

ECUADOR: A MODEL SYSTEM FOR OUTLINING THE PROBLEMS OF SURVIVAL OF ORCHIDS IN THE WILD

Alexander Hirtz

Caracara Silver Inc., Corporate Headquarters, 120 Adelaide Street, West Toronto, Ontario- M5H 1T1, Canada

Abstract

The present paper discusses the chances of the survival of orchids in the wild, highlighting it for Ecuador, but the same factors would also apply in some degree to all other countries. In almost all of the lectures that were presented as a part of research that was carried out in the last 40 years, the work has been referred to the grim perspective of the survival of orchids and their natural habitats and the need to rescue a few plants of each species *ex situ*, where they may be multiplied in a laboratory and hopefully distributed, worldwide. There is a strong need to preserve as many pristine forests as possible and rescue as many species to be grown in public and private collections. This must apply for Ecuador, as well as for other hot spots in all other tropical countries where they are all facing the same problems of population growth, acid rain, and climate change.

Introduction

OF THE 4300 orchid species identified in Ecuador, close to 2000 are endemic and many are restricted to very small geographical areas. If these small habitats are threatened either by deforestation, acid rain or climate change, many will go extinct in the near future. Hence, the present study uses Ecuador as a model, outlining the problems faced by orchids in the wild.

Ecuador: Habitat, Ecology, and Economy

During the 3rd Congress of the Conservation of Andean Orchids in Quito in 2009, a lecture was presented as a part of my work, *What will be left of the Primary Forests in Ecuador?*, highlighting the new Constitution proclaimed in 2008, which became the first country to extend constitutional rights to nature, which includes the right to maintenance and regeneration of its vital cycles, structures, functions and evolutionary processes. It read well, but was otherwise unrealistic. Eight years elapsed and since then over 2 million Ecuadorians have reached the age of 18, of which over 7,00,000 were born in rural areas. Ecuador is the second smallest among the countries of South America, but has the highest population density with 67 inhabitants per km². The population of Latin America and the Caribbean is 625 million and it is estimated that it may increase by another 100 million by the year 2030. Ecuador has almost 17 million inhabitants, where 37% live in rural areas. In former decades, many have left the country looking for a job in North America or Europe, where it was roughly estimated that about 3 million had left in the last 30 years, but the recession in the last decade in Europe and North America had dramatically reduced the need for foreign labour, where many even

had to return to Ecuador. Besides oil, the country sustains itself from agriculture and seafood. Grasslands for cattle became extensive, most often without cows, where a government survey showed 20 hectares of pastures for one cow. The main reason was the inappropriate ecosystems for grazing, where the poor hoped to survive tending only a few cows, but reality forced them to sell the few animals in desperate times. As in all of South America, manufactured products represented only a small percentage of their revenue and very little was invested from outside to add new jobs other than farming, oil and mining. As pointed out, new jobs need to be provided for the population, which increases in Ecuador by a quarter of a million a year. In Brazil, population increases by a million and a half, every year. To allocate new jobs, fresh foreign investment is required, but recently most foreign investment is directed to Asia, while it has dropped in Latin America over 30% in the last ten years. Of the total \$135 thousand million invested in Latin America in 2015, less than 1% has been invested in Ecuador, mainly in oil and mining. The outlook for the unemployed to find a job looks grim. Ecuador is in deep debt over the next decade, which implies further decrease in new jobs. Thus, the question arises what the young population can do to survive other than incrementing the slums in big cities or turn to smitten agriculture.

Factors Detrimental for Orchid Survival

In previous times, like in the 30s of the past century, Ecuadorians successfully made a good living in extracting gold, from the placers, which may be found literally in all rivers of Ecuador. But due to environmental concerns, artisanal mining is considered illegal by the previous and current mining authorities. Ecuador has



Figs.1-4. Degradation of primary forests in Ecuador: 1, Felling of trees; 2, Construction and mining activities; 3-4, Loss of endemic orchids due to slash and burn method.

the highest network of primary and secondary roads in South America, adding up to at least 80,000 km. Rural population has easy access to invade these forests, which has been a tradition since the agrarian reform in

the 60's. Around 2,00,000 hectares of primary forests are lost every year (Figs.1-4). Due to the high density of plants growing on trees, the forest fires kill several million plants and insects every hour. It has been



Figs. 5-6. The effect of global warming over decades: 5, Cooler temperatures and less permafrost on the mountain peaks; 6, Decrease in the number of glaciers with rise in temperature over the last 43 years.

estimated that over 1,00,000 hectares of forests were burnt in the beginning of 2017 in the province of Loja and every wk, one hears that hundreds of hectares were lost here and there. On top of the internal growth of population, hundreds of thousands have fled from Colombia afraid of the guerrilla and related drug cartels where 2,00,000 are now legal residents in Ecuador living mostly in rural areas and a new wave of refugees are arriving as well from Venezuela.

Without the financial resources for sophisticated tool technologies, the new land owners may only resort to swidden cultivation, which still is a successful adaption to the rigors and constraints of the tropical forests. This is considered optimal by local authorities, but only viewed as a wasteful and destructive technique by a handful of well-intentioned conservationists. The general population ignores what is happening with the

primary forests, while the rural population and local authorities financing the new roads demand from the new landowners to be productive and farm the newly obtained land. These newcomers, local or foreign, started logging the valuable trees, there after they producing charcoal from the smaller trees and finally rest were slashed-and-burnt to grow potatoes and other horticultural products. It is expected that 90% of the remaining inter-andean forests will disappear in the next decade. The other factor detrimental to the survival of endemic orchids is global warming, but also local climate change. Global warming started in 1850. The latest worldwide mini ice age in the current interglacial period initiated in the XIII century and which had its cold peaks in 1650, 1770 and 1850.

As a reference, as seen in the detailed maps, notes and paintings produced by the geographers of the La



Figs. 7-8. The severe outcomes of climate change on forests: 7, Winds from the Pacific or the Amazon Basin reaching the Andean Cordillera carrying less humidity, where the dry and hot winds burn the orchids to death in a few wks in an extended summer in a single year; 8, Damaging effects of acid rain endlessly damaged high altitude forests and vegetation cover with acidic fogs and clouds mostly encircling them often on a daily basis all year round.

Condamine expedition to measure a meridian arc in Ecuador as well as by other geographers and botanists like Humboldt, Spruce, Guzman, Ruiz and Pavon, Reiss, Churchill among others, one may certify that many mountain peaks had glaciers in the XVIII and XIX century, where these scientists measured that the temperatures in those mountains were 3 degrees cooler and the permafrost was about 500 meters lower than today. Of the 8 Snow Mountains shown in 1744, only three had glaciers at the end of the 19th century. Hence, global warming started 167 years ago (Figs. 5-6). A much greater concern is climate change due to extensive deforestation in the lowlands and areas surrounding the buffer zones of the primary forests, it has been noticed over time, that every year the periods of no rain are now lasting several days and even wks longer than in the past, which is greatly affecting the habitat in primary forests. If an example of the Pleurothalids or the Telipogon is used, it can be imagined what would happen, if we left our greenhouse unattended for several wks without watering the orchids, particularly those without pseudobulbs, probably most, if not all, those orchids in our greenhouse will turn out to be dead. This is exactly what has been happening in the wild. Many forests that were visited again and again over the last 40 years, as a part of study are now barren of endemic orchids, where only colonizing species are seen because they survived due to the nutrients in their reservoirs in the pseudobulbs. Later in the rainy season, the same forests appeared pristine, full of healthy ferns, bromeliads and gesneriads, which have adapted to survive prolonged dry spells, but little or no orchids, have made it through an extended summer. Unfortunately, most conservationists, who have not

visited these forests over several decades, blame the disappearance of the endemic orchids to the practice of commercial orchid collecting, but this is definitely not the case, because even the unwanted and rather common *Stelis* and other species of no commercial value disappeared as well, while other strong orchids of great commercial value were still around.

Desertification is mostly due to the extensive farming in the lowlands, where deforestation, of the forests which were the natural sponge for water resources, is the main cause for the atmosphere to become drier. The winds from the Pacific or the Amazon Basin reaching the Andean Cordillera carry less humidity, where the dry and hot winds burn the orchids to death in a few wks in an extended summer in a single year (Fig. 7). The chain reaction critically affected the local ecosystems and many other species of plants, birds, insects and mycorrhiza went extinct soon thereafter. The third factor endangering the ecosystems worldwide is acid rain produced from forest fires, burning of coal, fumes from factories and exhaust from automobiles (Fig. 8). These emissions form in the atmosphere sulfuric acid, ammonium nitrate, nitric acid and other compounds, which end up deposited dry or wet in all ecosystems with detrimental effects on aquatic life-forms, forests and soil, particularly hitting the micro-organisms like the mycorrhizal fungi. These delicate mycorrhiza are essential for the germination of orchid seeds, in nature and for the provision of increased water and nutrient



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Figs. 9-12. Eco-tourism, an economic engine for conserving ecosystem: Sites in Ecuador including private orchid collections and jungle trails.

absorption capabilities in the root system of almost all plants in nature. The damaging effects of acid rain have endlessly damaged high altitude forests and vegetation cover, since acidic fogs and clouds mostly

encircle them often on a daily basis, all year round. The widespread effects of acid rain on ecological harmony have lead to stunted growth, disappearance of the endemic epiphytes and even death of the forests



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Figs. 13-14. Commercialization and popularization of orchids: 13, Mass propagation of orchids by commercial orchid companies which are later sold and distributed in collections worldwide; 14, A permanent display of orchids in an airport terminal, in Ecuador by Ecuagenera, to promote and educate about them.



Fig.15. The Botanic Garden of Quito conserves as many Ecuadorian orchids as possible, under the guidance and permission of the Ministry of Environment, it has the license to operate the garden annually and is also practicing to obtain new permits to rescue orchids from the wild.

and vegetation cover in certain areas. In view that the acid pollution reaches clouds, which may travel long distances; there is nothing that can be done to shield the orchids from the presence of these acids.

Present Status and Conservation Strategies

To save the various endangered orchid species from extinction, *in situ* and *ex situ* conservation has been fortified. To save the forests, these can be turned into an economic engine to motivate the surrounding human population to keep those ecosystems intact. The fastest and most rewarding industry has been eco-tourism. Three years ago, the central government of Ecuador declared the nation as *The Land of Orchids*, with the intention to facilitate, restrictive legal aspects to promote the necessary education, rescue, cultivation, commercialization and exportation of orchids. In view that in the last decades, innumerable publications have been produced in relation to orchids and the flora and fauna of Ecuador by various private and government institutions, the scientific information related to the incredible value of the endemic species of Ecuador already is in place. It is now a matter to convert these into an economic engine to preserve them.

The prefectures of the 24 provinces of Ecuador have the mandate to promote orchids and related subjects to motivate tourists to visit each province, where each prefecture declared its patrimonial orchid last year and several prefectures started to promote eco-tourist routes and some published the orchid flora of their

province. Considering there are over 500 species in the metropolitan district of Quito, it was established with the Botanic Garden of Quito and the prefecture of Pichincha the Avenue of Orchids with an initial 15 sites in the NorthWest of the province, which includes private orchid collections and jungle trails. Localities like birding and the Avenue of Chocolate have proven to be effective economic engines for the rural population (Figs. 9-12).

In light of the dramatic perspectives for the survival of endemic orchids in the primary forests of Ecuador, many might survive in National Parks and in private reserves, but these actions are not enough to secure the survival of the species inside and outside of these reserves. Contrary to the philosophy of most conservationists, it has been shown that well managed commercial orchid companies may mass propagate in their laboratories, as many species as possible, which are sold and distributed in collections worldwide. The best examples are Ecuagenera, Ecuaflores and Mundiflora, which have installed state of the art laboratories for the propagating of native species from seed or meristems (Fig. 13). These three companies have to obtain periodically from the Ministry of Environment, a permit to collect 5 plants of each species, in specified localities. For anyone, to collect any native plant in the wild is illegal. Collection for commercial or scientific purpose requires a mobilization permit from the agriculture authorities in each province, where the document specifies details of the vehicle, driver, dates of travel and number of intended species to be collected. Without such a permit, any native plant would be confiscated along the road by local controls and legal actions may be taken against the perpetrator. Considering that the commerce of orchid species has a comparatively small market, these companies have to finance their operations with the sale of hybrids and cut flowers, which represent a major percentage of their propagation. Ecuagenera has grown on a weekly basis a minimum of 30 species and have so far reproduced in their lab more than 1800 species, where in many cases one may see in their greenhouses several hundreds of each in bloom and thousands of them in the exhibits, at the World Orchid Conference (WOC). Ecuagenera also has a permanent display of orchids in flower in most airport terminals in Ecuador to promote and educate the beauty of them (Fig.14). Ecuagenera also has purchased two primary forests, which constitute an additional attraction of the orchid tours, which the travel agency of Ecuagenera offers year round.

In the Botanic Garden of Quito, the goal is to conserve as many Ecuadorian orchids as possible, where daily,

the Ministry of Environment is dealt with, for them to allow for maintaining the permit to operate the garden on a yearly basis and continuous lobbying is practiced to obtain new permits to rescue more orchids from the wild (Fig.15).

Conclusion

To reach effective goals, local and international legislation need to be adapted to facilitate these efforts, particularly where these endangered species may be multiplied *in vitro* in laboratories to be distributed worldwide. Unfortunately, governmental authorities of most countries, supported by certain conservation groups who think differently, are tightening the legislation to impede the rescue and multiplication of endangered species. These conservationists who demand that nearly, nobody may be permitted to collect orchids and other endangered species in the wild need to adjust their well-intended actions. In the past two decades, in all the 24 provinces of Ecuador, several dozen eco-lodges have acquired pristine forests, which they are passionately protecting with wonderful paths for the tourists to admire. New regulations should facilitate that these lodges may be allowed to rescue orchids and other ornamental species in the nearby logging areas to grow them in orchid greenhouses and in gardens around their lodges.

Ecuador is fortunate to have well-organized foundations, like the Rainforest Alliance, Conservation International, La Unión Internacional para la Conservación de la Naturaleza (UICN), Fundación de Conservación Jocotoco, Maquipucuna, are amongst others who promote sustainable tourism operations, reduction of deforestation and greenhouse emissions, reforestation enhancing forest carbon stocks, sustainable indigenous forest economy, acquisitions of pristine forests, scientific research and spatial planning for protected areas in response to climate change among other enterprises. Most recently, Marta Kolanowsaka and a team of scientists, social campaigners, and local environmental activists have implemented a Biodiversity Research

Institute, a non-profit organization dedicated to preserve biological diversity, where I have been invited to participate. The initial project is the purchase and conservation of a reserve in Sibundoy, Colombia. Another magnificent and successful conservation program that should be pointed out is of Ecominga, spearheaded by Lou Jost, who has a special interest in conservation of endemic orchids. Ecominga has acquired critical hotspot forests in the province of Pastaza and several more in the province of Carchi, highlighting Reserva Dracula and surrounding areas. These reserves are well managed and protected by Ecominga, where their scientific staff is doing an excellent job with the inventory of the flora and fauna discovering every month new species in orchids and in other families of plants. To conclude, it shall not be considered that international treaties like Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) that will supervise the traffic of orchid species or the Paris Climate Agreement to be implemented in 2020 are favoring the conservation of orchids in the wild as of today, which are threatened to disappear on a daily basis and are outside our control in the immediate future. Renewed efforts can be pooled through private initiatives to conserve the few remaining patches of pristine forests outside the national parks despite the risk than many species will regardless disappear due to acid rain and prolonged dry spells but at the same time, lobby for new legislations to facilitate scientific international research and the rescue of orchids and other endemic species, particularly in areas where it is a public and well-known fact that those pristine ecosystems will be destroyed to be used for agriculture or for hydroelectric dams, roads and other infrastructure.

It is important to emphasize the need to preserve as many pristine forests as possible and rescue as many species, that are to be grown in public and private collections. This must apply for Ecuador, as well as for other hot spots in all other tropical countries where they are all facing the same problems of population growth, acid rain, and climate change.