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Bioprospecting and the Convention on Biological Diversity: an Ecuadorian experience

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SUMMARY

BG is a small bioprospecting group in Ecuador, first established in 1992. Its work to date has been commercial but its aim is to become self sufficient and to make a contribution to the sustainable use and conservation of Ecuadors genetic resources in the spirit of the Convention on Biological Diversity (CBD). An account is given of BG's experience of working with industry and the challenges of working within the remit of the CBD.

[Editor's Note: Since the drafting of this contribution there has been substantial activity regarding the Andean Pact that will affect future operations in Ecuador. The reader is referred to the Guest Editorial, [PY97002](#), for an up-date on these developments].

INTRODUCTION

Ecuador is a small (275.830 km^{^2}) equatorial country in the north western part of South America with a population of approximately 11 million. The Andes run through the centre of the country, north to south, creating three distinct geographical and climatic regions: the flat coastal plain; the Sierra (mountains) and the Oriente (tropical Amazonian basin).

The Sierra has a mean altitude of 2500m and mean temperature of 13 C. Several mountains are permanently snow covered, the highest being Chimborazo (6277m) in the province of Chimborazo. The Indian population represent more than 50% of the total population in some central provinces. These indigenous people are mostly subsistence farmers living at high altitudes; their farming practices are often unsustainable and this is creating severe upland erosion.

The coastal region has a maximum latitude of 800 metres and is flat, hot (max. 35 C) and arid. It represents an important agricultural region for shrimp farming and the production of bananas, coffee, sugar cane and pineapples.

The Oriente has an altitude varying between 300 and 2500m with a warm, humid climate, covered for the most part in tropical forest. A number of studies (Gentry, 1982; Gentry, 1988) indicate that much of the forest covering Amazonia is one of the most species-rich in the world. Indeed, it is estimated that 20% of the world's plant species can be found in Ecuador (Gentry, 1988) and this is largely due to its geographical and climatic diversity.

The Galapagos lie 1000 km from the coast and consist of a group of 13 islands with a unique flora and fauna: these represent a fourth distinctive region.

Social and economical structure in Ecuador has become the focus of increasing interest for foreign industries and institutions because of its floral and faunal diversity, and because it is politically stable. It has a history of progressive and democratic governments who welcome foreign scientists and conservation projects.

However, there is high gross national debt (US\$ 13,200,000,000), considerable poverty, and wide scale environmental destruction caused by poorly regulated foreign and national industries, and unsustainable farming practices. Standards of education are poor: although the Ecuadorian constitution states that 30% of the national budget should be dedicated to education, barely half of this figure is actually given to educational institutions. So although most universities are public, government funding is barely adequate and there are virtually no funds available for research, equipment and trained personnel. The best option for university departments interested in improving standards is to seek funding from overseas.

ESTABLISHING PROJECTS WITH FOREIGN INDUSTRY

The following gives an account of a small bioprospecting group (BG) set up by the Department of Biological Sciences in the Faculty of Natural Resources at ESPOCH (Escuela Superior Politecnica de Chimborazo), Riobamba. Riobamba, capital of the province of Chimborazo, is a city of 120,000, situated at 2800m in the Andes in the centre of Ecuador. ESPOCH is a public university and operates autonomously except for its funding, which is governmental. This means the university independently organises its academic development and can become involved in public and private sector projects both nationally and internationally without government permission.

In 1993 BG established a relationship with company AX, an European private biopharmaceutical company interested in the accession of microbial materials. The relationship was established through a consultant to the company who had many years experience of working in Ecuador. AX had two key reasons for wanting to foster such a relationship: to access microbial and plant samples, and to establish a research base for expeditions to remote regions of the country. Salaries were paid to technical staff, funds were provided to cover refurbishment of the laboratories, provision of equipment, materials and in-house training. The contract included royalty payments in event of significant commercial discoveries. The initial project was for one year, but was sufficiently successful to be continued on a yearly basis until the present time.

The project was one of mutual benefit at the time. It provided a unique opportunity for AX to access a wide range of materials from different parts of Ecuador, and for BG to set up a quality microbial laboratory. Equipment was purchased including communication systems (telephone line to the Department, fax machine and modem), and several staff received training both in-house and in the UK in the isolation, culture and identification of fungi and actinomycetes. The project gave BG the confidence to begin to seek other relationships in Europe and the USA.

At the same time, AX sought similar relationships with institutions in other parts of the world. BG was one of the few significantly successful projects created, and this was largely due to the joint commitment of BG and key personnel at AX who established an informal but effective system of communication. Maintaining close contact was viewed as an absolute priority.

The importance of goodwill needs to be recognised, and was as fundamental to the success of the project as good communications. For BG the relationship with a foreign company represented a unique opportunity to obtain training, and equipment for the laboratory. In a gesture of good will AX made the effort to recognise the special needs of BG, and provided, for example, books and subscriptions to journals. Financial donations, small pieces of equipment and other materials were given to other laboratories in the Faculty in the same spirit.

The project was run autonomously without the intervention of the university administration. The spirit in which it was conducted would have been broadly acceptable to the objectives of the CBD. The contract included training and technology transfer, there was a clause for royalty payments in the event of a significant commercial discovery, and given the needs of BG at that stage, it was mutually beneficial.

The current concern for BG is how to best develop its bioprospecting activities according to the objectives of the CBD. Ecuador signed and ratified in February 1993. A unique characteristic of the Convention is that its provisions are expressed as overall goals and policies, rather than precisely defined obligations (Glowka, 1996), and planning is to be done at the national rather than the international level. But it is still very new, and most countries, including Ecuador, have still to establish clear policies; there are no clear guidelines or bodies from which BG can seek legal or practical advice.

Clauses in the CBD most relevant to BG are articles 12, 16, 17 and 18 (See Appendix).

Education and training (see Article 12, Appendix).

This article is based on the provision by Contracting Parties to provide education and training in measures for the identification, conservation and sustainable use of biological diversity and its components

BG's relationship with AX enabled the group to train in the essential skills of microbial isolation, culture and basic identification, and AX later provided training in the UK to one member of staff. During the last few years BG has been able to train other

members of staff in taxonomy at academic institutions in Brazil and the UK through the help of the Foundation for Tropical Research and Technology Andre Tosello and the British Council.

Recently, BG have experienced a drawback to the industrial training it has received. Personnel trained by AX are required to work exclusively for them in Ecuador. This means that although BG has received training and knowledge, it cannot use it to obtain more business or for other conservation activities; this is not in the spirit of the CBD. Moreover, AX has provided training only in those areas that are specific and relevant to them. This means that the transfer of technology relevant to the conservation and sustainable use of biological diversity (see Article 16 below) has only occurred in a limited way.

However, the value of this initial training opportunity for BG must be emphasised; it provided a unique opportunity for BG to become established as a commercial and non-commercial bioprospecting group.

Technology transfer (see Article 16, Appendix)

This Article concerns the transfer by Contracting Parties of technology relevant to the conservation and sustainable use of biological diversity.

To date BG has worked on projects designed to supply large numbers of microbial cultures. Although this work has required that clients provide the basic training and know-how in field and laboratory isolation, culture and classification, other technology transfer necessary for long term capacity building has not been forthcoming.

Pharmaceutical and agrochemical industries looking for new chemical compounds seek bioprospecting relationships because they need access to raw materials (genetic resources in the form of microbial cultures), but this material is generally regarded as having no commercial value until potentially useful chemical compounds have been discovered. The discovery process involves extensive screening and chemical analysis. To be cost effective and competitive with other sources of chemical compounds, such as combinatorial chemistry, the raw materials need to be cheap, reproducible and available in large numbers. This means that, in general, BG's clients want to buy whole cultures and not fermented extracts, and they do not require value added to the cultures in the form of identification, taxonomy and preliminary selective-screening as this can all be done in house.

There is an impasse here. Bioprospecting groups like BG need to meet the needs of industry and at a price that maintains natural products as a viable alternative to other sources of chemical compounds. But in order to establish a programme for in-situ conservation and sustainable use of microbial resources in the spirit of the CBD, BG needs to establish a culture collection from which they can licence cultures and sell extracts, not the cultures themselves. Contractual obligations can easily ensure exclusivity of extract supply. But the technology transfer, finance and training needed to develop a culture collection and a fermentation capacity are not readily available.

Article 16 (Appendix 1) clearly states that where a Contracting Party is supplying genetic resources, the recipient is obliged to transfer technology which can help the supplier make use of those resources. So, to work within the spirit of the CBD, industry needs to be more progressive and far-sighted in its approach. Indeed, BG points out that transfer of fermentation technology could be in the interests of its clients. The work can be done at a lower cost in Ecuador because of cheaper labour and laboratory costs.

Lyle Glowka (1996) points out that Article 16 could translate into a new global ethic concerning the use of genetic resources and the responsibilities of non-commercial and commercial genetic resource users: a new contract for a new era. In the interim, funds could be made available to such organisations as the World Federation for Culture Collections (WFCC) to enable academics, ex-industrialists or small start-up biotechnology companies to assist in the training and technology transfer needed for bioprospecting groups to establish culture collections and to become self-sufficient.

Exchange of information; technical and scientific cooperation (Articles 17 and 18. Appendix).

Article 18 promotes the establishment of joint research programmes and ventures which are likely to be the most beneficial and sustainable way forward for groups such as BG. Indeed, AX had this in mind in their initial contract with BG; thus salaries were paid rather than payments made on a cost per culture basis. But joint research programmes are not practical until BG has relevant technology to make such relationships attractive to commercial and non-commercial genetic resource users.

The WFCC has recently drawn to the attention of the Conference of the Parties (COP) (WFCC, 1996) the importance of microbial resources, and the role of microorganisms within ecosystems. The promotion of sustainable use of microbial resources and their conservation and exchange of information are likely to stem from the activities of non-commercial groups such as WFCC, at least in the short term.

MECHANISMS FOR IMPLEMENTING THE CBD

Until now, university autonomy in Ecuador has enabled BG to establish relationships directly with foreign commercial partners

without the intervention of government or other administrative bodies. This has been cost effective, and BG and the clients with whom it works are keen to maintain relationships that involve minimum outside involvement. Financial mechanisms could be adopted nationally to minimise deflection of funds and maximise the value of project funding, especially for national conservation strategies. For example, BG currently has a project in which a proportion of the total budget is dedicated to a conservation project. Financial mechanisms could be put in place to supplement these funds or provide tax free incentives. ten Kate (1995) outlines some potential sources of funding for bioprospecting projects.

CONCLUSIONS

BG is now sufficiently experienced to establish mutually beneficial relationships with industry but it has involved a steep learning curve. What works for this group in Ecuador may not work for similar groups in other countries. Moreover, BG had no guidance at the outset about working with industry and was fortunate in that its first partner was non-exploitative and had genuine concern for the interests of the group.

Published guidelines could be of enormous help for both bioprospectors and genetic resource users, providing legal and practical advice on setting up relationships that adhere to the overall objectives of the CBD. Preparation of such guidelines could come under the remit of the IUCN, intergovernmental organisations, or other international institutions who employ legal advisers expert on CBD issues.

Moreover, without experience, it is difficult to estimate the value of a microbial culture or its fermented extract. Guidelines could be prepared for the estimation of value as a proportion of total cost of a particular project, taking into account, salaries, consumables, depreciation of equipment and other maintenance costs.

The interpretation of equitable sharing of benefits, a fundamental theme of the CBD, needs to remain flexible. For new bioprospecting groups royalty payments may be less attractive than donations for conservation projects, upfront payments, donations of equipment and provision of training.

The CBD has raised a global awareness to the potential value of genetic resources and the urgent need to establish programmes for their conservation and sustainable use. Small bioprospecting groups like BG are forming in most countries. But even with the advances of biotechnology and renewed pharmaceutical and agrochemical interest in natural products, it is never likely to be a large market (ten Kate, 1995). The CBD includes obligations that put new demands on industry and it is perhaps inevitable that commercial groups may choose to work with those groups that offer the most attractive service which may sometimes not be in the spirit of the CBD. So, there is an urgent need for widescale promotion of the CBD, to educate industry, governments and non-commercial genetic resource users and suppliers. Although implementation of the CBD is national, countries could usefully cooperate to set standards and codes of conduct; indeed, this has been attempted with the recent Andean Pact (Lyle Glowka, personal communication), and see PY97002.

To date, BG has been financed entirely from commercial sources, but this is not sufficient for the capacity building and technology transfer needed to establish a self-sustaining, profitable group that can make a significant contribution to conservation and sustainable use of microbial resources. Additional investment is needed. ten Kate (1995) points out that trade and private investment to less developed countries is increasing far more rapidly than aid and will continue to do so. Potential sources of funds for bioprospecting projects may include private foreign investment (eg. venture capital, collaborative research and development), national public funds such as environmental taxes, national private funds (eg. venture capital and joint ventures) and multilateral and bilateral aid, ten Kate, 1995).

APPENDIX: RELEVANT ARTICLES FROM THE CONVENTION ON BIOLOGICAL DIVERSITY (1992)

Article 12. Research and training

The contracting parties, taking into account the special needs of developing countries shall:

- a) establish and maintain programmes for scientific and technical education and training in measures for the identification, conservation and sustainable use of biological diversity and its components and provide support for education and training for the specific needs of developing countries;
- b) promote and encourage research which contributes to the conservation and sustainable use of biological diversity, particularly in developing countries, *inter alia*, in accordance with decisions of the Conference of the Parties taken in consequence of recommendations of the Subsidiary Body on Scientific and Technological Advice; and
- c) In keeping with the provisions of Articles 16, 18 and 20, promote and cooperate in the use of scientific advances in biological diversity research in developing methods for the conservation and sustainable use of biological resources.

Article 16. Access to and transfer of technology

1. Each Contracting Party, recognising that technology includes biotechnology, and that both access to and transfer of technology among Contracting Parties are essential elements for the attainment of the objectives of this Convention, undertakes subject to the provisions of this Article to provide and/or facilitate access for and transfer to other Contracting Parties of technologies that are relevant to the conservation and sustainable use of biological diversity or make use of genetic resources and do not cause significant damage to the environment.
2. Access to and transfer of technology referred to in paragraph 1 above to developing countries shall be provided and/or facilitated under fair and favourable terms, including on concessional and preferential terms where mutually agreed, and, where necessary, in accordance with the financial mechanism established by Articles 20 and 21. In the case of technology subject to patents and other intellectual property rights, such access and transfer shall be provided on terms which recognise and are consistent with the adequate and effective protection of intellectual property rights. The Application of this paragraph shall be consistent with paragraphs 3,4 and 5 below.
3. Each Contracting Party shall take legislative, administrative or policy measures, as appropriate, with the aim that Contracting parties, in particular those that are developing countries, which provide genetic resources are provided access to and transfer of technology which makes use of those resources, on mutually agreed terms, including technology protected by patents and other intellectual property rights, where necessary, through the provisions of Articles 20 and 21 and in accordance with international law and consistent with paragraphs 4 and 5 below.
4. Each Contracting Party shall take legislative, administrative or policy measures, as appropriate, with the aim that the private sector facilitates access to, joint development and transfer of technology referred to in paragraph 1 above for the benefit of both governmental institutions and the private sector of developing countries and in this regard shall abide by the obligations included in paragraphs 1 ,2 and 3 above.
5. The Contracting parties, recognising that patents and other intellectual property rights may have an influence on the implementation of this Convention, shall cooperate in the regard subject to national legislation and international law in order to ensure that such rights are supportive and so not run counter to its objectives.

Article 17. Exchange of Information

1. The Contracting Parties shall facilitate the exchange of information, from all publicly available sources, relevant to the conservation and sustainable use of biological diversity, taking into account the special needs of developing countries.
2. Such exchange of information shall include exchange of results of technical, scientific and socio-economic research, as well as information on training and surveying programmes, specialised knowledge, indigenous and traditional knowledge as such and in combination with the technologies referred to in Article 16, paragraph 1. It shall also, where feasible, include repatriation of information.

Article 18. Technical and Scientific Cooperation

1. The Contracting Parties shall promote international technical and scientific cooperation in the field of conservation and sustainable use of biological diversity, where necessary, through the appropriate international and national institutions.
2. Each Contracting Party shall promote technical and scientific cooperation with other Contracting Parties, in particular developing countries, in implementing this Convention, inter alia, through the development and implementation of national policies. In promoting such cooperation, special attention should be given to the development and strengthening of national capabilities, by means of human resources development and institution building.
3. The Conference of the Parties, at its first meeting, shall determine how to establish a clearing-house mechanism to promote and facilitate technical and scientific cooperation.
4. The Contracting Parties shall, in accordance with national legislation and policies, encourage and develop methods of cooperation for the development and use of technologies, including indigenous and traditional technologies, in pursuance of the objectives of this Convention. For this purpose, the Contracting Parties shall also promote cooperation in the training of personnel and exchange of experts.
5. The Contracting Parties shall, subject to mutual agreement, promote the establishment of joint research programmes and joint ventures for the development of technologies relevant to the objectives of this Convention.

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The Convention on Biological Diversity, and details of the most recent activities of the Conference of the Parties can be obtained on the Internet.

URL <http://www.unep.ch/bio/conv-e.html>

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