

Guatemala: Sierra de la Minas Biosphere Reserve

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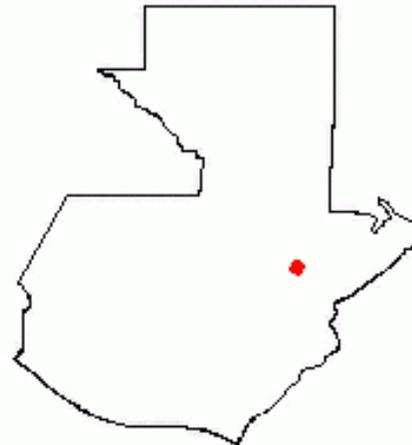
Location: Departments of Baja Verapaz, El Progreso, Alta Verapaz, Izabal and Zacapa.

Year of creation: 1990

Area: 242,642 ha

Ecoregion: Central American Pine-Oak forest

Habitat: Dry forest, humid forest with pine and oak groves, cloud forest, summit forest



Summary

Description

The Sierra de Las Minas Biosphere Reserve is located in eastern Guatemala. The reserve encompasses a mountain range that runs south to northeast across five departments in Guatemala up to Mexico and Belize. It shelters the best-preserved cloud forest in all of Mesoamerica with altitudes ranging from 150 m to more than 3,000 m above sea level. Certain characteristics of the reserve influence the climate in the adjacent regions as well as the water supply in the Polochic and Motagua valleys that fall within its boundaries. A total of 63 rivers originate in the reserve.

Biodiversity

The Sierra de Las Minas Biosphere Reserve is home to 885 species of mammals, birds and reptiles that represent 70 percent of all species registered in Guatemala and Belize. Twenty-one species of regional endemic birds have been reported. Flora species include *Persea schiedeana*, *Quercus purulhana*, *Abies guatemalensis* and *Cornus disciflora*, which are at high risk of extinction. *Parathesis vulgata* and *Magnolia guatemalensis* are threatened species and *Agave minarum* and *Beaucarnea guatemalensis* are endemic to the region. The reserve is habitat of the Quetzal (*Pharomachrus mocinno*), horned guan (*Oreophasis derbianus*), and the harpy eagle (*Harpia harpya*).

Threats

The biosphere reserve is [vulnerable](#) and there is a high risk that biodiversity will not be protected in the near future. The principal threats stem from forest fires, deforestation, illegal logging and hunting, human encroachment, extraction of forestry products and the future construction of hydroelectric dams.

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Description

Physical description

The Sierra de las Minas Biosphere Reserve is located in eastern Guatemala and encompasses a mountain range that runs south to northeast, cutting across the departments of Baja Verapaz, El Progreso, Alta Verapaz, Izabal and Zacapa. To the southeast it borders the Chuacús Sierra, to the south the Motagua River Valley, to the north Lake Izabal and the Polochic River valley and to the extreme northeast Sierra del Mico. Legally, the reserve, including the buffer zone, has an approximate area (sic) of 236,300 ha. Subsequent land purchase, on the part of the Defensores de la Naturaleza, increased the size of the reserve to include 242,642 ha. The protected area is located in a mountain range that runs approximately 180 km southeast from Izabal Lake. It has enormous altitude variations, ranging from 150 m to 3,010 m. Ravines and gullies, with slopes that surpass 65 degrees in some areas, mark the terrain. The geographic isolation and varying altitudes have given rise to enormous diversity of flora and fauna. Similar to the so-called "genetic evolution islands" (CECON, 1995), there exist a high number of endemic species.

The cloud forest covers 1,300 km, which represents the most significant cloud forest extension in Mesoamerica (Dix, 1983). The northern part of the protected area abruptly descends toward the Polochic Valley. On the western side, the altitude exceeds 2,000 m above sea level and reaches its highest point at Raxón Hill. There is a gradual decline east toward the Motagua River and Izabal Lake valleys. The southern highland terrain is not as rugged and thus is the most accessible. The Sierra de las Minas Biosphere Reserve divides the eastern zone of the country into a humid region to the north (Polochic Valley) and a very dry region to the south (Motagua Valley).

The climate and ecological conditions in the adjacent regions are influenced by the location of the mountain range, altitudinal variations and the Caribbean winds. Precipitation varies dramatically from one area to the next. For example, some areas on the upper part of the Polochic, to the north, receive more than 4,000 mm of rain a year. In the Motagua Valley, to the south, the mountain range forms a barrier to rainfall and annual precipitation is less than 500 mm. The temperatures also vary considerably, although detailed information is currently unavailable. Average temperature in the Motagua valley is 24° C. In the intermediate elevations, the temperature ranges from 5° C to 25° C (Dix, 1993), while above 1,750 m temperatures fall below zero between December and March.

Vegetation

According to the Dinerstein et al (1995) classification, the Sierra de las Minas ecological region is a Central American pine-oak forest. The protected area covers four of the life zones in the Holdridge classification (1987): dry forest, humid forest with pine and oak groves, cloud forest and summit forest.

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Dry forest

The southern part of the protected area is one of the driest areas in Guatemala, with precipitation between 500 to 1,000 mm annually. Areas that have less precipitation are known as extremely hot semi-desert zones. Areas with greater precipitation are deciduous or semi-deciduous. Average temperatures vary between 24° C and 19° C, depending on altitude. Maximum temperatures can reach 40° C in the lowest areas.

In this area, the terrain tends to be rough and does not exceed 900 m above sea level. Vegetation depends on the aridity and composition of the soil. In the driest areas, the vegetation is low and sparsely distributed. This area is dominated by leguminous species.

Deciduous trees are found in some of the cooler areas. Species present in the ecosystem include: Gumbo limbo (*Bursera simaruba*), pochote (*Ceiba aesculifolia*), leucaena (*Leucaena guatemalensis*), *Cochlospermum vitifolium*, *Gliricidia sepium*, *Pseudobombax ellipticum* and oak (*Quercus* spp.) (Dix, 1993). Oak covers extensive areas, but occasional fires allow for large stands of pine to succeed in affected areas.

Humid forest with pine and oak groves

On the northeastern side of the reserve, below the cloud forest (below 1,000 m), there is a humid, warm forest receiving 2,000 mm of precipitation annually. Caribbean pine groves, *Curatella Americana* and Oak (*Quercus* spp), grow on the hillsides (Dix, op. Cit). Below 1,000 m and west of the Sierra, the forest is drier and characterized by oak groves (*Quercus* spp.), Oocarp pine (*Pinus oocarpa*) and Evergreen Alder (*Alnus jorullensis*).

In the western areas of Sierra de las Minas, there are pine and oak groves between 1,000 and 1,200 m. Dominant species are: *Quercus* spp. Patula pine (*Pinus patula*), (*Tecunumanii*), Oocarp pine (*P. oocarpa*.), sweet gum (*Liquidambar styraciflua*) and maple (*Acer skutchii*). This is another region where fires have resulted in monocultures of pines (Secaira et al, 2000).

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Pine forest. Degraded area where pines grow, substituting the original forest. This substitution is a major problem in areas degraded by forest fires.

Cloud forest

The cloud forest, which has faced little or no intervention, covers approximately 130,000 ha of the protected area, with the majority in the nuclear zone (FDN, 1997). It includes a variety of different altitudes. On the northeastern hillsides, the forest falls below 1,000 m and in the south areas reach higher than 1,900 m (Dix, 1993). The area is marked by ravines and gullies with very pronounced slopes. The bio-temperature exceeds 20° C in the low areas, while in the high reaches it is closer to 11° C. The more humid northeastern areas receive around 4,000 mm annually; while in the driest areas receive 1,500 mm. The flora composition varies depending on the altitude and the orientation.

Between 1,500 and 2,700 m, the forest is dense with well-developed trees that reach a height of up to 35 m. Broad leaf species predominate. They are characterized by a wide, dense canopy with robust trunks supporting abundant branches in the high reaches. There is limited sunlight below the canopy, and in combination with the humidity, this gives rise to a thick carpet of moss sometimes dozens of centimeters thick.

The superior level, 30 - 35 m, is dominated by oaks (*Quercus* spp.), Perseas (*Persea donnell-smithii*, *P. sessilis*, *P. schiedeana*, *P. vesticula*), magnolia (*Magnolia guatemalensis*), *Podocarpus oleifolius*, *Alfaroa costarricensis*, *Billia hippocastrum*, *Brunellia mexicana* (Dix, op. cit.), *Phoebe bourgeauviana*, *Cornus disciflora*, *Dendropanax oliganthus* y *Parathesis vulgata* (CDC, 1993). Depending on the situation, tree communities are also dominated by *Quercus* spp., *Persea sessilis*, and *Podocarpus oleifolius*, or *Quercus* spp., *Quercus sapotaefolia* and *Persea vesticula*.

Between 2,400 (CONAP/INAB, 1999) and 2,900 m, (CDC, op. Cit), many parts of the forest

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are dominated by oak (*Quercus* spp.) and conifers. The lowest temperatures fall below 0° C between December and March. The upper canopy reaches 35 m.

In this area, the Guatemalan fir (*Abies guatemalensis*) makes up 21% (CONAP/INAB, op. cit.) of the forest, and there is less diversity in tree species than at lower altitudes (CDC, op. Cit.). *Quercus* spp is found along with white pine (*Pinus ayacahuite*), (*Taxus globosa*) (Dix, op. cit.), cypress (*Cupressus lusitanica*) (CONAP/INAB, op. cit.), *Pinus pseudostrobus* (CDC, op. cit.) and *Abies guatemalensis*.



*Detail of the cloud forest in the northwestern part of the protected area. The Chipe, *Cyathea* spp, is a giant fern that grows in the most humid areas of the cloud forest*

Summit forest

Above 2,500 m in areas exposed to harsh climate conditions, the flora community is dominated by bushes and stocky trees. They rarely grow higher than eight meters. Dominant species include *Pinus pseudostrobus*, *P. Ayacahuite*, *Quercus* spp. and *Podocarpus oleifolius*. The tree stratum, up to two meters high, is extremely dense and dominated by ericaceous, with a presence of rhamnaceous, theaceous and agavaceous (CDC, op. Cit).

Biodiversity

Sierra de las Minas shelters 885 species of mammals, birds and reptiles, which represents 70% of the species registered in Guatemala and Belize (Nations et al., 1989). The different elevations and climate conditions in the protected area mean the mountain range operates similarly to the so-called "genetic evolution islands" (CECON, op. Cit) with a high presence of endemic species.

In the protected area, there are 21 species of regional endemic birds (Dix, op. Cit) and a high diversity of reptiles (Campbell, 1988). The cloud forest is an area with unique biological

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diversity (Dix, op. cit). Among the flora species, the threatened Hollywood lignum vitae (*Guaiacum sanctum*) (1) exist in a severely fragmented population that is in serious decline (UICN, 1994). In the cloud forest, there is an enormous variety of endemic and threatened species.

According to the IUNC Red List (2001), *Persea schiedeana*, *Quercus purulhana*, *Abies guatemalensis* and *Cornus disciflora* are species at high risk of extinction (2), while *Parathesis vulgata* and *Magnolia guatemalensis* are classified as threatened species due to the collapse of their habitat (3). *Taxus globosa* is considered to be at low risk although it is close to being classified as vulnerable (4). The *Pinus ayacahuite* and *Cupressus lusitanica* are also regional endemic species and *Agave minarum* and *Beaucarnea guatemalensis* are local endemic species (Dfix, op. cit.). According to the CONAP Red List (2001a), the wild populations of *Podocarpus oleifolius*, *Taxus globosa*, *Abies guatemalensis* and *Guaiacum sanctum* cannot be used for scientific purposes.

The reserve also shelters species of fauna that are threatened and have restricted distribution. The cloud forest is the habitat of the Quetzal (*Pharomachrus mocinno*) and the horned guan (*Oreophasis derbianus*), two species that are protected along with the harpy eagle (*Harpia harpya*), which is nearly extinct (5). These three species are highly threatened (6). There is also a significant presence of felines, including the jaguar (*Panthera onca*), puma (*Felis concolor*), onza (*Herpailorus yagouaroundi*), ocelot (*Leopardus pardalis*) and margay (*Leopardus wiedii*.) (FDN, 1997.) Other mammals include the red brocket (*Mazama americana*), the howler monkey (*Alouatta palliata*) and Baird's tapir (*Tapirus bairdii*) (UICN, 1997). Several of these mammals are included on the UICN Red List (2001) (7), and the CONAP Red List (2001b) places the Baird's tapir (*Tapirus bairdii*) in serious risk of extinction.

Sierra Minas Abies: Abies guatemalensis, an extremely threatened regional endemic

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species. It develops in the high parts of the Sierra where it is associated with conifers and wide leaf forest.

Management

Officially declared a protected area by Congress in 1990, according to Decree No. 49-90 (8) (Guatemala 1990), that same year, UNESCO's Man and Biosphere (MAB) program included the reserve within the World Biosphere Reserve Network (UNESCO 2002). Creation of the Sierra de las Minas Biosphere Reserve came under criticism by landowners who wanted to continue extracting lumber from the reserve without any restrictions. The new law banned the use of land within the reserve without providing monetary compensation.

Landowners argued that the Decree, which created the reserve, was unconstitutional because it violated the right to private property (inscribed in the Constitution of the Republic). In 1991, two different lawsuits were filed against the reserve before the Constitutional Court. The Court refuted the arguments of the landowners because the Constitution also stipulates that the interests of common property prevails over individual property and confirmed the legal existence of the reserve.

The Sierra de las Minas Biosphere Reserve has a five-year master plan as well as an annual operating plan that is approved by CONAP. Management plans include protecting ecosystems, managing sustainable natural resources, spearheading environmental education and community extension and scientific and administrative investigation. The current master plan was in effect until March 2002, and the plan for the next five years is currently being finalized (Tot, 2002, pers. com.).

Administration of the Sierra de las Minas Biosphere Reserve was delegated to a Board of Directors that includes a representative from CONAP, the Defensores de la Naturaleza

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Foundation, the Urban Department, the Rural Development Council and from the departments in the reserve area, including a landowners representative from Sierra and a representative from the indigenous communities in the area (Guatemala, 1990).

The same law appointed the Defensores de la Naturaleza to act as executive secretary and CONAP to act as president of the Board of Directors. However, the Board of Directors was never created because the regulations approved by the government were passed in such a manner that created obstacles for the board's operation (Tot, 2002, pers. com.).

Since the board was never constituted, Defensores de la Naturaleza is the current administrator of the park, acting under the supervision of CONAP. This has also created the impression that Defensores de la Naturaleza was given the task of managing the protected area (Núñez, 2000; Secaira et al., 2000), something that is only partially true.

The administration of Sierra de las Minas is divided into three different districts that correspond to the different departmental basins and population groups: the Motagua district to the south (departmental district of Zacapa and Izabal), the Polochic District to the north (departmental jurisdiction of Alta Verapaz and Izabal) and the Chilascó District to the west (departmental jurisdiction of El Progreso and Baja Verapaz).

The reserve is divided into four zones: nuclear, recovery, buffer and multiple-use. The objective of each is defined in the Master Plan of the Sierra de las Minas Biosphere Reserve (FDN, 1997) in the following fashion:

The [nuclear zone](#), with an approximate area of 112,000 ha, is dedicated to the conservation of environmental and biological diversity and the preservation of water sources. Only scientific investigation and ecological tourism are permitted. Extraction and human settlements are banned.

The recovery zone, with 4,200 ha, seeks the regeneration of forestry coverage in some areas that are seriously damaged by human activity. Once these areas are recovered, the forest will be designated for production or protection on a case-by-case basis.

The buffer zone, covering 91,800 ha, promotes the sustainable use and management of resources, and the participation and education of communities to protect the nuclear zone.

The multiple-use-zone, with an area of 34,600 ha, maintains the forestry cover and works to achieve the sustainable use and management of the reserve's resources (changing soil use is prohibited).

Currently, Defensores de la Naturaleza has 44 employees for the management of Sierra de las Minas. Of these employees, 35 are park guards, 20 are provided by CONAP (Paiz, 2002, com. pers.; Tot, 2002, com. pers.). Five Defensores de la Naturaleza employees work within the

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communities and the remainder work in administration including the director and office assistant of the protected area whose offices are located in San Agustín Acasaguastlán. Moreover, Defensores de la Naturaleza has a development director and a director of protected areas, who is responsible for coordinating the four protected areas managed by the Foundation. These individuals, while related to Sierra de las Minas, are not exclusively dedicated to managing the protected area on a full-time basis.

The budget for the conservation of Sierra de las Minas is Q. 3,000,000 (approximately US \$387,000) (Tot, 2002, pers. com.), which includes donations from individuals, the private sector, CONAP and the financial management of an endowment.

Financial support for this area has declined; therefore, new mechanisms have been implemented to collect money, such as the sale of water that the reserve provides for industry and neighboring communities. Defensores de la Naturaleza's fundraising capacity is one of its important assets, and it is likely that the budget for this area will increase in the future.

In 1995, income from Defensores de la Naturaleza was distributed as follows: 51% to protection, 13% to sustainable development, 6% to environmental education, 5% to investigation, 6% to forestry activity and 13% to administration (FDN, 1995^a).

Since 1992, several government and non-governmental organizations have contributed to environmental education, conservation and technical support. For example, the US Forestry Service trained 58 people and eight volunteer brigades in fire fighting, and along with USAID, helped combat the southern and round-headed pine beetle (*Dendroctonus Frontalis* and *D. adjunctus*) infestation, a problem for many pine forests in the reserve (Cano, 2001). Some municipalities have also contributed financial support to the area. In 2001, the municipality of Panzós granted Defensores de la Naturaleza financial support for 25-years to locate their headquarters in the Polochic District, while the municipality of San Agustín Acasaguastlan provided financial support for 30-years for the reserve's headquarters.

Human influence

The total population living within Sierra de las Minas is relatively small. In the upper northern region, there have been new migrants from the Q'equchi and Pocomchí groups, which came from the Polochic valley and moved towards the interior of Sierra de las Minas. There are three communities in the western region, and there are 27 in the south. The communities are primarily mestizo and they have established residence on municipal land, forming small villages on the mountain. There are 140 communities surrounding the protected area.

The protected area has an administrative center, three regional offices, three scientific stations and seven shelters. The administrative center is based in San Agustín, Acasaguastlán, in the department of Progreso. It is a training center for personnel with the capacity to house 30 people.

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Regional offices are located in Salamá, Río Hondo and Telemán and have audiovisual equipment, radios, kitchens, meeting rooms and sleeping quarters. Within the reserve, there are three scientific stations equipped with solar panels, potable water, kitchens, bedrooms, bathrooms, workrooms and equipment to monitor and observe the flora and fauna in the area. In addition, the protected area contains seven shelters to patrol and monitor wildlife.

Dirt roads, which are difficult to navigate during the rainy season, provide access to the northern region of Sierra de las Minas. The reserve is accessible from several entrances located on the Cobán highway near Senahú. However, visitors rarely utilize the northern route to access the reserve. The paved highways of the western and southern region of the reserve are more easily accessible and connect this zone to the rest of the country. There is a highway in the nuclear region of the reserve that runs from San Agustín Acasaguastlán to Albores allowing access to the southern zone. Part of this road is unpaved and only accessible by four-wheel drive vehicles in the rainy season.

Sierra de las Minas is a tourist destination. Defensores de la Naturaleza uses its installations for visitors, who are charged US\$15 per day for cabins. Plans are currently underway to offer two stations for tourism operators, who must fulfill the terms of reference established by Defensores de la Naturaleza (these include working with communities, controlling the cargo capacity, and general policies regarding the use of installations etc.). In Chilascó, there is a visitors' center administered by the Chilascó de Salto Committee, which is legally constituted and includes a General Assembly and a Board of Directors. Because there are different ways to access the protected area, the exact number of visitors to the area is unknown; however, the area administrator estimates that approximately 400 people visit each year, including those who come with Defensores de la Naturaleza and other groups.

Conservation and Investigation

Research on a variety of topics is carried out in the area including archeology, integration, community participation, monitoring wildlife, tourism potential, forestry and non-forest products, and the dynamics of deforestation. In 1995, Defensores de la Naturaleza began to define criteria for prioritizing possible areas of investigation and made a list of potential themes for research.

Threats

Defensores de la Naturaleza has reported important findings that impact the conservation of this protected area. When the reserve was declared in 1990, it was heavily threatened by logging activities and this threat continues today. The reserve also faces other threats arising from activities such as changes in soil use, forest fires and hunting.

Conflicts

The administration of the protected area has been both criticized and praised by those involved

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in the reserve. Criticism is primarily based on three aspects: the major importance placed on collecting funds, which has limited the Defensores de la Naturaleza's operating criteria and independence, the absence of public involvement or information on problems facing the area, and information on the acceptance of projects within or near the protected area.

This perception has created minor conflicts and could potentially pose significant problems for administrators in the future, which in turn could affect management of the protected area. The construction of a dam in the northeast region could spark negative reactions toward Defensores de la Naturaleza, unless it re-evaluates its position based on its conservation role.

Current threats

Forest fires

In April 2002, the daily Prensa Libre reported that in the Sierra de las Minas protected area there were eight different forest fires, and 1,700 ha were burned. The same news source reported that in 2002, 3,481 ha were burned within the reserve (Prensa Libre, 2002). Forest fires constitute a major threat for the ecosystems in the reserve because the original structure of the pine-oak forest is being replaced by pine groves, a species that grows faster and propagates easily after fires (Dix, 1993).

Fires stem from two main causes, those provoked by farmers to favor the swift regeneration of grazing land and those provoked for subsistence agriculture. The first generally begin with annual uncontrolled fires in the pine-oak grove, started by small and mid-sized ranchers (Secaira et al, 2000). This is common practice in the south and leads to extensive forest fire damage each year. In the northern area, fires are more commonly associated with subsistence crops and the advance of the agricultural frontier. Defensores de la Naturaleza has begun an educational program to combat fires, which is supported by the US Forestry Service and US AID. Programs have also been implemented with farmers; however, the risk of fire damage remains very high.

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Sierra Minas Fire: Fire on the southern side of the protected area, reaching the nuclear zone. Fires in the southern zone are frequent and represent one of the major problems in the area.

Deforestation and illegal logging

One of the most serious threats to ecological integrity in the reserve is deforestation. The main causes of deforestation are slashing and burning for subsistence crops, changes in soil use in surrounding areas for commercial crops and illegal logging, particularly in the primary forests in the protected area and in their zone of influence.

Between 1987 and 1995, the annual deforestation rate was 1.1% of the total area of the reserve, a surface equivalent to 1,860 ha per year (Jolom-Morales, 1997). While deforestation has decreased since 1990, it has not been possible to eradicate it completely or reverse the process.

The exploitation of wood in the southern region has seriously depleted many forests in areas surrounding the reserve (Dix, 1993). The nuclear zone has been penetrated only occasionally. In the Motagua valley, some of the largest and most economically powerful logging companies in the country run sawmills.

For this reason, some people, including government officials (who asked to remain anonymous), believe that logging is the main cause of deforestation in the southern part of Sierra de las Minas. According to them, the swiftness and intensity of logging surpasses the impact that small-scale farmers have on the forest.

According to Defensores de la Naturaleza, the volume of wood extracted in 1992 surpassed the forest's natural recovery capacity and the logging techniques used are destroying and degrading the forest (FDN, 1992). CONAP and Defensores de la Naturaleza have implemented forestry management plans that decreased the problem but they have not been able to stop logging completely. To avoid major conflicts with logging interests, Defensores de la Naturaleza has purchased land with the support of funding drives backed by The Nature Conservancy and the

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Eternal Forest Group of Sweden, (9).



Logging in the nuclear zone is being carried out by one of the strongest logging companies in Guatemala, Maderas el Alto. Illegal industrial logging or logging legalized through dubious means is one of the major problems in the area. Photo taken in June 2002.

Illegal hunting

For many years, the local population has hunted wild fauna to compliment their diet, protect crops or for sport. There are also foreign hunters who enter the area and hire local guides for sport hunting (Lehnhoff y Núñez 1998).

The species most often hunted include the horned owl (*Oreophasis derbianus*) (Tot, 2002, pers. com.), a species catalogued as threatened by the IUNC (2001) and the red brocket (*Mazama americana*), which is also included on the UICN list.

Given that the reserve is a protected area and that hunting is illegal in the nuclear zone, it is difficult to gather trustworthy information to determine the frequency and impact of this activity. In 1997, Defensores de la Naturaleza began a study focused on hunting in the reserve to obtain information about the main species targeted, and their relationship with the state of conservation of the forest where they are found.

Defensores de la Naturaleza has carried out educational workshops, follow-up interviews with hunters, as well as a hunting calendar and monitoring system. It also plans to initiate a project on sport hunting with the support of the Wildlife Conservation Society. According to the Defensores de la Naturaleza (1997), in recent years there has been a significant recovery of many game species, particularly the horned owl, in areas where there are reserve personnel. During our field visits, we were able to interview local personnel who did not have the impression that hunting was a problem in the area, and they were under the impression that hunting had decreased.

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Land Invasion

In the southern part of Sierra de las Minas, the loss in land fertility is a major problem, forcing peasant farmers to deforest and expand cultivation which reaches the high region of Sierra de las Minas. In the northern part of the reserve, the expulsion of indigenous peasant farmers found in the Polochic Valley was one of the factors that originated the unofficial colonization of this region.

In 2002, there were at least two communities that moved into the nuclear zone of the reserve and in 2001 there were three (Tot, 2002, com. pers). The extreme level of poverty and population growth has led peasant farmers to abandon their villages on the hillsides and migrate to higher areas of the mountain where they burn the forest in order to plant, export wood and manufacture carbon.

As a result, areas that once contained mature forest are gradually being degraded. The correlation between population growth, demand for land and deforestation in the zone seem consistent with trends in other parts of the country (Secaira et al, 2000).

To resolve this problem, a multi-sector committee was formed. It is presided over by Defensores de la Naturaleza (Tot, 2002, com. pers) and is made up of 12 different institutions. This committee is seeking solutions for the problems presented by the purchasing of land and relocation of land invaders. At the same time, they are working to update land registration to give legal security to peasant farmers living near the northern zone and to other landowners in the reserve. Despite the fact that the purchase of land from land invaders could lead to invasions as took place in other protected areas in Guatemala this danger is not readily perceived by the administrators of Sierra de las Minas as a serious threat (ParksWatch, 2002).

Extraction of forest products

In many communities near the Sierra de las Minas, wood is the primary form of fuel. Forestry products used in artisan work from the area are also extracted from the reserve. The extraction of medicinal plants has threatened many species of medicinal flora and put the *taxus globosa* in serious danger in the 1980s and early 1990s. In terms of ornamental products, there has been major extraction of arborescent ferns, orchids and other plant epiphytes for commercial purposes. There is growing pressure on the natural resources in the protected area.

The growing pressures on natural resources in Sierra de las Minas are complex and difficult to resolve. The poverty and marginalization of local rural inhabitants, the limited possibilities for economic development and the limited opportunities for employment restrict the majority of inhabitants in surrounding villages to salaried fieldwork (Secaira et al, 2000). As a result, many people depend heavily on the extraction of forest products for which there is little control. There is limited unbiased information about the impact of these activities and therefore it is difficult to determine the significance of this threat.

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Future threats

Construction of hydroelectric dams

Sierra de las Minas currently has one dam, and the construction of another between the Colorado and Jones River Basin has been authorized. Due to the growing scarcity of water in the dry areas and plans to establish irrigated crops around the region, there is growing support for construction of hydroelectric dams. Currently, one is proposed for Chilascó, north of the protected area. The current position of Defensores de la Naturaleza to projects of this magnitude suggests that there will be no opposition to the construction of the dam, despite the impact it will have on the environment. Residents from the zone where the proposed dam will be built, as well as local organizations have publicly expressed their opposition to the project and have criticized Defensores de la Naturaleza's position.

Recommended solutions

Recommendation for all threats: changes in the attitude of the administration

All threats facing Sierra de las Minas are problems that are difficult to resolve in the short-term. For the most part, Defensores de la Naturaleza has initiated programs obtaining satisfactory results. However, conservation problems continue to face the protected area.

When questioned about the denouncements and complaints, area administrators said they were rarely informed of such problems. This is very common in Guatemala and is compounded when no one follows-up on the complaint. Corrective measures are much more likely when and if the affected party carries out parallel activities such as providing evidence, investigation, sharing denouncement and information with the media, and by lobbying state authorities to present evidence and follow-up on the complaint.

The effectiveness of a complaint, and the subsequent condemnation of those who have broken the law could improve with a change in attitude of those responsible for administration. In this area, Defensores de la Naturaleza has demonstrated little desire to enter into conflict, with the exception of extreme cases. Normally, they have left it up to CONAP to file any charges while Defensores de la Naturaleza has been responsible for negotiating and implementing the projects. While it is true that negotiation favors some problems, it is also true that illegal activities are not stopped by negotiation alone but also require a will to strictly uphold the law.

Human encroachment in protected areas, illegal logging, hunting, slashing and burning, changes in the use of soil and the extraction of wild products are regulated and any transgressions should be sanctioned. Those who fail to uphold the law can and should face charges and sanctions. This is an area with room for improvement for Defensores of the Naturaleza. There is also a need for the authorities to more aggressively follow-up and pursue complaints. A specific department should be created to manage this.

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Recommendation for all threats focus on strengthening the protection of the areas that are already under the administration's jurisdiction prior into expanding to new areas.

The fact that Defensores de la Naturaleza has expanded its activities also makes it difficult for it to confront growing problems in Sierra de las Minas.

Currently, Defensores de la Naturaleza manages four protected areas, three with a high degree of conflict. Less than a year ago, it began administering Sierra del Lancandón, an extremely volatile area. It is also carrying out studies to declare the Thorny Mountain Valley of Motagua a protected area. Despite the fact that this is a highly threatened area with enormous ecological value, it is probable that administration of a new, potentially volatile area will make it more difficult to protect the areas it currently administers.

The fact that the declaration of the Sierra de las Minas delegates the administration to a Board of Directors, with Defensores de la Naturaleza as the executive secretary, makes it very difficult for another organization to participate in the administration of this area. This is an argument that both Defensores de la Naturaleza and CONAP should take into account if plans are underway to have Defensores de la Naturaleza administer other areas. If the efforts for both fundraising and attention are enlarged, the possibility for the successful management of Sierra de las Minas will decrease. Therefore, future efforts should concentrate on managing the areas currently under its responsibility, rather than trying to expand its responsibilities. CONAP should play a fundamental role when deciding whether or not Defensores de la Naturaleza should administer other protected areas.

Construction of hydroelectric dams and other infrastructure works

The attitude of Defensores de la Naturaleza regarding work of this nature - as well as other industries that operate close to the area is marked by two characteristics: a need to collect funds and a refusal to accept that these projects will have a negative impact on the reserve (unless it has been convincingly demonstrated that they will) (Tot, 2002, pers. com.).

The first of these positions means that Defensores de la Naturaleza is one of the most successful non-government organizations capable of fundraising for the area it manages. However, at the same time, through its aggressive fundraising, it has been stripped of its capacity to confront powerful economic actors. The ability to refuse projects is perhaps the most dangerous threat to Defensores de la Naturaleza success, as it often accepts activities within or near the area without the potential environmental impacts being assessed in advance. For example, there are hydroelectric dams in the nuclear zone and companies are allowed to extract marble in the sustained usage area without a system in place to analyze the environmental impact of these activities.

In order to develop solutions to the problems presented by developing infrastructure works that threaten the protected area, there must be an overall change in attitude. Defensores de la

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Naturaleza should establish funding policies that regulate economic income and clearly state under what circumstances funding will be approved. At the same time, Defensores de la Naturaleza should err on the side of precaution, which is the opposite from their current operating principle. Prior to being given permission to set-up operations, any company that plans to work in the area should demonstrate sound environmental policies that will not damage Sierra de las Minas.

Conclusions

The Sierra de las Minas Biosphere Reserve is one of the most valuable ecological areas in Guatemala. The high levels of biodiversity, the marked existence of endemic and threatened species and the fact that it is the most significant cloud forest in Mesoamerica makes it a place of enormous importance for conservation.

However, it is an area that is quickly being degraded. Forest fires and changes in soil use in 2001 meant the loss or degradation of 2.5% of the forest in the protected area. The impact of human activity is not yet known; however, the change from the original coverage of oak to pure pine groves provides an idea as to what is happening due to hunting and gathering.

If the degradation of forests remains similar to what took place in 2001, in a few decades one of the last remaining forests of this type in the world will have disappeared. This is enough to consider reclassifying the area from vulnerable to threatened. There is a high probability that Sierra de las Minas will fail in protecting biodiversity in the future if immediate steps are not taken. The possibilities of failure accelerate with time.

Defensores de la Naturaleza has had considerable success, above all in carrying out community education, research and fundraising projects. However, its 12-year administration has lacked the strength to consolidate the protected area in a way that provides reasonable security that the reserve will last over time. Other areas in Guatemala, such as the Tikal National Park, demonstrate that without being perfect or problem free, it is possible to obtain relative stability from threats in the mid to long-term future.

Given that the experience of Defensores de la Naturaleza is broad in carrying out community projects and that it has been successful in this area, there are few recommendations to make. However, as it is recommended in the above section, as a first step, those responsible for the Defensores de la Naturaleza must make an effort to prioritize the areas they are managing and if necessary, abandon those responsibilities that spread them too thin in order to ensure the successful conservation of Sierra de las Minas.

The fact that Defensores de la Naturaleza has more than a decade of experience in managing protected areas, more than most organizations in Guatemala, is not a sufficient reason to expand its activities to new areas without having consolidated those it currently administers. CONAP must ensure that the administration of other areas is not affecting the conservation efforts for Sierra de las Minas, potentially annulling joint administration contracts if necessary.

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Once it is clearly established that the efforts of Defensores de la Naturaleza are not going to be diluted, a system to monitor illegal activities in Sierra de las Minas should be implemented. This system should decrease illegal activities in the area through the constant monitoring by administrators to ensure that people are punished according to law.

The clarification of fundraising policies and the Defensores de la Naturaleza attitude towards new projects is a long-term goal. The current management goal of the protected area is that the management of Sierra de las Minas should be a model to follow throughout Guatemala. Creating a model demands a great deal of work and a willingness to adopt measures that are not always agreeable to everyone.

Community work demands significant technical support and money, while conservation demands that the law be upheld (Terborgh and Davenport, 2002). If those responsible for administering the protected area realize this and adopt it as a model there is still the possibility that the valuable Sierra de las Minas ecosystem will be conserved for the good of present and future generations.

Footnotes

1. Classified in the IUCN Red List as EN2a
2. Classified in the IUCN Red List A. *Guatemalensis* VUA1d, *C. Disciflora* VUA1cd, *P. Schiedeana* VUA1c y *Q. Purulhana* CUA1c.
3. Classified as EN2a
4. Classified as LRnt
5. CONAP's Red List (2001b) includes it within species not reported in the country for the past 50 years and therefore considered nearly extinct. However, Biologist Robin Bjork saw one in the Mayas Montañas in 2001.
6. Classified in the IUCN Red List in the following fashion: *Pharomachrus mocinno* LR/nt, *Oreophaps derbianus* EN2a y *Harpya harpia* LR/nt
7. *Panthera onca* is cataloged as LR/nt, *Alouatta palliata* as VUA1c,B1+2c and *Mazama americana* as DD.
8. Its limits are located at 15° 1' 30.75" y 89° 44' 52.01"/15° 2' 2.26" y 89° 40' 35.62"/15° 4' 5.68" y 89° 36' 10.28"/15° 7' 37.47" y 89° 30' 47.30"/15° 11' 38.17" y 89° 21' 59.34"/15° 12' 26.76" y 89° 19' 42.56"/15° 14' 1.80" y 89° 15' 53.29"/15° 15' 14.80" y 89° 12' 7.93"/15° 16' 7.37" y 89° 9' 50.26"/15° 17' 22.52" y 89° 6' 24.94"/15° 18' 42.70" y 89° 5' 33.79"/15° 21' 17.72" y 89° 7' 32.66"/15° 21' 44.03" y 89° 9' 52.05"/15° 21' 17.05" y 89° 14' 14.06"/15° 20' 38.06" y 89° 16' 50.04"/15° 20' 43.53" y 89° 18' 30.95"/15° 18' 7.55" y 89° 43' 33.62"/15° 17' 44.65" y 89° 44' 51.20"/15° 17' 24.18" y 89° 46' 8.82"/15° 16' 52.48" y 89° 49' 24.35"/15° 16' 34.53" y 89° 53' 43.68"/15° 10' 23.03" y 90° 8' 21.08"/15° 9' 31.54" y 90° 7' 59.18"/15° 5' 2.02" y 90° 8' 26.22"/15° 1' 15.82" y 90° 8' 9.17"/15° 0' 53.80" y 89° 59' 18.76"/15° 1' 31.50" y 89° 54' 44.16"/15° 1' 5.79" y 89° 48' 57.58"
9. It was shocking that during interviews that ParksWatch held with the director of the

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reserve, the logging activity was not perceived as a threat, even though direct questions were asked.

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