twas

The National Institute of Biodiversity

SANTO DOMINGO DE HEREDIA, COSTA RICA

INBio

EXCELLENCE IN SCIENCE

Profiles of Research Institutions in Developing Countries

PUBLISHED WITH THE SUPPORT OF

the David and Lucile Packard Foundation

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Published by TWAS, the academy of sciences for the developing world,
with the support of the David and Lucile Packard Foundation

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Foreword

Founded in 1983 and officially launched in 1985 in Trieste, Italy, by the secretary general of the United Nations, TWAS, the academy of sciences for the developing world, is dedicated to the promotion of scientific excellence and research capacity in developing countries.

With an initial membership of 42 'Founding Fellows', TWAS now counts 880 eminent scientists in 90 countries among its members. More than 85 percent of these scientists live and work in developing countries. This membership not only gives the Academy insight into the state of science in developing countries, but also provides a unique network of individuals and institutions through which the Academy can coordinate its activities.

Among these activities are annual TWAS Prizes designed to honour scientists in the South for their outstanding work in the fields of agriculture, biology, chemistry, earth sciences, engineering sciences, mathematics, medical sciences and physics. TWAS Prizes help bring the achievements of scientists working in the South to the attention of their national governments, providing them with a rare opportunity for recognition in their home countries. TWAS also offers research grants to individual scientists working in developing countries, as well as to research groups based in the world's least developed countries (LDCs) and other science- and technology-lagging countries. In addition, in

collaboration with the governments of Brazil, China, India and Pakistan, TWAS oversees the world's largest South-South fellowship programme. Under this scheme, young scientists from one developing country visit participating institutions in another developing country – particularly those mentioned above – to further their research, often by having access to equipment and materials not available at their home institution.

Institutions of scientific exellence in the developing world are included in a unique resource book, *Profiles of Institutions for Scientific Exchange and Training in the South*, produced jointly by TWAS and the Commission of Science and Technology for Sustainable Development in the South (COMSATS), based in Islamabad, Pakistan. The fourth edition of this book, published in 2007, lists 485 such institutions located in 65 different countries in the South and outlines their main scientific achievements, facilities and future plans.

Despite the perception that science in the South is lagging behind science being carried out in laboratories in the North, these 485 institutions provide evidence that top-quality research can be carried out in developing countries. And with a growing consensus that indigenous capacity in science and technology drives sustainable economic development, there is a need for more countries in the South to build their own scientific infrastructure – in terms of both human and institutional resources.

The purpose of this series of TWAS publications, which has been generously funded by the Packard Foundation, is to provide details about individual 'centres of excellence', including how they developed, how their research programmes are organized, their achievements, their strengths and weaknesses, and – most important – how they can

act as a model that other governments and organizations can follow when considering building scientific capacity. In this way, we hope the series will form a 'blueprint for a centre of excellence' that can be used by policy-makers and those involved in the administration of national science policies.

The choice of which institutions to include in the series was difficult. However, it was felt that if the selected institutions all focused on a similar research area, then comparisons between institutions and countries would be simplified, making it easier to draw valid conclusions once several institutions have been studied. We have therefore taken advantage of the existence of a network of institutions created thanks to a programme originally operated by the Third World Network of Scientific Organizations (TWNSO), a TWAS-affiliated organization also based in Trieste and recently transformed into the Consortium on Science, Technology and Conservation for the South (COSTIS), which focuses on indigenous and medicinal plants and the conservation and sustainable use of biodiversity. Despite the common theme, the institutions profiled in this series cover a wide range of activities, from the scientific validation of traditional medicines to the use of modern biotechnology. Taken together, however, these institutions are representative of a cross-section of countries in the South. They have also been instrumental in taking indigenous resources – in terms of local biodiversity – and transforming them into profitable commercial products available on local and international markets. In this way, these institutions are excellent examples of how capacity in science and technology can lead to innovation and socio-economic development.

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Introduction and History

Costa Rica, which in Spanish means 'rich coast', is a small, reed-like nation of endless beauty and allure.

Emerald coasts drape both the Atlantic and Pacific Oceans, offering ever-changing vistas of the sea, sky and land. Lush rain forests cut across the landscape at elevations that rise to nearly 4,000 metres, creating a stark, imposing contrast between the green-tipped treetops above and the rugged, shadowy terrain below. More than 100 extinct and active volcanoes pockmark the countryside, lending muted streaks of grey and red to a magical terrain where nature's colourful palette is always on full display.

Not surprisingly, Costa Rica, which is home to untold exotic plant and animal species, has earned an international reputation as an earthly paradise. The nation, which is 465 kilometres long and no more than 275 kilometres wide at any one point, covers some 50,000 square kilometres. That is just 0.3 percent of the world's total landmass. Yet, Costa Rica, which serves as a land bridge between North and South America and enjoys expansive territorial waters in both the Atlantic and Pacific Oceans, is home to an estimated 500,000 species, including 40,000 species of beetles and 20,000 species of butterflies. That is more than 4 percent of the total number of species on Earth, and more than twice the estimated number of species on the continent of Europe.

Costa Rica's treasure trove of natural beauty and rich biodiversity is more than a source of wonder and beauty: it also provides a potential source of income. And that potential is increasingly being realized, thanks in large measure to policies that view the nation's natural bounty as both ecological and financial assets.

INBIO – THE NATIONAL INSTITUTE OF BIODIVERSITY

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In the 1980s, this 'small green' Central American nation faced an environmental crisis of its own making. Nearly one-third of its forests had been cut down during the previous 30 years as part of a concerted effort to boost the economy by harvesting timber and clearing land for agricultural cultivation. That amounted to a greater loss of forests than the previous 450 years combined, reaching back to the time of the early European explorers. The destruction of the forest, of course, meant the destruction of habitat. And that, in turn, undermined the nation's natural beauty and threatened its biodiversity.

A group of enlightened public officials and scientists realized that the rapid pace of deforestation was unsustainable and that a new course of action would have to be taken. Their thinking, while largely shaped by national events, was also nurtured by a broad and growing array of international developments and documents that together constituted a paradigm shift in conservation theory and practice.

In 1980, the *World Conservation Strategy* – drafted by the World Conservation Union (IUCN), the United Nations Environment Programme (UNEP) and the World Wildlife Fund (WWF) – introduced the term 'sustainable development' and contended that conservation strategies should be tied to development. Seven years later, the Brundtland Report, *Our Common Future*, expanded upon these ideas.

Traditional 'preservationist' approaches had sought to protect individual landscapes and species from human use in national parks or wildlife reserves. In contrast, the concept of 'sustainable use' recognized that, in the developing world at least, people often depended upon local biological resources for their survival. What was needed, therefore, was to encourage them to recognize their real value and to use them sustainably.

> *Costa Rica is home to an estimated 500,000 species, more than 4 percent of the total number of species on Earth.*

Then and now

The *Instituto Nacional de Biodiversidad*, or National Institute of Biodiversity (INBio), was one of the key organizations to take shape as part of this welcomed trend to build a more sustainable future. Its stated mission was, and remains, "to promote a greater awareness of the value of biodiversity as a means of ensuring its conservation and improving the quality of life".

KEY PERSONNEL

RODRIGO GÁMEZ-LOBO, president

• *Rodrigo Gámez-Lobo has served as the president of INBio since its inception. He was also the first and only director-general until December 2003. Under his tenure, INBio grew from a lofty concept that first took shape in a small converted warehouse in the outskirts of San José, Costa Rica, into an internationally renowned science centre staffed by some 175 people. Beyond his path-breaking work at INBio, Gámez-Lobo has been involved in many wide-ranging international and national initiatives. He was the Costa Rican government's delegate at the negotiations of the UN Convention on Biological Diversity in 1991–1992. He served as the coordinator of the National Biodiversity Advisory Board, established by Costa Rica's Minister of the Environment, from 1994 to 1998, playing an advisory role in the drafting of both Costa Rica's National Biodiversity Law and the National Biodiversity Strategy. As an advisor to President Oscar Arias from 1986 to 1990, Gámez-Lobo spearheaded the process leading to the creation of the National System of Conservation Areas, which have helped make Costa Rica a world leader in conservation policy.*

Gámez-Lobo earned a PhD in plant virology and botany from the University of Illinois (USA) in 1966 and was a research professor at the University of Costa Rica from 1958 to 1990, where he also assumed a wide range of administrative responsibilities, including head of the School of Plant Sciences, vice rector for research, and director of the Cellular and Molecular Biology Research Centre. His scientific publications have focused on viruses of basic food crops in Centra America, insect transmission of plant viruses and the molecular characterization of viruses. Gámez-Lobo has won numerous awards for both his scientific and administrative accomplishments, including the Organization of American States' (OAS) Bernardo Houssey Prize in Science.

"We were motivated", says Rodrigo Gámez-Lobo, founding president of INBio, "by the belief that the creation of protected areas – national parks, forests and wildlife reserves – would not be enough to save Costa Rica's land and resources".

Instead, the group concluded that more comprehensive strategies for sustainable development would have to be devised and implemented. Such strategies, they reasoned, would fully recognize that conservation and consumption were part of the same 'balanced' equation and that progress in the promotion of sustainable economic development would largely depend on tapping the best available scientific information to help ensure that people could live securely and comfortably in the present without jeopardizing the well-being of future generations.

Many of INBio's founders were university-trained researchers who were employed at institutions of higher education and who deeply valued the contributions that such institutions make to society.

"INBio's mission is to promote greater awareness of the value of biodiversity."

ALFIO PIVA-MESÉN, executive director

• *Alfio Piva-Mesén was appointed executive director of INBio in 2003. Before assuming the institute's top executive post, he had served as advisory general-director of INBio for 12 years. Piva-Mesén led efforts to reorganize the organization's bio-inventory programme, melding the organization's well-respected surveying and information processing techniques to the new communication technologies. Piva-Mesén also played a key role in the creation of INBioparque.*

He has served as the president of the National University of Costa Rica and the National Council for Scientific and Technological Research of Costa Rica (CONCIT), president pro tempore *of the National Council of Rectors (CONARE), dean of the faculty of health sciences and professor of physiology at the school of veterinary medicine at the National University of Costa Rica. He has published and lectured widely in Costa Rica and abroad, and has won numerous awards, including the Grande Ufficiale della Republica Italiana, bestowed by the president of Italy. Piva-Mesén earned a PhD in veterinary science from the University of Parma (Italy) in 1963 and pursued post-doctorate studies in animal physiology at the University of Milan (Italy).*

Yet, as Gámez-Lobo observes, "we were driven by the belief that universities would not be the right places to pursue INBio's goals". Institutions of higher education, in their minds, were too individualized and too discipline-oriented to successfully pursue the strategies that they had in mind. "In a display of what others might justifiably say was naivety and arrogance," Gámez-Lobo notes, "we came to the conclusion that we would have to do this ourselves and in our own way".

A modest grant of US$85,000, approved by the Federation for National Parks in Costa Rica in 1989, got INBio off the ground. From these humble beginnings, the institute has grown into a large international organization with a staff of nearly 175 (including 40 scientists) and an annual budget of approximately US$6 million. Today, approximately 25 percent of INBio's annual budget is derived from external sources provided by foundations and funding agencies that include the Netherlands Development Assistance (NEDA), the World Bank, the Inter-American Development Bank (IDB) and the United Nations Development Programme (UNDP). Slightly less than 70 percent of the annual

budget comes from income-generating sources, which include its bioprospecting partnerships, revenues from INBioparque, book sales and fees for consulting services. Finally, just under 10 percent of the annual budget comes from 'special projects' – that is, projects managed by INBio that include, for example, the purchase of computers for schools, for which the institute earns administration fees.

Those who founded the organization – a core group led by Gámez-Lobo, internationally renowned University of Pennsylvania ecologist Daniel Janzen and executive director Alfio Piva-Mesén, and which at no time exceeded 12 individuals – agreed upon the guiding principles that have characterized the work of INBio ever since.

"We believed", says Piva-Mesén, "that the principles we established at the institute's inception for advancing our overall goals were not only critical for the sustainable development of Costa Rica but also for the very survival of the organization. These principles were based both on a vision of a better future and on practical considerations of critical significance to the well-being of INBio".

"The driving principle", says Gámez-Lobo, "was that our organization had to pursue objectives that were pertinent to society". INBio is neither a governmental agency nor a university. This means it has neither a guaranteed annual budget nor a precisely defined set of responsibilities designed as part of the government's overall environmental policies.

"It is an organization", says Piva-Mesén, "whose relevance – and, ultimately, longevity – is largely determined by the people of Costa Rica and our external funders, and their willingness to value and support our activities".

> *"INBio is neither a governmental agency nor a university."*

The quest for relevance, notes Gámez-Lobo, "did not, of course, minimize our quest for scientific excellence". However, it does mean, he says, that INBio's world-class research must be useful to society and adaptable to its needs; that the organization must be responsive to its clients and efficient in its operations; and that it must seek ways to leverage its own expertise through collaborations with other institutions as a means to extend both its impact and visibility.

It also means that INBio has always had to keep more than one target audience in mind as it pursues its multifaceted goals. There are politicians and funders, students and teachers, resource managers and scientists, and representatives of the national and

international media. All of these audiences – constituents, if you will – must be addressed and considered in INBio's efforts to meet society's needs and expectations for the preservation and sustainable use of biodiversity. Indeed, before the term was coined, INBio had set out on the path directed by what is now referred to as 'demand-driven' science.

When asked what are the main factors in the institute's success, Gámez-Lobo cites two: First, "INBio does not work alone." The organization, he explains, "works in close collaboration with partners, both persons and institutions, from Costa Rica and outside the country, and from the public and the private sectors." The second factor, he says, is "a skilled working team highly committed to INBio's mission and vision".

Less than two decades after its inception, INBio has emerged as one of the leading organizations for biodiversity conservation and management, not only in Costa Rica, but throughout the world.

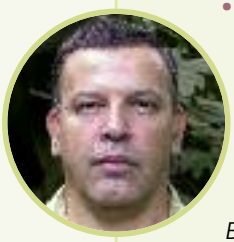
What INBio Does

INBio's principal mandate is to promote public awareness of the value of biodiversity in Costa Rica and, in this way, to ensure its conservation and sustainable use. The different sectors of society, INBio's administrators and scientists reason, will only choose to conserve biological resources if they are persuaded of both their intrinsic and material value.

Fundamentally, INBio is about information. Although it made its reputation by generating and processing information – namely, through its taxonomic surveys – the institute recognizes that, ultimately, such information, if it is to serve its purpose, must be shared with the public.

As Alonso Matamoros, INBio's director of Institutional Planning, notes: information "must be developed when it's needed (that is, it must be timely) and produced in the form it is needed in (that is, it must be accessible). Sometimes that means a 25-page

ALONSO MATAMOROS, director of Institutional Planning



Alonso Matamoros is INBio's director of Institutional Planning, where he is responsible for strategic and operational planning and for designing training activities at INBio. He also serves as the coordinator of the 'Development of Biodiversity Resources' project, which is executed by INBio in cooperation with the Ministry of Environment and Energy's (MINE) National System of Conservation Areas (SINAC).

Before coming to INBio, Matamoros managed the Parque Nacional Tortugero, supervised the forest areas of Guanacaste and Esparza national parks, and headed the Office of Planning at the National Park Service, where he helped launch the National System of Conservation Areas (SINAC). He has participated in operational planning processes in the Ministry of Agriculture and Livestock, and played a key role in the formulation of Costa Rica's conservation and sustainable development strategy for forests and protected areas in the late 1980s. He has also lent his expertise to conservation planning in Honduras, Nicaragua and Ecuador. Matamoros holds an MSc degree in natural resource planning from the Centro Agronómico Tropical de Investigación y Ensenanza, and a BSc degree from the National University of Costa Rica.

fully cited scientific report; other times, a one-page executive summary containing five bullet-point paragraphs".

INBio adopted as its motto the phrase 'save, know, use', from the *Global Biodiversity Strategy*, drafted by UNEP, IUCN and the World Resources Institute (WRI) in 1992. These three little words neatly express its philosophy: to save and sustainably use biological resources, one must possess the necessary knowledge; and to justify saving them, the resources must be used. (Although 'use' need not mean 'consume'.)

The organization seeks to achieve these goals through a diverse set of activities that includes:

- species inventory and monitoring (to date, INBio staff have collected and identified more than 3 million species);
- communication and education (it oversees the management of a biodiversity park, INBio Editorial and a broad range of training courses);

- conservation (information generated by INBio is used in decision-making processes concerning the protection and sustainable use of biodiversity in both the public and private sectors);
- state-of-the-art research initiatives that draw on such cutting-edge science and technology as bioinformatics and geographic information systems; and
- bioprospecting, often conducted with both public- and private-sector partners, as part of a larger effort to broaden the institute's financial base without compromising its research agenda.

"To save and sustainably use biological resources, one must possess the necessary knowledge."

INBio's Future Past

Although INBio was initially proposed as a government agency, the government ultimately decided against creating such an organization, citing budgetary limitations as well as the bureaucratic constraints that would likely prevent quick responses to Costa Rica's urgent environmental challenges.

Thus its proponents devised a scheme for a non-profit, non-governmental organization that would have close ties to government but nevertheless operate independently and rely largely on aid agencies, foundations and private sources of funding for its financial well-being.

This initial decision was a bold, unprecedented step in Costa Rica and, more generally, a first for the region, where government has historically served as the sole source of support for environmental endeavours.

More significantly, it was a decision taken at great risk and which cast a shadow over the future of the yet-to-be-born institute.

Without government backing, where would the money to support such an organization come from? Would international aid agencies step in and fill the void? How would members of the core group, all of whom had other positions and responsibilities, find the time to write proposals and do the necessary lobbying to convince funding agencies that the concept merited their investment? Would hopes of enticing the private sector prove unrealistic? Would well-trained scientists be willing to work for a research centre that offered more hope than resources? In short, without a visible means of support, a permanent full-time staff, or even a place to call home, how could the organization ever succeed?

Despite the risks (or perhaps because of them), the organization's independent status has, over the long run, enabled INBio to remain responsive, flexible and effective. On the downside, it has also made fund-raising and budgets a constant preoccupation.

As Gámez-Lobo notes, "our non-profit status is one of the primary sources of our strength. If we were part of the government, we would not be able to move so swiftly or so responsively".

"While not having a government sponsor has been a source of constant anxiety", he adds, "it has also kept us on our toes. Governmental status may have provided a guaranteed source of funding and peace of mind, but over the long term it would likely have come at a price that may well have depleted the very energy and drive that helps account for our success".

"Our non-profit status is one of the primary sources of our strength."

How INBio Works

Species surveys and collections

INBio's taxonomical work remains at the centre of its mandate and its most noteworthy activity in the view of the international scientific community.

Indeed INBio's reputation is based largely on its expert ability to collect and catalogue Costa Rica's rich biodiversity. Three taxonomic units (fungi, arthropods and plants) lie at the heart of the organization's scientific efforts. Additional units – in bioprospecting, bioinformatics, geographic information systems and training – aid these efforts.

To date, INBio has collected, identified, catalogued and labelled more than 3 million species. The institute's vast collections make it one of the world's largest and most important organizations conducting this kind of work.

PUBLISHING AND TRAINING

• As part of its strategy to make the information it generates available to the wider public, INBio operates its own publishing house. Drawing largely on data, information and issues that drive the institute's programmatic agenda, it has, to date, produced more than 90 monographs, as well as 11 children's books. INBio sells some 14,000 books a year. Among the titles published by Editorial INBio are Timber Trees of Costa Rica, Birds of Tapanti National Park, Biodiversity in Costa Rica *and* Costa Rican Mammals. *Children's books include* Tropical Insects, Tales of the Tropical Forest *and* Understanding Biodiversity. *INBio also sponsors and offers training activities – conferences, workshops, courses, internships, field trips, a speakers bureau and tours – which are designed to build the scientific and managerial capacity of both individuals and institutions on issues related to biodiversity. It oversees more than 250 training courses a year on a variety of subjects. Annual attendance at these events totals nearly 5,000.*

SNAPSHOTS

> *INBio has collected, identified, catalogued and labelled more than 3 million species.*

In the late 1980s and early 1990s, the Norwegian Agency for Development Cooperation (Norad) provided funding for devising the survey methodology and strategy and for organizing the initial workshops that have made this work possible. Subsequent grants from Norad, the Global Environment Facility (GEF) and the Danish International Development Assistance (Danida) have enabled INBio to substantially expand the effort. All told, the initiative has received some US$21 million.

Even in this most conservative of scientific pursuits, which at its core is based on painstaking observation and attention to detail, INBio's inventorying efforts have proven to be innovative. Early on, INBio decided to turn to local citizens as a valuable resource in the collection and cataloguing of new species. Gámez-Lobo and Daniel Janzen conceived of the idea of training lay people to be what they would call 'parataxonomists' (modelled on the concept of 'paramedics').

"We realized", explains Gámez-Lobo, "that we had set an enormous task for ourselves, and that it would be difficult to sustain this effort – both in terms of personnel and finance – over the long haul. So we concluded we had no choice but to try to turn our resource-limiting liabilities into long-term assets by asking citizens to join us".

In deciding to solicit public help to accomplish one of its fundamental goals, INBio sought to achieve another goal as well. "From the beginning", says Gámez-Lobo, "the institute has been dedicated not just to pursuing excellence in science but also to garnering public support for our efforts and to educating the public about the value of biodiversity conservation and use. We were convinced that the best way to move forward on all of these fronts would be to engage the public in our activities".

After a rigorous selection process, the new recruits received six months' training, based on a curriculum specially designed to teach non-scientists how to effectively conduct the fieldwork necessary for the collection of a diverse set of species. To date, INBio has given five parataxonomy courses, training more than 100 individuals who have worked for INBio at different times over the past 18 years. Currently, the institute employs seven parataxonomists in the field and two who work as laboratory technicians.

With their invaluable assistance, INBio has managed to find, over the past decade, an average of one new species every three days. Over the past three years, the average discovery rate has been approximately one new species a day – proof positive that scientists and lay citizens can work together to achieve a common goal of high social and ecological value.

The institute has also forged strong partnerships with 300 professional taxonomists worldwide, both to provide training and to help identify the species that are collected. INBio estimates that the value of their voluntary services has amounted to more than US$40 million over the past two decades. And, of course, the organization has its own small staff of scientists and technicians as well.

Biodiversity Informatics

To better organize and access the information that has been collected, INBio created Atta, an innovative computer-based system designed to facilitate the process of assembling, managing and generating information on Costa Rica's rich biodiversity – its plants, insects, molluscs, arachnids, fungi, lichens, nematodes and vertebrates.

The Atta system contains a database with more than 3.5 million records, each corresponding to a specimen collected by one of INBio's parataxonomists. Through a barcode label attached to each specimen, users of Atta can access the associated digital information. This includes where, when and how the specimen was collected, as well as who collected it. When the identification process is finished, a complete taxonomic description is added. Atta allows this information to be cross-referenced with such ecological information as forest cover, precipitation patterns, soil type and temperature variations.

The system, which has been funded by Norad, the Dutch government and the GEF, has led to the creation of a series of ecological guidebooks that have facilitated the analysis and application of critical interrelated information historically stored in different places. In addition, Atta provides a framework for a digital publication system enabling a worldwide information exchange on Costa Rica's rich biodiversity. It has become a vital tool for biodiversity conservation and use.

INBio's biodiversity informatics unit, which was launched in 1996, employs five software developers and three graphic artists. It took four years to develop Atta, which is not only devoted to digitally storing information and making it easily accessible to researchers across the globe, but also to developing videos and computer games that will allow it to serve as a learning device for those interested in ecology and biology, especially in Costa Rica.

The effort depends in part on the development of digital maps that provide detailed data, generated by a geographic information system (GIS), concerning forest cover and other ecological features. Such data can be cross-referenced with species' migration patterns that have been detected by INBio's team of surveyors.

"We began developing 'eco-maps' immediately after the department launched its operations, and received valuable support from Norad, the Dutch government and the GEF to pursue our goal of providing full country coverage of Costa Rica at a 1:50,000 scale", says Erick Mata, director of INBio's Biodiversity Informatics programme.

The maps, he believes, will have to be revised every two years to ensure that those who use the service have up-to-date information to work with. Mata estimates that the biannual updates will cost about US$100,000 to cover the expense of salaries, fieldwork and software programming. He is now searching for possible funders and also seeking to devise a 'user-pay' strategy that he hopes "will generate funds without stifling demand".

KEY PERSONNEL

ERICK MATA, director of Biodiversity Informatics

• *Erick Mata is INBio's director of Biodiversity Informatics. He came to INBio as the information management coordinator in 1995, where he was in charge of coordinating all biodiversity informatics projects, including: the development of Atta; the use of multimedia technology to develop CD-ROMs for children; and the implementation of ECOMAPAS, a project focusing on ecological data collection and mapping of the distribution of ecosystems and their vegetation in Costa Rica.*

Mata is an associate professor at the Costa Rica Institute of Technology. He has chaired the Outreach and Capacity-Building Scientific Subcommittee of the Global Biodiversity Information Facility (GBIF) and participated in such national and international biodiversity informatics initiatives as EOL (Encyclopedia of Life) and IABIN (Inter-American Biodiversity Information Network). Mata was awarded the 2004 Premio al Mérito Informático prize by Costa Rica's Computer Scientists Professional Association. He obtained his MSc and PhD in Computer Science from the University of Oregon, in 1986 and 1990, respectively, and his BSc in Computer Science from the University of Costa Rica in 1980.

Bioprospecting

Biodiversity prospecting, or 'bioprospecting', is the systematic search for chemical compounds, genes and micro- and macro-organisms that could lead to the development of products and services in pharmaceuticals, agriculture, biotechnology and other fields.

Because a useful compound or gene discovered in, say, a fungus on a leaf can yield greater financial returns than the logging or planting of whole swathes of forest, bioprospecting can be considered sustainable use *par excellence*. And it fits well with INBio's principles of 'save, know, use': Prospecting for 'biochemical gold' promotes the idea of the hidden value in biodiversity and thus the importance of conserving and studying it.

For these reasons, bioprospecting is an essential component of INBio's conservation strategy. Indeed, the institute has been a pioneer in the field. Its goal has been to plough any profits from the activity back into its research and conservation efforts.

INBio instituted its bioprospecting programme in 1991. In the same year, it made international headlines when it signed a research collaboration agreement with the pharmaceutical giant Merck. The path-breaking deal was widely hailed as an example of how to achieve the 'equitable sharing of benefits' that would be called for the following year in the Convention on Biological Diversity (CBD) at the 'Earth Summit' in Rio de Janeiro, Brazil.

Whereas in the past, firms looking for interesting compounds would simply go to developing countries and take them, the CBD seeks to ensure that countries in which valuable genetic resources are discovered receive a portion of the profits from any products derived from them. The INBio-Merck deal was the first time this principle was applied, and as such it had a significant influence on the CBD.

> *"Sustainable development needs to be centred on people."*

Under the agreement, INBio supplied Merck with thousands of samples of plants, insects and soils. The pharmaceutical company was given exclusive rights to study these for two years, as well as to retain the patents to any drugs that might be derived from them. In return, Merck paid INBio US$1 million up front to cover the costs of its surveying and research efforts. It also provided INBio with US$190,000 worth of laboratory equipment and agreed to pay the institute 50 percent of any royalties from drugs developed out of the partnership. These funds were to be channelled to Costa Rica's Ministry of Natural Resources for investment in biological conservation programmes.

Merck also agreed to help train INBio personnel in the most advanced technologies used for bioprospecting. Such training would have been prohibitively expensive for INBio, given its budget constraints.

To date, INBio has signed bioprospecting agreements with more than 40 organizations, including the firms Bristol-Myers Squibb, Eli Lily, Diversa (now Verenium Corporation), Givaudan-Roure, British Technology Group and Indena, as well as several universities and research institutes.

"INBio has signed bioprospecting agreements with more than 40 organizations."

ANA LORENA GUEVARA, director of Bioprospecting

• Ana Lorena Guevara has managed INBio's Bioprospecting unit since 1999, spurring a broad expansion of the organization's bioprospecting efforts. During her tenure, Guevara has overseen the 'Support to the Use of Biodiversity by Small Entrepreneurs' programme funded by the Multilateral Investment Fund (MIF) of the Inter-American Development Bank (IDB). The programme has generated the first royalties stemming from a product jointly developed with a local company.

Before coming to INBio, she worked in a variety of positions with Costa Rica's Ministry of Agriculture, including as a forestry researcher and certifying seed agent. In the 1990s, she was the executive director of the National Seeds Office and coordinator of the Phytogenetic Resources Area. She has held leadership positions in several conservation committees, including the National Commission of Phytogenetic Resources, the National Commission of Research and Technology Transfer, and the Advisory Committee of the Latin American Fund for Irrigated Rice (FLAR). Guevara earned an engineering degree with a specialization in agronomy in 1985, and a master's degree in management of international trade in 2005 from the National University of Costa Rica.

In 1999, under a joint programme with the Inter-American Development Bank (IDB) to promote the use of biodiversity by local small enterprises, INBio collaborated with six Costa Rican firms, including La Gavilana (to develop eco-friendly techniques for vanilla cultivation) and Lisan Laboratories (to develop pharmaceutical products based on medicinal plants).

Yet, for all of this effort, bioprospecting returns have been disappointing. Among the few industrial products to have been developed are a fluorescent protein for tagging the movement of molecules during industrial research for new materials, and an enzyme for processing cotton, both by the US biochemical firm Diversa.

Only two products – both natural remedies developed with Lisan – have been marketed at the retail level: Q-assia, for indigestion, and Estilo, for anxiety and insomnia. Both are sold over the counter in pharmacies in Costa Rica and throughout Central and South America (see *Commercial dreams*, p. 32). Again, royalties have been modest.

COMMERCIAL DREAMS

• INBio's ongoing search to find ways to profit from its research without compromising its research agenda led it to forge a partnership with Lisan Laboratories, the third-largest drug company in Costa Rica.

Lisan is a 25-year-old family business that began producing generic drugs in the 1980s. At the time, the nation's pharmaceutical firms were protected from international competition by high tariffs. "When the tariffs were eliminated", says Rodolfo Carboni, Lisan's president, "the nation's pharmaceutical firms found themselves facing an insecure future, and many could not survive". Indeed, the number of pharmaceutical companies fell from 22 to 12 between the mid-1980s and the mid-1990s. "Lisan's initial defence", Carboni says, "was to market products in neighbouring countries. Several years later", he continues, "we moved into the development and sale of natural products. This was a new line of business for us, for which adopted a new name – Lisanatura".

In 1999, Lisan signed an agreement with INBio that it hoped would help give it an advantage in its competition with international companies. "We thought that to enter the international market, it might be good to begin by thinking locally and drawing on the vast potential for natural products derived from Costa Rica's vast biodiversity".

Lisan wanted to produce a standardized product, which could be subject to stringent quality controls, and, for this, it needed INBio's expert help in analysing a number of medicinal plants, native species grown locally. Under the agreement, INBio performed the chemical analysis to identify and then isolate the active compounds in the plants.

Lisan, in turn, assumed responsibility for the clinical studies and trials, registration and marketing. To engage in this effort, INBio not

only received some financial backing from Lisan but also secured a loan from the Inter-American Bank (IDB). Indeed 20 percent of the cost of the project was covered by Lisan, 30 percent by INBio and 50 percent by the loan.

Two commercial products have emerged thus far from this partnership: Q-assia tablets, a digestive aid derived from bitterwood (Quassia amara) *extracts, for indigestion and stomach cramps; and Estilo tablets, derived from 'fresh cut'* (Justicia pectoralis), *a natural sedative, for stress, anxiety and insomnia. Carboni notes that Q-assia has similar medicinal qualities as Alka-Seltzer, which has been a big seller in the United States for decades.*

The effort at commercialization has not been as smooth as either Lisan or INBio had hoped. Initial projections anticipated that the product would take one year to bring to market. It took three years instead. Sales through 2006 have been somewhat disappointing – about 1,200 to 1,500 boxes a month – and confined largely to Costa Rica and neighbouring countries.

Nevertheless, Carboni is philosophical about the initiative, pointing with pride to the fact that it has been a locally based effort, using local extracts. Lisan is eager to pursue other projects as well. Clinical trials are now underway on two new natural products: an anti-inflammatory gel for gingivitis and mouth sores, and a cream for sunburn and skin irritations.

And while Merck is said to have found many of the compounds it screened to be promising, in the end no products were developed.

"The inability to produce a number of commercial products from this joint venture", says Ana Lorena Guevara, director of INBio's Bioprospecting unit, "does not mean INBio failed to derive significant benefits".

In fact, she notes, in addition to providing INBio with laboratory equipment and valuable training, Merck contributed funds totalling US$3.5 million for INBio's capacity-building and conservation initiatives in the Guanacaste Conservation Area on the northwest Pacific coast and other sites. Moreover, it helped INBio staff gain valuable experience in managing projects designed to achieve commercial output. INBio, says Guevara, "now highlights this experience when seeking to collaborate with other research institutions and private companies. We are particularly keen to make this experience known to potential funders".

INBio's track record reflects both the promise and the pitfalls of bioprospecting, especially efforts that seek to combine the diverse talents of product-oriented corporations and research-oriented institutions. It also underlines the odds against discovering a compound that will lead to the next blockbuster drug.

Nevertheless, thanks to its collaboration with Merck and other firms, INBio has managed to set itself up as a respected partner in the bioprospecting business, acquiring the requisite skills, experience and equipment.

INBioparque

INBioparque, a five-hectare biodiversity park located at the edge of the institute's administrative headquarters, opened in February 2000.

The idea to build a botanical garden designed for public enjoyment and education was inspired by a visit, in 1998, by Spain's Prince Felipe to Central America to raise public awareness of the value of biodiversity and, more generally, the region's underappreciated natural wonders. The success of the Prince's trip, and of the series of events at grade schools throughout the region that followed, showed how public education efforts could effectively alter attitudes and nurture support for the environment.

Encouraged by this response, INBio began to discuss the possibility of creating a park in Costa Rica that would be part reserve and part interactive museum. The goal was to place the region's ecological riches on permanent display in a natural, yet easily accessible, setting and, at the same time, to build an educational centre for both children and adults.

Last year, the park drew over 150,000 visitors – 120,000 who came to see the park, and 30,000 who came for special events, including conferences, workshops and even weddings. They not only enjoy access to a sampling of Costa Rica's ecosystems but also get to see the critters that inhabit these environments – butterflies, frogs, caimans, tarantulas and snakes.

"Planning and construction for the park", says Natalia Zamora, who directs the facility, "took some time". First and foremost, there was the question of financing. "We knew it would be expensive." Indeed the business plan indicated the project would cost US$3 million to complete. But such costs would prove to be more of a challenge to be overcome than an insurmountable obstacle.

Nearly a decade after INBio's creation, its administrators realized that scientific research would not suffice to realize its lofty goals and that the institute needed to broaden its agenda to increase public awareness of its activities and what it hoped to achieve.

As a result, INBio agreed to invest US$3 million in the INBioparque project. The institute turned to the Central American Economic Integration Bank and, more specifically, the bank's fund for small-scale environmental projects, to obtain a 10-year, US$3 million loan that carried an annual interest rate of 7.5 percent. The terms of the loan also included a three-year grace period, during which only the interest would need to be paid.

"INBioparque provides visitors with an opportunity to experience a range of ecological zones in Costa Rica."

NATALIA ZAMORA, general manager of INBioparque

• *Natalia Zamora has been INBioparque's general manager since March 2003, a post she had held previously (1997–2002) while also serving as coordinator of INBio's social outreach programme. From 2002 to 2003, Zamora served as INBio's director of Education and Communication. She began her career at INBio as a communication specialist (1995–1997). Earlier in her career, Zamora worked in the office of external relations and in fund-raising for the Faculty of Environmental Sciences and Wildlife at the University of Idaho (USA). She has also worked as an interpreter and translator.*

Zamora earned a bachelor's degree in Collective Communication Sciences and Journalism, and a licenciatura degree in Public Relations, both from the University of Costa Rica, San José, in 1991 and 1992, respectively. She received her MSc in Environmental Education and Communication Sciences from the University of Idaho (USA) in 1995. Since 2002, she has been pursuing a doctoral degree in environmental education from the Universidad Autónoma de Madrid (Spain).

"INBioparque", says Zamora, "provides visitors with an opportunity to experience a range of ecological zones in Costa Rica over the course of a three- or four-hour tour. There is the pre-mountainous forest, the rainforest, the dry forest, and a butterfly garden in what used to be a coffee plantation".

"The committee, which is separate from INBio's corporate board", notes Zamora, "has broad responsibility for overseeing both the park's programmatic activities and budget".

"The number of people visiting the park has increased 10 percent on average each year. In some years, the increase has exceeded 25 percent. The park reached an operational break-even point in December 2004. Since then, it has generated the income needed to continue with the bio-literacy activities offered to international tourists and Costa Rican families and students".

Conservation in a Changing World

Rapid deforestation and habitat loss in Costa Rica in the 1970s and 1980s led to the creation of INBio in 1989, and efforts to conserve and wisely utilize the country's bountiful resources have remained central to the institute's agenda.

"INBio", observes Randall García, the institute's director of Conservation, "has always been – and always will be – dedicated to the protection and sustainable use of Costa Rica's fragile ecosystems and unmatched biodiversity".

Yet, the social and political context – both in Costa Rica and internationally – in which the institute's environmental conservation efforts take shape has changed dramatically over the past two decades.

In particular, there have been enormous institutional changes. INBio began as an organization that defiantly – indeed proudly – separated itself from both government and universities. Today, it works closely with both. As García notes, the government of

Costa Rica has emerged as one of the most prominent and vocal champions of the nation's environment, and it has developed increasingly effective programmes for the conservation and wise use of the country's resources. "INBio has become a partner in these national efforts, serving as a consultant and, in some instances, a lead player".

Universities, in the meantime, have become much more amenable to multi-disciplinary approaches to resource challenges and also more willing to engage with individuals and institutions beyond the tranquil confines of their campuses.

INBio has taken advantage of this changed environment, signing collaborative agreements with the University of Costa Rica, the University of Strathclyde (Scotland), and, in the USA, the University of Massachusetts, and Cornell and Harvard Universities, as well as the National Cancer Institute. When it made the decision to concentrate its inventory

efforts on insects, plants and fungi, INBio handed over its valuable collection of molluscs and nematodes to Costa Rica's universities.

During INBio's early years, García notes, "we believed one would have little trouble finding the scientific data and information in Costa Rica, or elsewhere in the world. Yet, we also believed that such data and information – particularly in the developing world – was largely locked away in universities, available only to researchers. New scientific knowledge, of course, is always welcomed. But we were convinced that more attention needed to be placed on accessibility and applicability. Thankfully, this is no longer the case".

Meanwhile, many conservation projects are now cooperative ventures, assessed as much for their impact on the ground as for the contribution they make to science. For example, since 2003, INBio, with support from the Norwegian government, has worked

on improving the quality of the information contained in herbarium collections in Central American countries, and produced guidebooks on such topics as toxic plants in Guatemala and Mayan ethnobotany in Honduras. In 2008, INBio, with support from the government of Netherlands, began a three-year South-South cooperation programme with Benin and Bhutan. Like Costa Rica, both of these are developing countries very rich in biodiversity. Projected activities include the development of information management systems and the sharing of technology for sustainable production.

Many factors account for this transformation in institutional behaviour, including changes in public attitudes towards the environment and intensive global campaigns that have succeeded in increasing awareness about the ecological challenges the world faces. But the most important reason for this change in attitude has been a growing awareness among policy-makers and, more generally, the public, of the inherent economic value of all things ecological.

For example, in Costa Rica, the ecologically based economy – largely focused on ecotourism – has, over the past decade, grown on average by more than 7 percent annually. Tourism alone now generates US$1.7 billion in revenues each year. That is three times the financial value of the country's much-sought-after commodities, including coffee, bananas, beef, sugar and timber. More than half the tourists come to visit the nation's protected areas, combining fun with a real educational experience.

A recent report by the International Centre for Economic Policy for Sustainable Development at the National University indicated that Costa Rica's national parks alone generated US$800 million a year in revenues, 80 percent of which was derived from tourism. In a nation with a national gross domestic product of US$48 billion, this is a significant amount of money.

> *"Over the past decade, the ecologically based economy in Costa Rica has grown on average by more than 7 percent annually."*

Some of what nature has to offer, of course, is hard to put a monetary value on. "The nation's ecosystems and biodiversity", García points out, "are the source of many valuable services that may be difficult to quantify but are nevertheless central to our lives and well-being". These services include clean drinking water and air, fertile soils, diverse forest products and even the beautiful vistas afforded by mountain lakes or fast-moving streams.

INBio's role in Costa Rica's efforts to promote ecology and biodiversity as key elements in economic development is, of course, impossible to calculate. It is safe to say, however, that the institute's efforts have helped raise public awareness about the nation's environmental treasures; that its effective advocacy in powerful circles has encouraged government environmental reforms; that its presence in the international scientific community has brought prestige to Costa Rica; and that its emphasis on excellence has provided a valuable scientific underpinning to the public debate. The latter has helped lend authority to the growing recognition that, in Costa Rica at least, what is good for the environment is also good for the economy.

JESÚS UGALDE, director of Biodiversity Science

• *Jesús Ugalde was appointed director of Biodiversity Science at INBio in 2004. He also serves as Curator of Hymenoptera and Coordinator of the National Biodiversity Inventory. He was the scientific coordinator of the 'Development of Biodiversity Resources' project, which is executed by INBio in cooperation with the Ministry of Environment and Energy's (MINE) National System of Conservation Areas (SINAC). Ugalde led efforts related to the bio-inventory programme, monitoring of biodiversity, and climate change. He has actively participated as a systematic expert in national and international initiatives.*

Ugalde received his bachelor's and master's degrees in Biology from the Universidad de Costa Rica, in 1991 and 1992, respectively. He also holds a licenciatura degree in Management of Natural Resources from the Universidad Estatal a Distancia, Costa Rica, which he received in 2001.

KEY PERSONNEL

RANDALL GARCÍA, director of Conservation

• *Randall García was appointed director of Conservation at INBio in 2004. He also serves as coordinator of the 'Biodiversity as a Tool for Central American Development' project, a joint project of INBio and the government of Norway. García participates in the institutional support programme to Costa Rica's National System of Conservation Areas, contributes to the institute's fund-raising efforts, and facilitates INBio's connection with the conservationist sector. García received a degree in forestry engineering from the Universidad Nacional Autónoma, Heredia, Costa Rica, in 1980. He earned his master's degree in Ecological Tourism from the Universidad Latinoamericana de Ciencia y Tecnología in 1993.*

For all these reasons, it was with a deep sense of satisfaction and pride that García cited a recent international survey that described Costa Rica as a "small green" nation with enormous assets that were increasingly being put to work to improve the well-being of the people who live there.

"We are small by virtue of our history", says García. "We have become green by choice. And, increasingly, it is this combination that is making our country a good place not just to visit but to live in and to emulate".

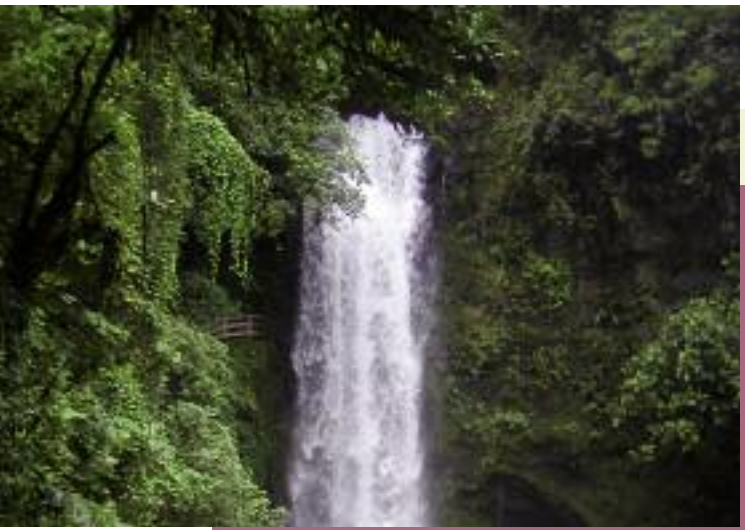
> *"Costa Rica's ecosystems and biodiversity are the source of many valuable services that may be difficult to quantify but are central to our lives."*

Challenges ahead

The year 2005 proved to be a watershed in the history of INBio. Several large grants funded by the GEF and aid agencies in the Netherlands and Norway, which had fuelled the institution's inventory efforts and provided the backbone for its biodiversity resource development programme over the past seven years, came to an end.

Although the loss of funding was not unanticipated, it did require INBio to lay off nearly one-third of its 50-member taxonomic staff. Some 13 parataxonomists, curators and technicians lost their jobs. The institution, in turn, created smaller taxonomic units, which continued the inventory activities at a slower pace, while expanding such products and services as field guides and training courses.

In many ways, these developments ushered in a new era for INBio's inventory programme, which has been a main pillar of the organization's mandate ever since the institute's inception. Taxonomy has always been a hard sell. It is an exercise that requires enormous patience, not only on the part of those in the field but also funders who are



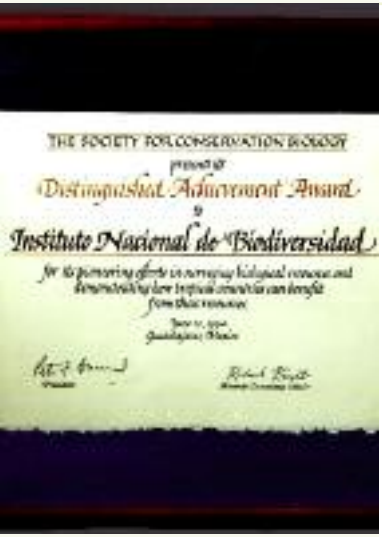
seeking results. Thus, taxonomic surveys can be dogged by anxious questions: How much more information do we really need about a species? Must we really locate every species? And – most importantly – will these efforts ever pay for themselves?

Efforts to fund INBio's taxonomic work have been further complicated by Costa Rica's growing prosperity, due in part to the nation's successful efforts to take advantage of its unrivalled biodiversity. Donors have been increasingly interested in assisting regions that need the most help, most notably sub-Saharan Africa. This shift in focus has made it more difficult for universities and research institutes in middle-income countries, such as Costa Rica, to secure grants from foundations and international aid agencies.

INBio responded to the challenges by developing a strategy to make the institute less dependent on large external grants. It also sought to increase self-generated revenue from the marketing of its services and expertise – including consulting, training and bioprospecting – as well as from book sales and INBioparque receipts. The strategy, developed in 2002 in anticipation of the budget squeeze, called for 66 percent of revenue to be generated by INBio, and 34 percent from external grants. By 2006, this goal had been largely achieved.

In addition, INBio returned to its way of operating when the institute was started – maintaining a large number of small projects, instead of a few large ones. Such an approach allows for more dynamism in the search for resources, while not excluding the possibility of larger donors. It also reduces the risk posed by the loss of a grant from a particular funder.

> *"The year 2005 proved to be a watershed in the history of INBio."*



AWARDS

• Over the course of nearly two decades of work, INBio has received a number of prestigious awards. Among the most notable are the 1995 Prince of Asturias Foundation Award in Science and Technology, the 2003 Annual Technology Award from the Technology Museum of Innovation in California, and the 2004 Augusto González de Linares Award from the University of Cantabria, Spain. In 2007, INBio received the National Award for the Contribution to Agriculture and Rural Development from the Inter-American Institute for Cooperation on Agriculture (IICA) and the Costa Rican Ministry of Production.

So, as INBio looks ahead, it draws encouragement from its history of weathering storms and succeeding against long odds. A grant from the Spanish government, Nature Conservancy and Conservation International, for example, has cushioned the blow to its inventory programme. The pharmaceutical company Pfizer's decision to finance the search for a natural product to combat the larva of the *Aedes aegypti* mosquito, a vector for dengue fever, is welcome. As is the launch of two research projects with Harvard University's School of Medicine designed to study endophyte fungi, terrestrial and marine fungi, lichens, myxobacteria and other organisms that have received little attention from the scientific community.

There have also been discussions about the possibility of establishing a multi-million dollar endowment for INBio that would be invested in land purchases and research designed to promote biodiversity conservation.

Ultimately, INBio will have to do what it has always done to move ahead – design innovative strategies both to promote the value of biodiversity and to generate the revenues needed to do the job.

When asked what are the most important lessons other institutes can learn from INBio, president Gámez-Lobo replies: "innovation and excellence in every task the institution does, and institutional adaptability to changes."

Meanwhile, INBio's other activities continue to progress. Attendance at INBioparque now exceeds 150,000 people annually, and efforts to take advantage of electronic communications have led to the creation of state-of-the-art virtual learning rooms. Book sales at Editorial INBio continue to rise – by 65 percent in 2005 alone – and INBio's award-winning website currently records an average of 20,000 page hits a day. To assist the policy community, INBio remains a critical source of scientific and technical reports as well as a depository for maps outlining developments and trends in ecology and biodiversity in Costa Rica. And the institute continues to attract global attention both from foreign ministries and research centres and from the international media.

> *"INBio's ability to embody high principles in concrete actions has made it an iconic institution."*

Conclusion

While INBio's tactics may continually change, the institute's goals do not. As a result, INBio's vision remains as intensely focused as ever: to serve as "a scientific and technological organization renowned for excellence and leadership, generating information and promoting initiatives to be incorporated into the life of society for the conservation and sustainable use of biodiversity".

As articulated in INBio's examination of the future of the organization, *The Essence of the Institution*, "Conservation is a human activity and depends on the interests and motivation of people". Consequently, the institute remains unstintingly dedicated to the belief that "sustainable human development needs to be centred on people and based on conservation".

It is this enduring principle – founded on the belief in the oneness of people and place, conservation and use, and knowledge and application – that has defined the success of INBio in the past. And it is this principle that will continue to determine the institute's level of success in the future. Ultimately, it has been INBio's ability to embody high principles in concrete actions that has made it an iconic institution in the world of biodiversity and ecology.

Some institutions are research oriented. Some are action oriented. INBio is both, and therein lies its uniqueness and value – a treasure of enduring significance in the varied world of ecological institutions.

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TWAS

TWAS, the academy of sciences for the developing world, is an autonomous international organization that promotes scientific capacity and excellence in the South. Founded in 1983 by a group of eminent scientists under the leadership of the late Nobel Laureate Abdus Salam, TWAS was officially launched in Trieste, Italy, in 1985, by the secretary general of the United Nations.

TWAS has 880 members from 90 countries, over 85 percent of whom live and work in developing countries. A Council of 13 members is responsible for supervising the Academy affairs. TWAS is assisted in the administration and coordination of programmes by a small secretariat, headed by the executive director. The secretariat is located on the premises of the Abdus Salam International Centre for Theoretical Physics (ICTP) in Trieste, Italy. UNESCO is responsible for the administration of TWAS funds and staff. A major portion of TWAS funding is provided by the Ministry of Foreign Affairs of the government of Italy.

The main objectives of TWAS are to:

- recognize, support and promote excellence in scientific research in the South;
- provide promising scientists in the South with research facilities necessary for the advancement of their work;
- facilitate contacts between individual scientists and institutions in the South;
- encourage South-North cooperation between individuals and centres of scholarship.

To achieve these objectives, TWAS is involved in various activities and collaborates with a number of organizations, especially UNESCO, ICTP and the International Council for Science (ICSU).

For additional information, see www.twas.org.

THE DAVID AND LUCILE PACKARD FOUNDATION

The David and Lucile Packard Foundation was created in 1964 by David Packard (1912–1996), co-founder of the Hewlett-Packard Company, and his wife, Lucile Salter Packard (1914–1987). Throughout their lives in business and philanthropy, the Packards sought to use private funds for public good.

Guided by the founders' values, the David and Lucile Packard Foundation supports both people and organizations with the aim of enabling the creative pursuit of science; conserving and restoring the Earth's natural systems; improving the lives of children; and advancing reproductive health.

For additional information, see www.packard.org.

EXCELLENCE IN SCIENCE

This series of booklets – published by TWAS, the academy of sciences for the developing world – highlights successful scientific institutions in the South and explains how their research has both been sustained over a number of years and is helping their host nations achieve sustainable economic development.

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