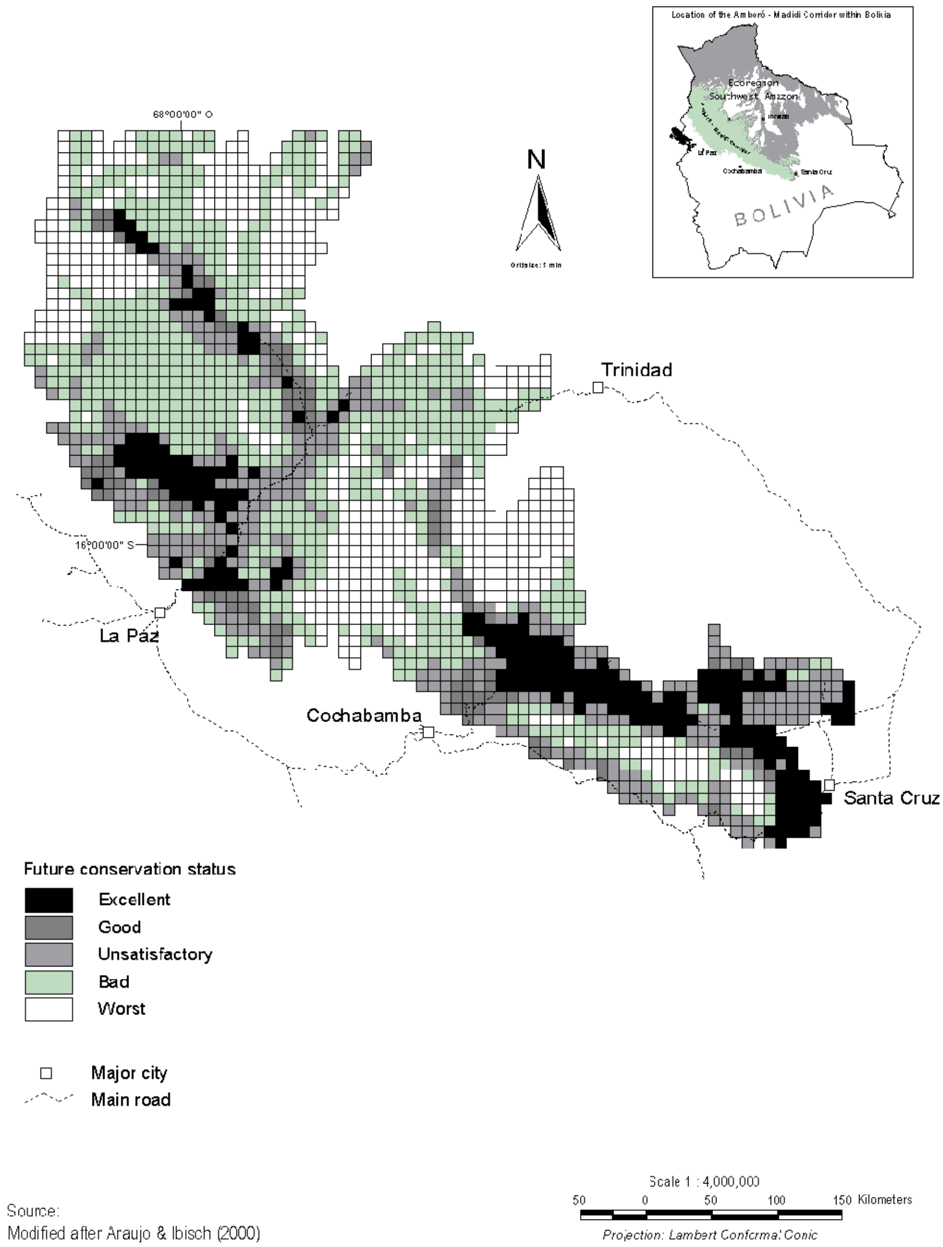

Fig. 6: Future conservation status of the study area.

Humidity values were derived from a precipitation map (Ibisch et al. 2001) which mainly followed Hanagarth (1993) improving the resolution by considering the topography and some proper unpublished data (e.g. for the Amboró National Park). To each square of the grid a mean annual precipitation value was assigned. This value was then corrected considering the altitude and acknowledging that the same amount of precipitation causes distinct humidity according to different temperatures. Following a regression analysis of Skov & Borchsenius (1997) we assumed that the evaporation decreases by 100mm with each 500m interval of increasing altitude (Skov & Borchsenius calculated 213 mm on 1000 m altitude). So, in every grid square, we divided the average altitude by 5 and discounted the result from its precipitation value. Of course, the derived humidity data are not completely reliable but are the best available approximation. The humidity value of a square was adopted as the humidity value of a plant sample point when registered within its limits. As in the case of altitude this value was extended automatically with the assumption that poor sampling reflects incompletely the true humidity tolerance/requirements of the species. The higher the precipitation values of the collection sites the larger the supposed humidity tolerance of the species. It is assumed that for species existing at sites with about 3,000 mm an increase to 5,000 or 6,000 mm is as significant or not significant as for another species that lives at 500 mm with an increase to 1,000 mm. So, the width of humidity classes increases with increasing humidity values; classes such as 1,000-2,000mm, 1,100-2,200mm, 1,200-2,400mm etc. were created. For each humidity class, we calculated the "logarithmic mean value" (l) of its minimum (min) and maximum (max) humidity value:

$$l = e^{\left(\frac{\ln(\min)+\ln(\max)}{2}\right)}$$

Each species was assigned to the humidity class whose "logarithmic mean value" corresponded best to the "logarithmic mean value" of the lowest and the highest humidity value (calculated in the same way) registered for this species. If the highest and lowest registered humidity values exceeded the limits of the corresponding humidity class, an individual class was formed limited by the registered extreme values.

b) *Historical factors* are defined here as factors that result in a species not occupying its *potential range* but being restricted to a smaller *realized range*. Such factors can be geographic barriers (like oceans or mountains) that hinder further range extension or historical events like glacial periods that cause partial extinction. Historical factors have rarely been included in range extrapolation studies, and, if regarded, they are reflected by distance to known collection points (Skov & Borchsenius 1997). When all records of a species were concentrated in a circle of 25 km diameter and the species was unknown from outside Bolivia it was regarded as local endemic. When all samples were recorded in a circle with a 100 km diameter we called them regional endemics. The *realized range* of a local or regional endemic was estimated by taking into account all grid squares of the potential range which are not more than 25 km or 50 km distant, from the nearest sample.

Species conservation status as integration of habitat's conservation status and range extrapolation

The key step for identifying the conservation status of the species is the overlapping of the extrapolated range with the map of the future conservation status. We use the future conservation status instead of the current conservation status in order to deduce more proactive conservation values. We then identify the quantity of grid cells corresponding to the range of the species that had good or very good conservation status. If there were at least 4 connected grid cells (together about 325 km^2) the species is classified as not threatened; 3 means vulnerable, 2 endangered, 1 critically endangered, and 0 high probability of extinction or extinct. As this study is of methodological nature, for practical reasons, we analyzed exclusively the endemic species with a small range-size (30 grid cells, i.e. about 2,430 km^2 or less) that are natural candidates for belonging to the threatened species.

Results and discussion

The method, results and biogeographical implications of the species range extrapolation will be discussed elsewhere (publications in prep.). It is clear that range size is underestimated, especially in the case of species with only one record. This means that the threat category of the species might be overestimated; however, this is acceptable if we are interested in conservation (‘in case of doubt in favor of the species’). In the following, we focus on the evaluation of the conservation status.

HABITAT CONSERVATION STATUS

Currently, an important percentage of the study area is very well conserved (Fig. 4). About 67.1% has at least a good conservation status (Araujo & Ibisch 2000). These areas are not scattered around in the study area but found in fairly large blocks of intact habitat. The most critical areas are found along the main roads that fortunately are rather scarce. Although the critical or worse areas cover only 13.9% they can cause conservation problems, especially related to connectivity. However, the area - at least for plant species with supposedly limited range size requirements - is well-off, especially when compared to similar ecosystems in other countries.

The future conservation status (Fig. 6) prediction shows that areas with regular or even worse conservation status will expand; there is a danger that they even cut some still existing blocks of excellent conservation conditions might be cut. However, overall habitat availability (with at least good conservation status) is expected to be high.

The advantage of the method of predicting the conservation status by taking into account socioeconomic indicators, especially road and river access, is that it should reflect even impacts that cannot be detected using remote sensing, like hunting or (semi)commercial plant collecting. Obviously, it is important to have the most current data base. In Bolivia, it will soon be possible to make a more precise and updated analysis because a new census has been carried out. Obviously, it is somewhat difficult to update the road map; e.g., new logging roads or tracks to recently colonized areas within forest hardly appear in satellite images. Therefore, it is necessary to have information on the operation status of concessions which normally can be obtained from governmental authorities and/or public sources. Small-scale colonization projects are the most difficult issue to be mapped; possibly, they can be documented spatially when specific information is obtained from municipalities that should be aware of what is happening within their territory. Independent of the species conservation status evaluation we recommend using proxy indicator mapping of habitat conservation status for (eco)regional conservation monitoring purposes. Of course, when smaller regions are considered the resolution should improve. We feel that our method exaggerates the conservation threats. Of course, even a 5’-grid cell of very critical conservation status can bear sufficiently large patches of intact habitat.

SPECIES CONSERVATION STATUS

Fig. 7-9 show examples of species' ranges overlapped with the habitat conservation status map. It is noteworthy, that small ranges do not imply automatically that the species are endangered. The study area is sufficiently well conserved that many species with a small range still can be considered as not threatened (e.g., *Masdevallia cocapatae*, Fig. 9, *M. oreas, Pleurothallis cerberus* – all with ranges of 16 grid cells). *Pleurothallis sanjanae* has the smallest extrapolated range (only 3 grid cells).

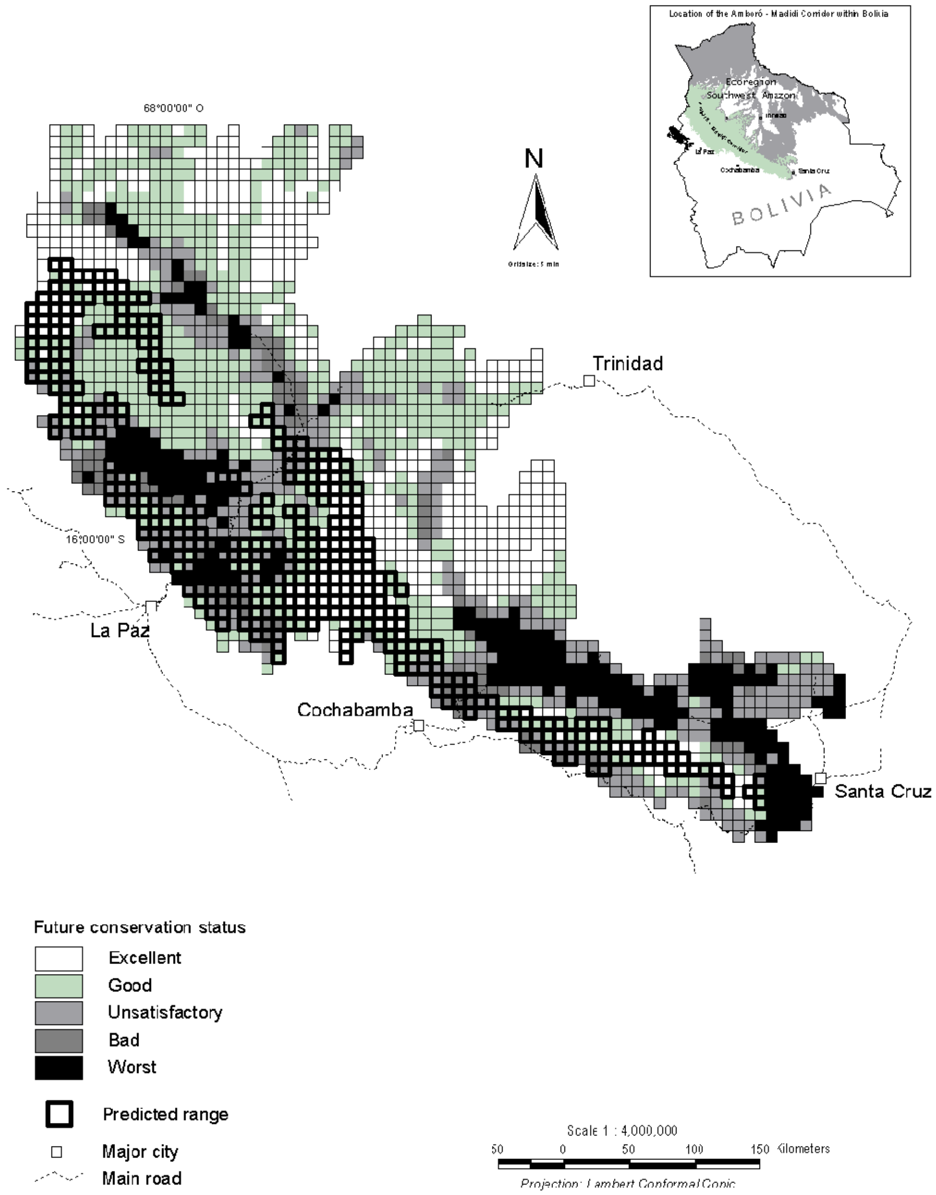

Fig. 7: *Stelis rutrum* – example of a species with a large range-size that is not threatened.

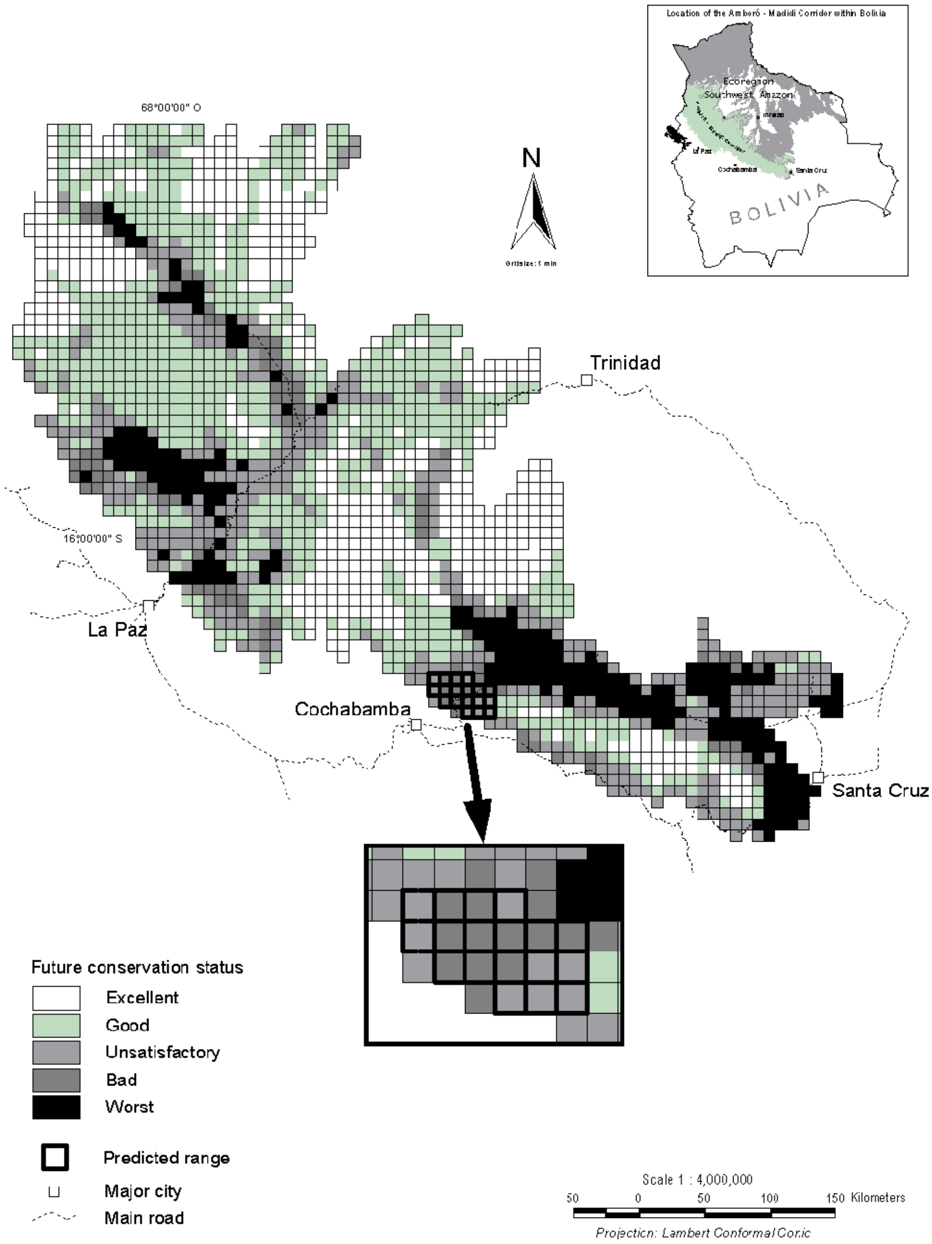

Fig. 8: *Lepanthes nebulina* – example of a species with a small range-size that has a high risk of extinction.

The analysis of the species conservation status is more positive than the evaluation done by Vásquez & Ibisch (2000) who postulated that about 44% of the species should be at least vulnerable or worse. However, it is confirmed that many species are threatened. Having analyzed the species with a small range-size we have identified more than 50 species that are vulnerable or worse (about 16%; see Table 2). The 15 species that have a high risk of going extinct belong to the genera *Lepanthes* (*L. brevis, L. ciliolate, L. glaberrima, L. miraculum, L. nebulina*, *L. pileata*, *L. puck*, *L. serriola*), *Masdevallia* (*M. chaparensis*, *M. nitens*, *M. tinekae*, *M. vasquezii)* and *Pleurothallis* (*P. sanjanae*, *P. weddelliana*) and Stelis (*S. iminapensis*). In the Vásquez & Ibisch list (2000), most species are in high threat categories as well. However, 11 (out of 28) species that in the cited previous study were considered to be in urgent danger (= high probability of extinction) now turn out to be not threatened. The present study identifies only a few threatened species that were not recognized by Vásquez & Ibisch (2000), e.g. *Brachionidium alpestre, Masdevallia elachys, Restrepia vasquezii*).

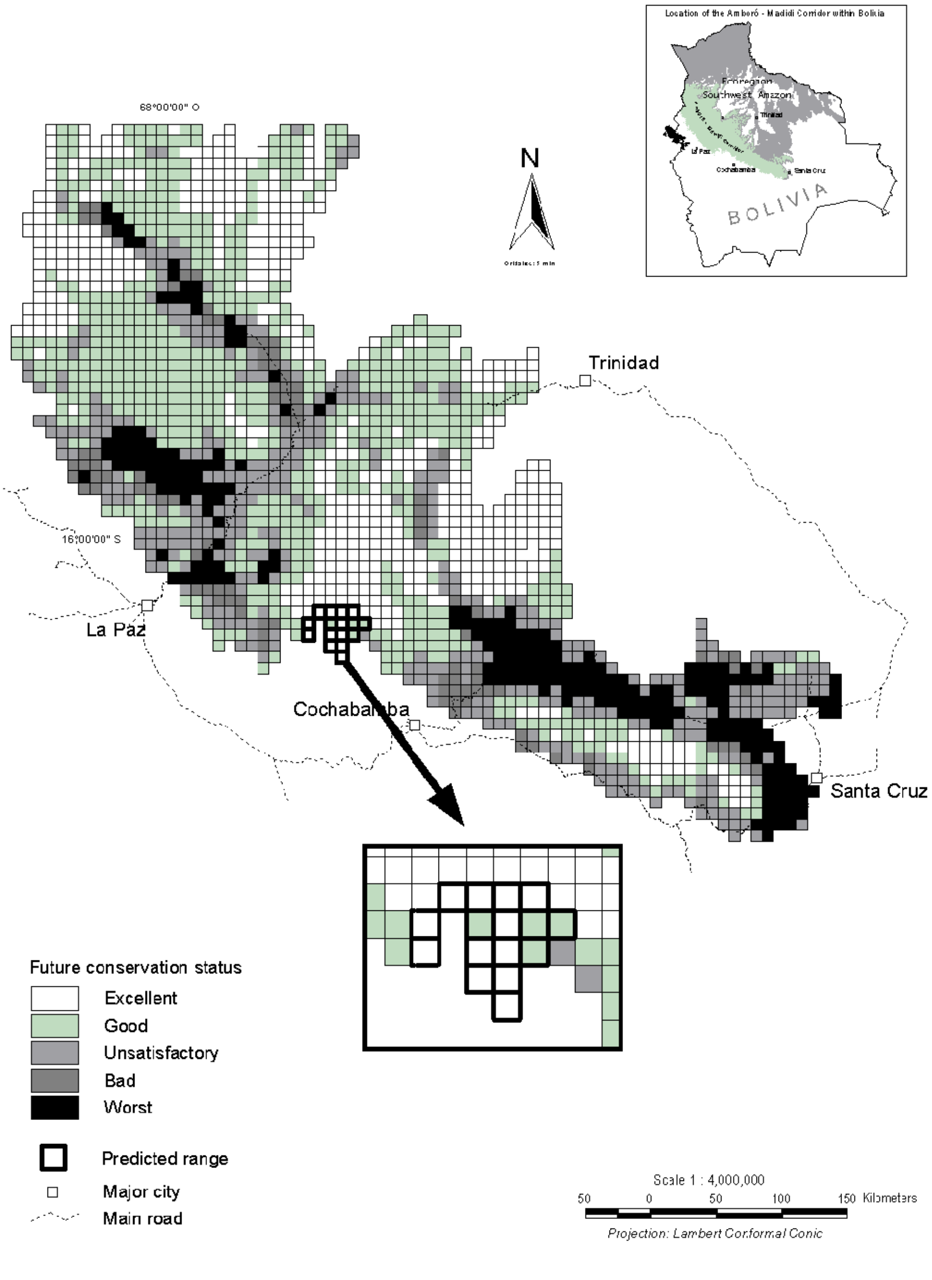

Fig. 9: *Masdevallia cocapatae* – example of a specie with a small range-size that is not threatened.

Table 2: Categorization of threatened species

Threatened species [%]	Threat category
28,8	High probability of extinction or extinct
19,2	Critically endangered
40,4	Endangered
11,6	Vulnerable

Naturally, the determination of the minimum viable range is the most crucial assumption with a strong influence on the results. Probably, when applying the method to other taxa, the minimum range of 4 connected grid cells must be revised and adjusted. In the case of the Pleurothallidinae this is rather arbitrary, but should guarantee that the species are 'on the safe side'. Of course, there is a methodological problem of grid and data resolution if we wish to apply smaller minimum viable ranges. We could also claim that not only a certain number of grid cells should be well conserved, but a certain percentage of a species range, ensuring the conservation of a good representation of populations and meta-populations. This methodological change also affected the number of vulnerable or endangered species.

For the compilation of the checklist of endemic and endangered plants of Ecuador (Valencia et al. 2000) the base assumption was that any species with a range of less than 20,000 km^2 is considered to be at least vulnerable (Pitman 2000). Indeed, many more Bolivian Pleurothallidinae would be classified as endangered if we applied the same criterion. However, we think that this proposed range is by far too large for tropical species; especially in montane regions.

A methodological doubt does exist in that the extrapolated ranges could be overestimated. When a species has been found in only one grid cell (= type locality) and its range is extrapolated to 10 neighboring cells, and all cells have a good conservation status with the exception of the type locality cell the species is classified as not threatened. However, if the species really is restricted to the type grid cell the classification would be wrong and euphemistic. If we look only at the conservation status of the type collection grid cells of the species that have not been collected elsewhere there is a certain quantity of species that should be endangered. Of course, experience has shown that species are not restricted to road-sides, and virtually all species tend to be discovered in more places when the search is intensified. However, up to now, it has not been intensive.

At the moment we can conclude that most species of Bolivian Pleurothallidinae are probably not threatened. Of course, all local endemics, especially meaning the areas that are endemism centers, merit special conservation attention. The Vásquez & Ibisch list (2000) and our maps of current and future habitat conservation status serve as early warning tools. Fig. 10 identifies the spatial concentration of threatened species. The concentrations mark the unfortunate coincidence of the existence of many species with naturally small ranges and a bad conservation status. Critical areas for Pleurothallidinae conservation are located in the La Paz department in particular, but also in the vicinities of the Carrasco National Park, Cochabamba. The degradation of montane rain forests on the Cochabamba border (e.g. Inquisivi) and around the Cotapata National Park give cause for concern.

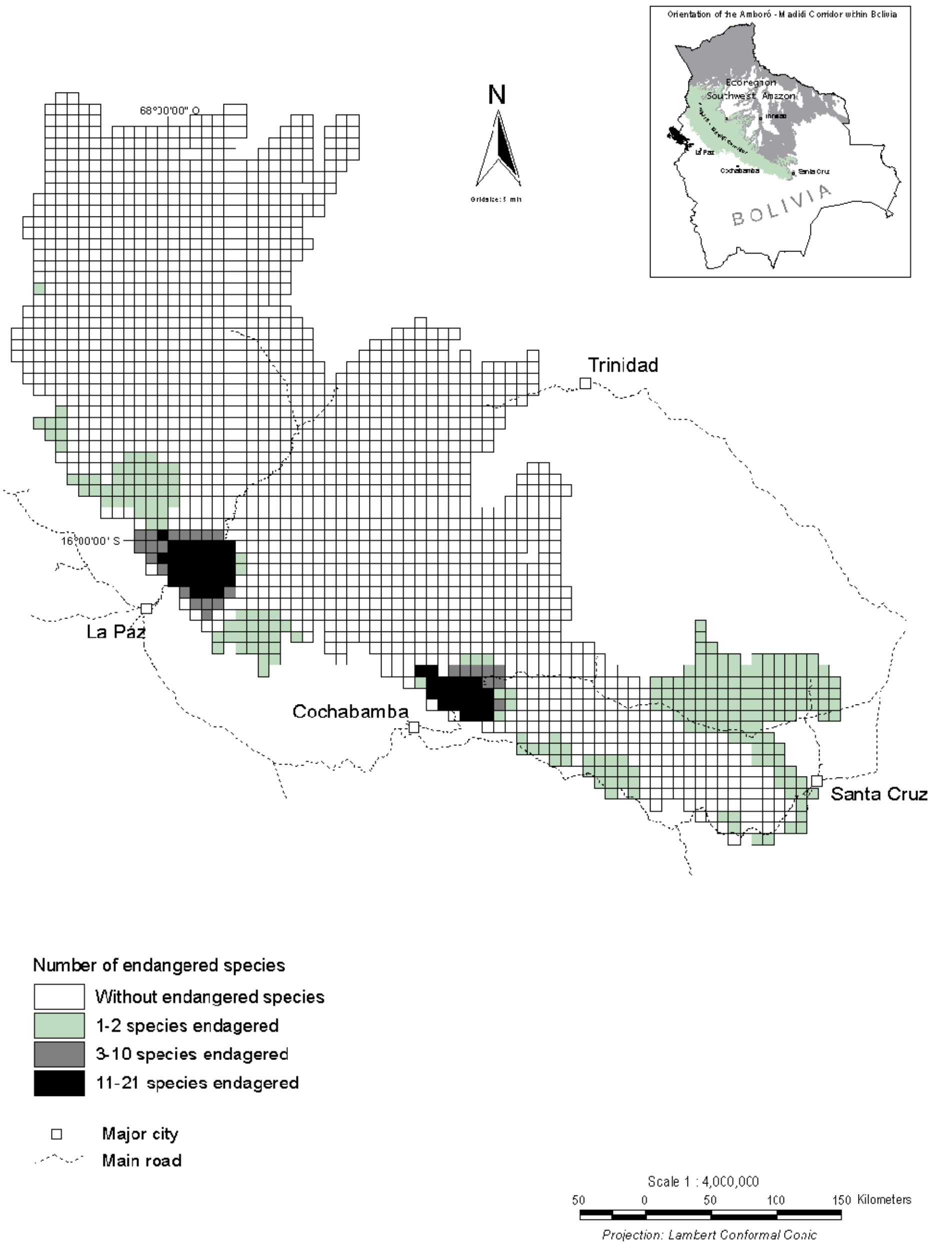

Fig. 10: Spatial concentration of threatened species within the study area.

Final conclusions and remarks

In the forest-covered portion of Bolivia, and especially in the study area, poor botanical knowledge is often correlated with good or excellent conservation conditions. When you travel by car – as most botanists do – you obtain a negative impression of biodiversity degradation and overestimate conservation problems …. but looking at satellite images and, especially, our maps of habitats conservation status it is possible to appreciate the large blocks of intact habitat where most of the species still should find enough space and resources to maintain viable populations. Our mission is not to deny or minimize conservation problems. But sometimes you may win more stressing the opportunities instead of exaggerating the threats: Bolivia, in comparison with most tropical developing countries, is special because of its well conserved biodiversity (especially with regard to montane and lowland rain forests), and therefore merits the special attention of conservationists and donors. Let us avoid in Bolivia what we did not avoid in Haiti (virtually deforested; FAO 1997), West-Ecuador (about 4% of forest left; Pitman et al. 2000), Ruanda (10% left; FAO 1997), Philippines (22% left; FAO 1997), and in many other countries.

We had the unique chance to contrast two conservation status evaluations of the same group with different results, partially undertaken by the same author. We do not claim that the proposed method using range extrapolation and ‘socioeconomic habitat conservation status’ is easier to apply than the IUCN estimations. Of course, especially when many taxa must be evaluated the required efforts are enormous. The new approach does not replace conventional methods of conservation status evaluation of species but they can enrich the analysis. However, we have experienced that the combined analysis of habitat conservation status and species range extrapolation offers additional and valuable criteria for decision taking. The secondary (or primary) products of the proposed analysis are abundant and, on their own, justify the data-intensive studies required for our method: diversity maps, representation evaluations, socioeconomic impact monitoring, We are especially convinced that they add value to existing data that normally are underexplored for conservation purposes. It is also our goal to show that existing data can tell a conservation decision maker more than we might have believed.

A better and more complete analysis would make use of any available data that at least permit an approximate of range size, ecological tolerance, sensibility to land-use change, and use of the species as well as conservation status of the habitat. A combination of numerical and spatial (GIS) analyses should guarantee the best objectivity. The issue of real sensibility of species to habitat conversion, until now, has not been addressed sufficiently. In our model case of the Pleurothallidinae it was not necessary to take it into account - we can assume that most of the species get into conservation trouble when forests disappears. We can also assume that none of the species is threatened through collecting and use.

We need more tools for objective conservation evaluations. Again, we want to stress the problem that many conservation biologists tend to exaggerate threats, especially when *their* favorite taxa are concerned. Longer red lists are not better lists for conservation policy and action, and red list species are not better species. Reality is bad enough, we do not need an artificial inflation of bad news to be heard.

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