CoCiBio

Programa de cooperación para la investigación orientada a la aplicación sobre la biodiversidad y cambio climático

German-Ecuadorian Research Co-operation Program on Biodiversity and Climate Change – CoCiBio

24 to 26 June 2019, Hostería San José de Puembo (near Quito)

cooperación alemana
DEUTSCHE ZUSAMMENARBEIT

Implementada por
giz

DAAD
Deutscher Akademischer Austauschdienst
German Academic Exchange Service

MINISTERIO DEL AMBIENTE
SECRETARÍA DE EDUCACIÓN SUPERIOR, CIENCIA, TECNOLOGÍA E INNOVACIÓN
INSTITUTO NACIONAL DE BIODIVERSIDAD

TABLE OF CONTENT

Dear participants,

On behalf of the DAAD, GIZ, MAE, INABIO, and SENESCYT, we are very pleased to welcome you to our matchmaking event for the newly published call of the

German-Ecuadorian Research Co-operation Program
on Biodiversity and Climate Change – CoCiBio

The aforementioned organizations already began working together in this endeavour a year ago. We are now proud to present our joint call and are looking forward to supporting new and promising cooperation projects between Germany and Ecuador.

The purpose of this event is to provide a networking platform for researchers and experts from the industries of both Germany and Ecuador, these countries' governments, and civil society to explore possible forms of cooperation in the relevant thematic areas. Joint research applications can also be discussed in advance and drafted at this event.

Bringing research partners together to promote new partnerships will be another of our aims during these three days. This will help disseminate knowledge and generate tangible innovation by linking interested scientists. Meanwhile, the matchmaking will give you the opportunity to initiate research partnerships and submit joint proposals. It will enhance the networking effect and support the realization of new partnerships.

We hope that the matchmaking – along with the individual matchmaking talks and the detailed overview of the call – will enable you to gain fresh knowledge, talk about your experiences, and establish new networks and cooperation projects.

We invite you to share your experiences as part of an intercultural learning dialogue over the next three days and wish you a pleasant and interesting time in Quito.

German Academic Exchange Service (DAAD) | Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH | Instituto Nacional de Biodiversidad (INABIO) | Ministerio del Ambiente del Ecuador (MAE) | Secretaría de Educación Superior, Ciencia, Tecnología e Innovación (SENESCYT)

AGENDA MATCHMAKING PUEMBO (QUITO), ECUADOR

German-Ecuadorian Research Co-operation Program on Biodiversity and Climate Change – CoCiBio

24 to 26 June 2019, Hostería San José de Puembo (near Quito)

Sunday, 23 June 2019

	Individual arrivals of the participants from Germany and Ecuador and check-in at Hotel Barrio San José Puembo San José de Puembo, www.sanjosedepuembo.com, Puembo (Quito)
7:30 pm	Group dinner at the hotel (optional)
Accommodation	Hotel Barrio San José de Puembo Manuel Burbano S7-150 and San Fernando I Puembo (Quito), Ecuador T: +593 2390 264 I www.sanjosedepuembo.com

Monday, 24 June 2019

Venue	Hotel Barrio San José de Puembo Manuel Burbano S7-150 and San Fernando I Puembo (Quito), Ecuador T: +593 2390 264 I www.sanjosedepuembo.com
8:15 am	Registration
9:00 am	Opening of matchmaking event
9:05 am	Welcome address Dr. Àngel Onofa Ecuadorian Ministry of Environment (MAE) Dr. Diego Inclán National Biodiversity Institute (INABIO) Katrin Gothmann Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) Stefan Bienefeld German Academic Exchange Service (DAAD)

9:20 am	Presentation • German-Ecuadorian Cooperation for Biodiversity and Climate Change Dr. Diego Inclán National Biodiversity Institute (INABIO)
9:45 am	Coffee break
10:15 am	Round table with GIZ, INABIO, and scientists • How to foster networks on biodiversity and climate change and to translate research into practical use Dr. Diego Inclán National Biodiversity Institute (INABIO) Dr. Nikita Gaibor Instituto Nacional de Pesca (INP)
12:00 noon	Lunch
1:00 pm	Start of matchmaking and presentation of all participants
2:00 pm	Coffee break
2:30 pm	Individual matchmaking talks – part I
4:30 pm	Summary of the day (plenary session)
5:15 pm	City tour – Quito's old town
Meeting point	Lobby of Hotel Barrio San José de Puembo
8:00 pm	Group welcome dinner
Venue	Vista Hermosa Mejía Oe4-45 y García Moreno I Quito, Ecuador T: +593 2 295 1401 I +593 2 295 6132-105 I https://vistahermosa.ec
10:00 pm	Transfer from restaurant to hotel
Accommodation	Hotel Barrio San José de Puembo

Tuesday, 25 June 2019

9:00 am	Wrap-up of the previous day
9:15 am	Presentation • Funding conditions of higher education co-operation • FAQs regarding the call Ilona Daun German Academic Exchange Service (DAAD) Anja Munzig German Academic Exchange Service (DAAD)
9:45 am	Coffee break
11:15 am	Poster presentation
12:30 pm	Lunch
2:00 pm	Individual matchmaking talks – part II
3:00 pm	Coffee break
3:30 pm	Presentation of RedBio Dr. Diego Inclán National Biodiversity Institute (INABIO)
4:00 pm	Individual matchmaking talks – part III
5:30 pm	• Summary of the day (plenary session) and brief explanation of the working sessions for application preparation
7:30 pm	Group dinner
Venue	Restaurant of Hotel Barrio San José de Puembo
Accommodation	Hotel Barrio San José de Puembo

Wednesday, 26 June 2019

6:45 am	Transfer from the hotel to the excursion locations
Meeting point	Lobby of Hotel Barrio San José de Puembo
8:00 am	Group breakfast
Venue	Tambo Condor Vía al Antisana Km. 14 I Sector Laguna de Secas I Pintag, Ecuador T: +593 022 383 921 I https://tambocondor.com
8:30-11:30 am	Excursion • Peñon del Isco (viewing point for Andean condors in the Antisanilla Reserve) • Humboldt's House (Empresa de Agua de Quito / FONAG) • Laguna de La Mica (Antisana Ecological Reserve)
11:30 am	Transfer back to hotel
1:15 pm	Lunch
2:00 pm	Individual working sessions for application preparation – part I Facilitated by DAAD and GIZ
3:30 pm	Coffee break
4:00 pm	Individual working sessions for application preparation – part II Facilitated by DAAD and GIZ
5:30 pm	Farewell – end of official part of matchmaking event Dr. Àngel Onofa Ecuadorian Ministry of Environment (MAE) Stefan Bienefeld German Academic Exchange Service (DAAD)
7:30 pm	Group farewell dinner
Venue	Restaurant of Hotel Barrio San José de Puembo
Accommodation	Hotel Barrio San José de Puembo

Thursday, 27 June 2019

Individual departures

ESCUELA POLITÉCNICA NACIONAL

CHARACTERISATION AND STUDY OF THE FERMENTATION PROCESS OF *AGAVE AMERICANA* AND ITS ECONOMIC AND ECOLOGICAL IMPACT

1

GENERAL INFORMATION

This is a multidisciplinary project proposed by researchers of the Escuela Politécnica Nacional (who are specified along with their expertise below):
Cristina Romero: impact of high-value chains and fermentation processes
Jenny Ávila Vélez: the effect of abiotic stress conditions on phenolic compounds and on the antioxidant capacity of some fruits of Ecuador
Neyda Espín: valorisation of agro-industrial products through fermentation
Mary Casa Villegas: production of second-generation bioethanol
Catalina Vasco: HPLC/MS and GC/MS spectrometers and related techniques for characterising plant products
Miguel Pinto: genetic studies of the biodiversity of Ecuador

THE CHALLENGE

The commercial agricultural systems currently implemented in the Sierra of Ecuador are characterised by monoculture and a high negative impact on local ecosystems. We are interested in contributing to the sustainable use of biodiversity by exploring the use of native species to restore degraded ecosystems and cultivate food products that promote the development of rural communities. We know that only one species of agave (Agave americana) is currently found in Ecuador, but several morphotypes are grown.

Our proposal seeks to answer the following questions:

Is Agave americana a native or introduced species? Does the genomic variation of Ecuadorian A. americana correlate with geography and morphotypes?

Are abiotic factors across the Andean region influencing A. americana's physical and chemical composition?

What are the main parameters influencing A. americana's fermentation process, and how are the native fermenting microorganisms influencing the organoleptic characteristics of the fermented beverage miske?

What are the ecological and economic impacts of the A. americana value chain?

THE APPROACH AND CIENTIFIC COOPERATION

The main goal of the project is to study the potential use of native species of the Agavaceae family to develop sustainable agro-ecological systems in soil-eroded areas of the Ecuadorean Andes. We propose to work on three areas of interest:

- Identification and characterisation of agave plants of ecological and economic importance in Ecuador
- Optimisation of the fermentation process developed by indigenous communities
- Impact analysis of agro-ecological systems where agave is grown

In a preliminary stage, we will sample plantations and individual wild specimens in the three main Andean areas where A. Americana is used: the north (Imbabura and Pichincha), center (Cotopaxi and Tungurahua), and south (Azuay). Next, to conduct the genomic characterisation, a ddRAD protocol to survey SNPs (single-nucleotide polymorphisms) across the genome will be performed. With this data collected, we will then proceed to conduct population genomic analyses (e.g. Structure) and phylogenomic analyses (e.g. SVDquartets).
A physical and chemical characterisation (e.g. size, number of leaves per plant, shape of the leaf, presence of thorns, soluble solids, reducing sugars, pH, fiber, ash, carbohydrates, and other compounds of interest)

2

will be carried out on the individual mature specimens sampled to identify the effects of different morphotypes and of different abiotic factors. These will help us identify the individuals with the best characteristics to be transformed into high-value products.
For the optimisation of the fermentation process developed by indigenous communities, we propose to study spontaneous fermentation. To characterise the microbiome of the fermented beverage miske, we will use a meta-barcoding approach and sample agave extracts of miske producers at different stages of fermentation. We will conduct PCR amplifications of bacteria, yeast, and other fungi using common targets for species identification. The amplicons will be sequenced in Illumina platforms, and the data will be assigned to OTUs through phylogenetic analyses. Factors influencing the efficiency of the fermentation process and the quality of the miske – such as the microorganisms employed, fermentation temperature, use of growth factors, and the concentration of fermenting sugars – will also be analysed. In order to assess the quality of the final product, the main alcohols produced and the volatile compounds at hand will be identified.
Finally, we expect agave to have a direct ecological and economic impact on the areas where it is being grown. It is of interest to quantify the support ecosystem services provided, namely soil restoration and diversity. For the value chain analysis, the agave chain will be mapped, including the main actors and the coordination mechanisms developed among them.

We seek cooperation in the following areas:

- Generation of genomic data —ddRAD seq of A. americana and microbiome sequencing of fermenting broths using next-generation sequencing technologies
- Statistical analysis to determine the effect of abiotic factors on the parameters of interest using GIS
- Characterisation of fermentable sugars in agave juice before and after fermentation
- Characterisation of volatile compounds obtained from the fermentation process
- Quantification of ecosystem services (methodology)

THE INNOVATION ANDINTENDED IMPACT

Restoration in dry Andean areas has proven to be extremely challenging. Due its adaptations to survive in severe environments, agave could facilitate this process. While indigenous populations have been using it for centuries, it is only in recent years that the plant has been used in high-value products targeting urban consumers. This represents an opportunity to preserve and disseminate an indigenous product in a sustainable way.

However, very little research has been conducted on the agave family. Improved characterisation and the support of food technology development can be of great help in promoting its growth and consumption.
The expected outputs are:

- A genomic, chemical, and physical characterisation of the Ecuadorian morphotypes according to the areas where the plant is grown
- A profile of the microbe succession in miske fermentation
- Standardisation of the fermentation process to produce a high-quality alcoholic beverage (miske).
- The ecological and economic impacts of promoting the development of the agave value chain

FACTS AND FIGURES

There is a national association of actors involved in the agave chain (ANAGAVEC) that includes:

- 14 miske (alcoholic beverage) producers
- 12 producers of other high-value products (beverages without alcohol, syrup)

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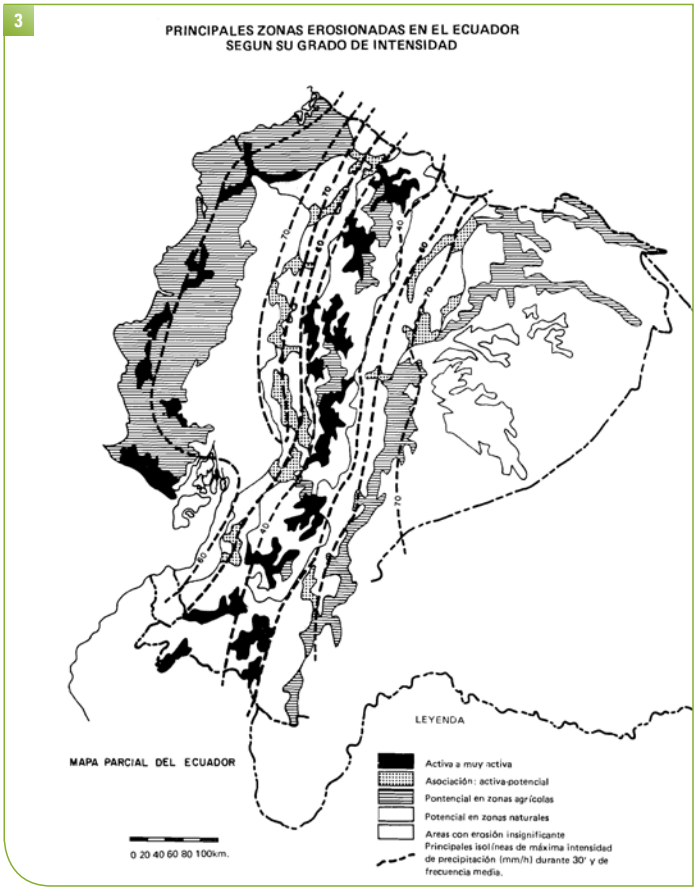

Contact

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Catalina Vasco Ph.D. (catalina.vasco@epn.edu.ec)
Miguel Pinto Ph. D. (miguel.pinto@epn.edu.ec)

PHOTOS AND GRAPHICS
1 Agave plant (Source: ANAGAVEC) | 2 Bioreactores | 3 Map of eroded soils of Ecuador. (Source: De Noni, G.; Castillo, G. La Erosión Actual y Potencial en Ecuador: Localización, manifestiaciones y causas, 1986) | © credits: EPN 2019

LINKING TREES' FUNCTIONAL TRAITS AND REMOTE SENSING TO ASSESS ECOSYSTEM FUNCTIONING DURING CLIMATE CHANGE IN THE MONTANE FORESTS OF ECUADOR

GENERAL INFORMATION

Ecuador
Selene Báez
Department of Biology, Escuela Politécnica Nacional del Ecuador, Quito, Ecuador

Oswaldo Jadán
Department of Agronomy, Cuenca, Ecuador
Universidad Juan Carlos Primero, Spain

Xavier Haro-Carrión
Department of Biology,
Escuela Politécnica Nacional del Ecuador, Quito, Ecuador

Ruth Utreras
Department of Biology,
Escuela Politécnica Nacional del Ecuador, Quito, Ecuador
CLAC, Quito, Ecuador

Germany
Paulina Álava
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Philipps University of Marburg, Germany

Jörg Bendix
Department of Physical Geography,
Philipps University of Marburg, Germany

Jürgen Homeier
Albrecht von Haller, Researcher, Institute of Plant Sciences,
Georg August University of Göttingen, Germany

Christine Wallis
Department of Physical Geography,
Philipps University of Marburg, Germany

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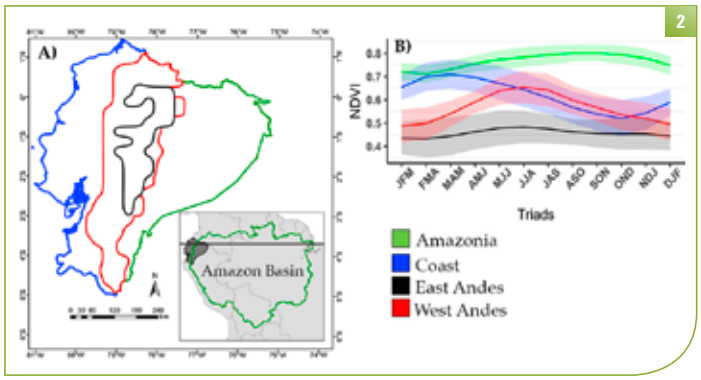

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THE CHALLENGE

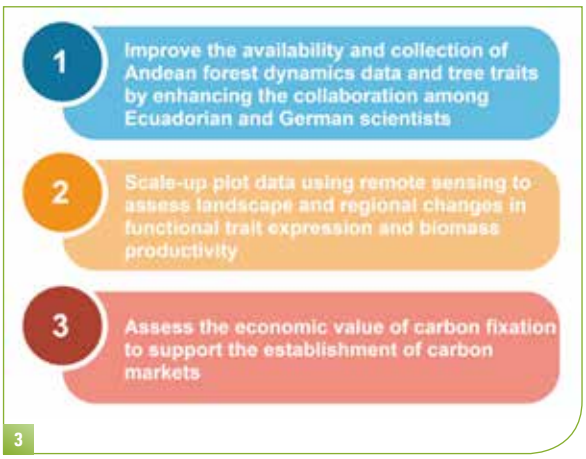
Remote sensing research linking productivity and the expression of forests' functional traits is needed to evaluate forest responses to climate change at the landscape and regional scales.

With carbon markets and related legislation causing much debate and controversy in Ecuador, economic assessments of the provision of carbon sequestration as an ecosystem service are urgently needed.

The goal of the proposed study is to investigate trees' shifting functional traits and the biomass of montane forests in Ecuador through field monitoring and remote sensing while also evaluating the economic value of carbon fixation as an ecosystem service.

THE APPROACH AND CIENTIFIC COOPERATION

Approach: Combining field data from forest monitoring with remote sensing imagery to assess functional forest trait expression and biomass over time.



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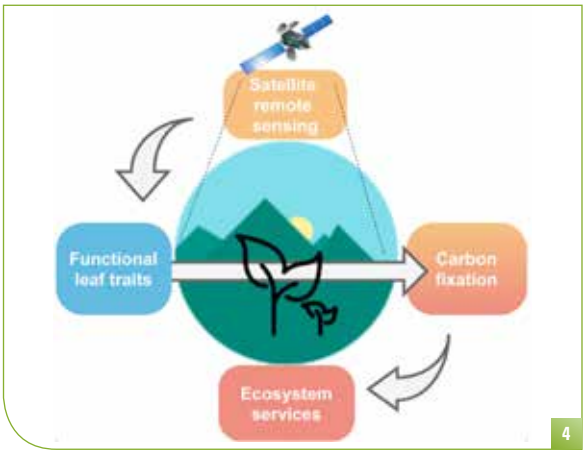

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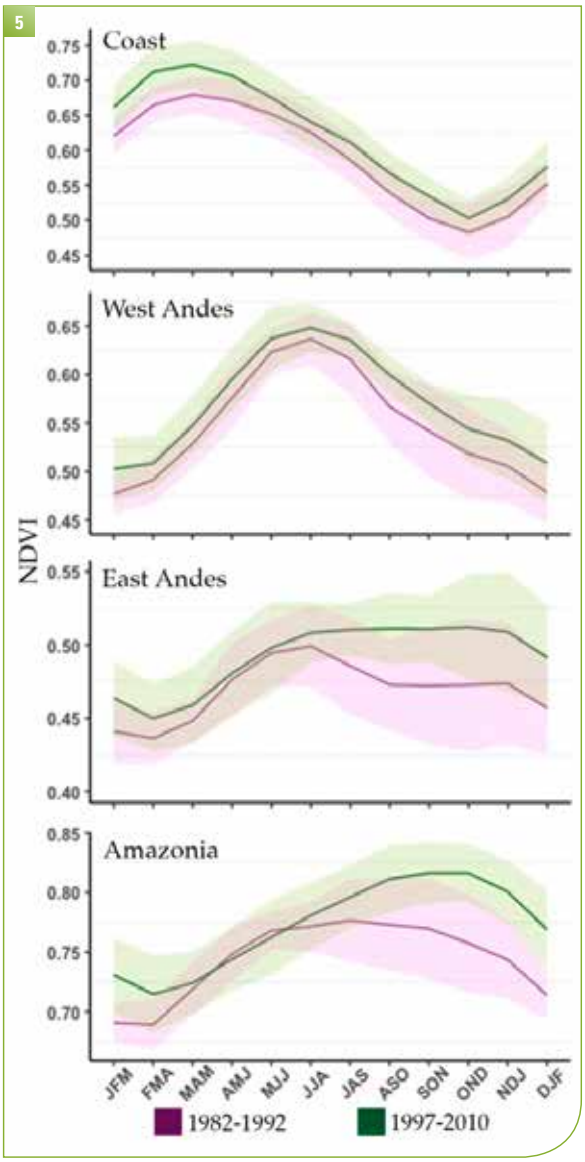
1. Improve the availability and collection of data on Andean forest dynamics and tree traits by enhancing the collaboration among Ecuadorian and German



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2. Scale up plot data using remote sensing to assess landscape and regional changes in functional trait expression and biomass productivity
3. Assess the economic value of carbon fixation to support the establishment of carbon markets

Cooperation structure:

Project coordination: Selene Báez, Jürgen Homeier and Jörg Bendix
Remote sensing research: two postdoctoral researchers (C. Wallis and X. Haro-Carrión) and a doctoral student (P. Álava)
Forest ecology: Researcher (O. Jadán)
Economics: Researcher (R. Utreras)

THE INNOVATION AND INTENDED IMPACT

Innovation
Use of satellite remote sensing to model functional traits in complex systems during climate change

Output
A framework to model functional traits and carbon fixation across highly complex and species-rich tropical montane forests

Relevance
Aichi targets 11 & 14
Public outreach

Workshops with German and Ecuadorian scientists, the central government, the Ministry of Environment, and local NGOs working on conservation and reforestation projects in Andean forests

Contact

Selene Báez, selene.baez@epn.edu.ec
Department of Biology
Escuela Politécnica Nacional

PHOTOS AND GRAPHICS
1 Montane forests in Ecuador | 2 Map of Ecuador and annual NDVI in the Andes | 3 Proposed project objectives | 4 Workflow of the proposed research | 5 Seasonal shifts in NDVI for the Amazon and the West and East Andes of Ecuador between the periods 1981-1992 and 1997-2010. The study periods were defined through binary segmentation change point analysis of AVHRR NDVI-derived data, 1982-2010. Labels on the y-axis correspond to monthly triads: JFM (January-February-March), … DJF (December-January-February). © credits: 1: J Homeier, 2, 5: Xavier Haro-Carrión, 3,4: C Wallis

UNIVERSIDAD DE CUENCA

EVALUATION OF *HUPERZIA* AND *AZORELLA* SPECIES AS ECOSYSTEMIC SERVICE-PROVIDERS AND SOURCES OF BIOACTIVE SECONDARY METABOLITES: ECOLOGICAL RELATIONS WITH ENDOPHYTE FUNGI

GENERAL INFORMATION

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Biotechnology and Biodiversity Group, Cuenca, Ecuador

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Omar Malagón,
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Jüergen Heinisch,
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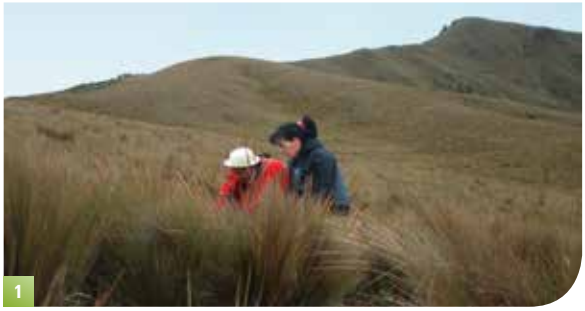
Knut Jahreis,
Department of Genetics,
University of Osnabrück, Osnabrück, Germany

Axel Mithöfer
Max Planck Institute for Chemical Ecology, Jena,
Germany

THE CHALLENGE

The southern páramos of Ecuador harbor plant species threatened by anthropic activities. Our challenge is to assess the conservation status of the genus Huperzia and Azorella by evaluating secondary metabolite production and relationships with endophyte fungi.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THE APPROACH AND CIENTIFIC COOPERATION

Objective	Actions	Expected results	Cooperation structure
Evaluate the status of Huperzia and Azorella as providers of ecosystem services in the páramos of southern Ecuador	Assessment of species abundance and risks associated with climate change	Master's thesis and scientific papers	UDA, UDC, UOS
	Socialization activities with members of the Saraguro and Cañar communities	Workshops with community leaders and local actors	UDA, UDC, UTPL, UOS, MPICE
Characterize the profile of secondary metabolites of two species of the genus Huperzia and two species of the genus Azorella	Secondary metabolites in volatile and fixed fractions of two Huperzia and Azorella species	Characterization of compounds through high-efficiency chromatography coupled with mass spectrometry (MS) and nuclear magnetic resonance spectroscopy (NMR); scientific papers	UDC, UTPL and MPICE
	Scientific stays of students and academics from the consortium	Master's and doctoral theses co-directed by scientific members of the consortium	UDC, UTPL and MPICE
	International School of Chemical Ecology and Biodiversity	Sharing of background and scientific methods	UDA, UDC, UTPL, UOS, MPICE
Isolate endophytic fungi associated with Huperzia and Azorella, establishing an endophyte bank	Purifying DNA from fungal isolates	Fungal isolates from Huperzia and Azorella tissues	UDA, UDC, UOS
	Phylogenetic DNA analysis	Endophytic fungi bank	UDA, UDC, UOS
	Secondary metabolite profile of endophytic fungi species	Promising endophytic fungi species due to secondary metabolite production	UDC, UTPL, UOS, MPICE

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THE INNOVATION AND INTENDED IMPACT

Evaluating Huperzia and Azorella as providers of ecosystemic services and studying the secondary metabolite profile and interaction with fungi will result in a more innovative approach to evaluating the biodiversity of the Ecuadorian páramos. Sharing the results with the Saraguro and Cañar communities will raise awareness of the need to preserve these threatened species from climate change challenges.

Contact

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maria.cazar@ucuenca.edu.ec

PHOTOS AND GRAPHICS
5 Objectives, actions, expected results and cooperation structure. UDC: Universidad de Cuenca, UDA: Universidad del Azuay, UTPL: Universidad Técnica Particular de Loja, UOS: Osnabrück University, MPICE: Max Planck Institute for Chemical Ecology

HUMBOLDT-UNIVERSITÄT ZU BERLIN

SACHA
SUSTAINABLE AGROFORESTRY – CHANGE ADAPTATION

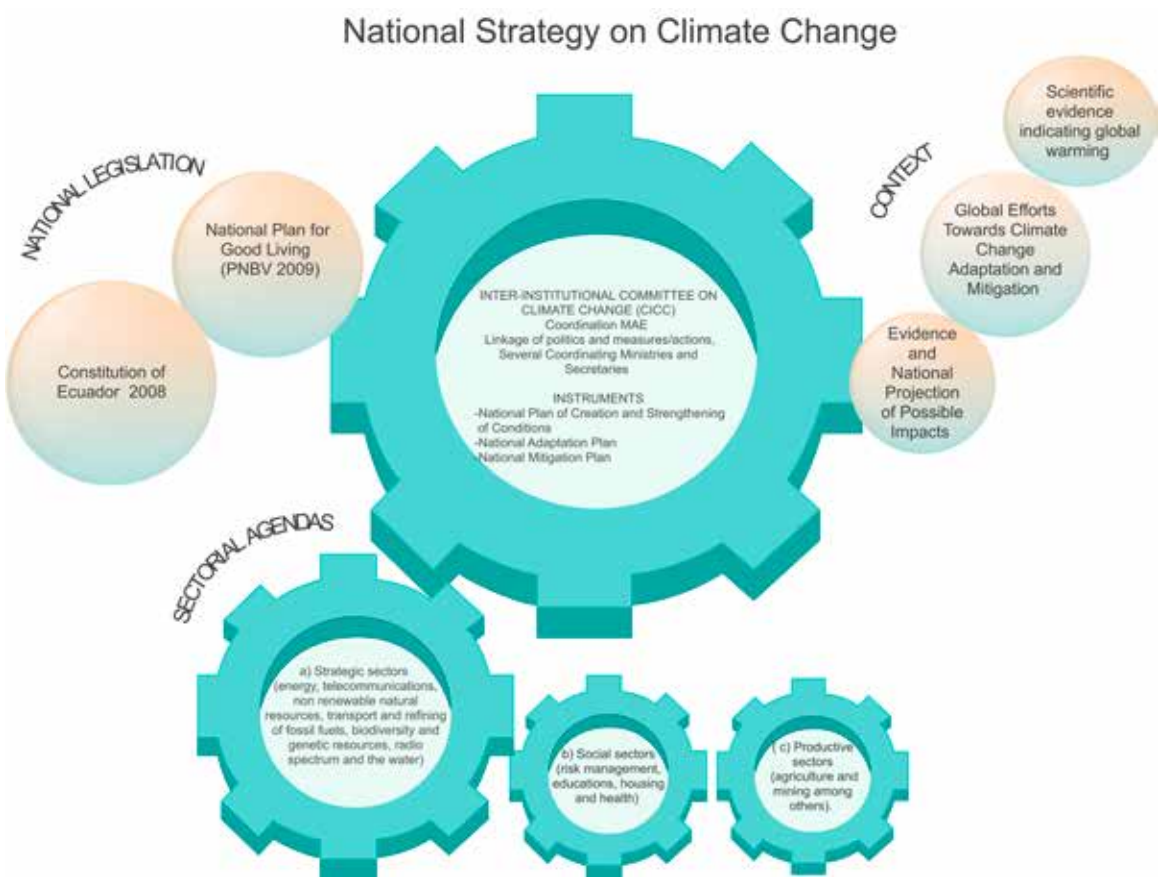
1

GENERAL INFORMATION

Prof. Wolfgang Bokelmann
Head of Division, Economics of Horticultural Production
Humboldt-Universität zu Berlin
Faculty of Life Sciences
Albrecht Daniel Thaer-Institute of Agricultural and Horticultural Sciences

THE CHALLENGE

In Ecuador, deforestation and changes in land use (the second strategic GHG reduction sector) represent a complex problem caused by multiple situations, including the expansion of the agricultural frontier, urbanisation, and land conversion in mountain and mangrove areas (MAE, 2012). Biological and cultural diversity in the hands of smallholder farmers and indigenous communities is under-valued as a global asset in addressing current socio-environmental challenges (Johns et al., 2013). Agroforestry has the potential to contribute to climate action, halt biodiversity loss, and promote gender equality as foreseen by the UN's Sustainable Development Goals (SDGs). By observing **traditional agroforestry practices in Ecuador**, we expect to answer the following question: **Is it possible to unite rich biodiversity and associated traditional knowledge with climate change adaptation and inclusive bioeconomic activity in the same space?**



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THE APPROACH AND CIENTIFIC COOPERATION

The main objective is to demonstrate how **non-timber products** produced by indigenous communities contribute not only to a bioeconomy, but to biodiversity conservation and climate change adaptation, as well. We emphasise the importance of **national and international cooperation** in order to extend the field of action of the **National Strategy for Climate Change**. A participatory approach to establishing conceptual frameworks, selecting comparative case studies, and transferring and co-creating knowledge is foreseen in order to generate context-specific, **nature-based solutions** that can be converted into **business models**. Trans-disciplinary research activities will be undertaken in collaboration with local universities and institutes, governmental organisations, private and civil society partners, and communities. The **gender dimension** will be made a central part of all activities.

THE INNOVATION AND INTENDED IMPACT

We offer a **dynamic approach** based on the fact that traditional practices are now facing challenges related to climate change, which creates the need for a methodology that combines indigenous knowledge with innovative adaptations. The knowledge generated will make it possible to **validate and reproduce results in other contexts** (in Germany, for example) and build **durable research networks for national and international cooperation**. The co-created knowledge will enable the identification of underutilised crops species, the understanding of traditional agroforestry system dynamics, and opportunities for sustainable business models.

5

Contact

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Faculty of Life Sciences
Albrecht Daniel Thaer-Institute of Agricultural and Horticultural Sciences
coguerrc@hu-berlin.de

PHOTOS AND GRAPHICS
1 Logo Project SACHA | 2 Climate Change Strategy | 3 Montaña | 4 Miel | 5 Cacao | © credits: 1: Logo Project SACHA_VF. Source: Cárcamo and Coral, 2019; 2: Climate Change Strategy. Source: Coral, 2019; 3,4: Robert Cárcamo Mallen; 5: Claudia Coral

UNIVERSIDAD TÉCNICA DE COTOPAXI

Ingeniería Medio Ambiente

ARTIFICIAL FLOATING ISLANDS AS AN ALTERNATIVE FOR THE RESTORATION OF POLLUTED WATER IN THE PROVINCE OF COTOPAXI, ECUADOR

GENERAL INFORMATION

c.1. Technical University of Cotopaxi (UTC)

1.1. Environmental Engineering Department

1.1.1. Water Resources Management Group / Manejo de Recursos Hídricos (MRH)

- Director, M.Sc Kalina Fonseca
- Main researcher, Ph.D Mercy Ilbay
- Secondary researcher 1, Ph.D Alina Freire
- Secondary researcher 2, M.Sc Joseline Ruiz
- Secondary researcher 3, M.Sc José Luis Agreda
- Research support, undergraduate students: José Tiche, Jessica Canchig, Cristián Molina, Carlos Córdova

c.2. Interinstitutional networks

- Department of irrigation and drainage management, Decentralized Autonomous Government (GAD) of the province of Cotopaxi
- National Laboratory for Water and Sediment Quality (LANCAS), INAMHI
- Water Resources and Aquatic Research Group/ Grupo de Investigación de Recursos Hídricos y Acuáticos (GIRHA), Amazon IKIAM University
- Ecuadorian Association of Botanists
- C40 Cities and Women4Climate

THE CHALLENGE

It is very common to hear the phrase "No life without water", but the correct way to say it is: "No life without clean water". That's why our research is focused on improving water quality in the province of Cotopaxi through eco-technologies.

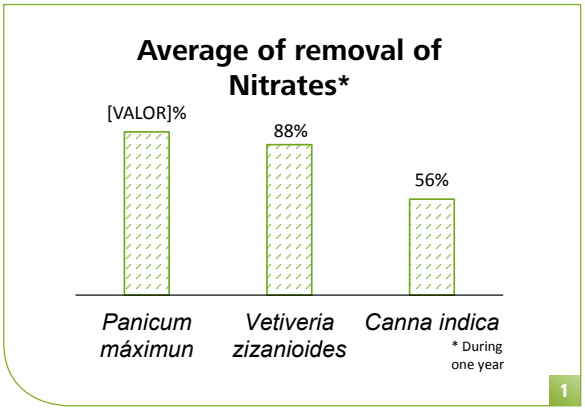
Cotopaxi is one of the largest agricultural producers in Ecuador. Its crops are irrigated with water contaminated with high concentrations of pollutants, including toxic substances such as arsenic and chromium.

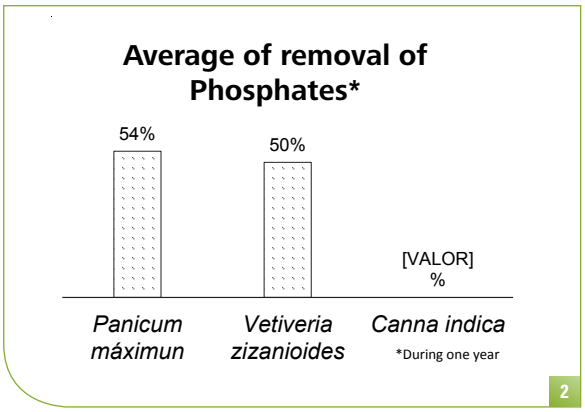
The Technical University of Cotopaxi (UTC), with its Water Resources Management research group (MRH), is focused on investigating low-cost, non-conventional water treatment that can be easily implemented to improve the water quality in Cotopaxi.

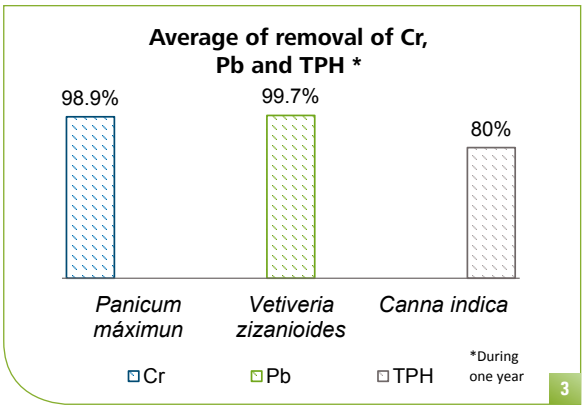
Artificial floating islands (AFI) are a non-conventional form of water treatment whose main structure is a matrix of floating support and plants. Their mode of operation is based on the removal of pollutants through the roots and surrounding submerged biofilm.

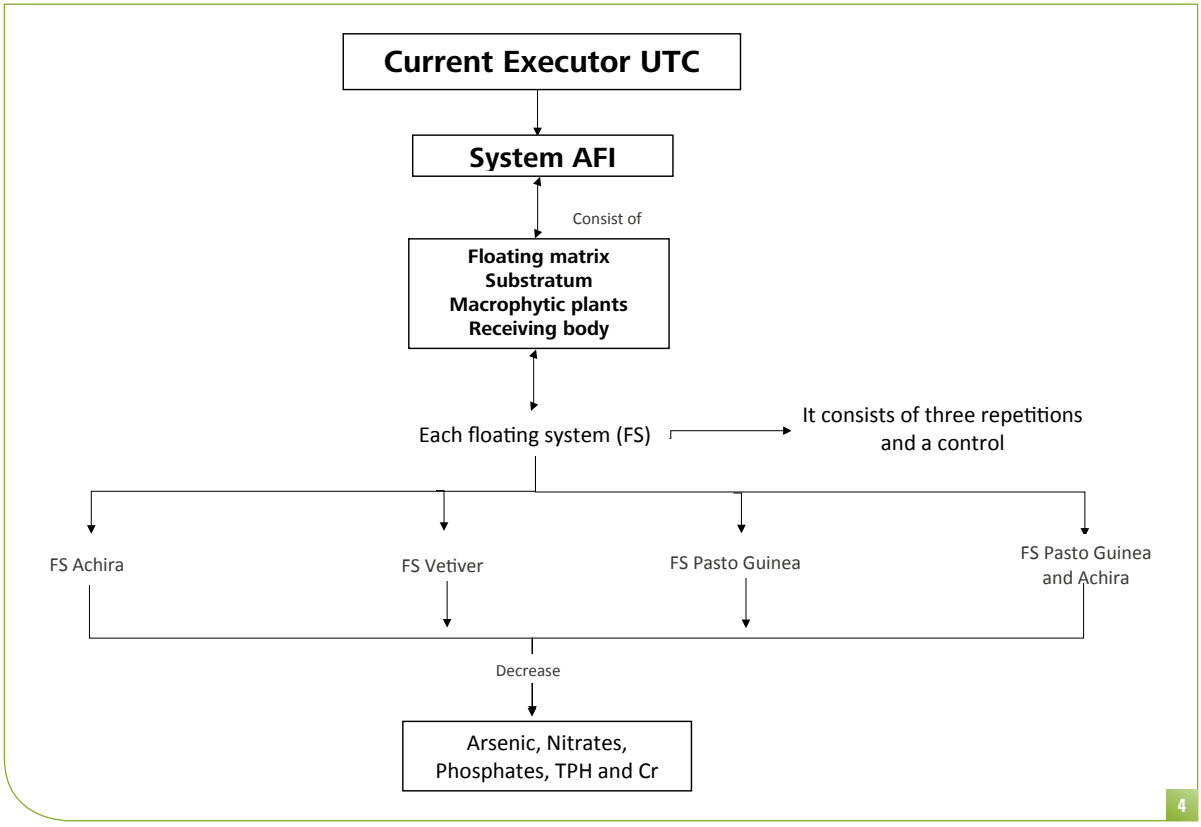
THE APPROACH AND CIENTIFIC COOPERATION

In one year, the MRH group has carried out the first evaluation of a prototype system and produced results (charts 1, 2, and 3) that already prove that AFIs can restore contaminated aquatic ecosystems (photo 6). The pilot research on the AFI system received national and international recognition from C40 and Women-4Climate as one of the 10 best projects about climate change.









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The AFI system evaluated is structured with *Canna indica, Panicum maximum*, and *Vetiveria zizanioides*. Currently, four types of floating systems (FS) are being investigated (figure 1). The chemical contaminants present in the water are being analysed in UTC laboratories (photo 5).

In order to obtain solid results that support the operation of AFIs, the MRH group is creating national alliances. The most important strategy to strengthen this research will involve the creation of networks with German universities through the CoCiBio cooperation programme. Through the formation of this network, the efficiency of the AFI system can be demonstrated as a tool for mitigating the effects of climate change to the benefit of society as a whole.

THE INNOVATION AND INTENDED IMPACT

The future use of AFIs in Ecuador will depend on the investigations related to the plants that improve water quality. The AFI system depends mainly on plants to restore contaminated water; it thus requires minimal investment because its operations do not cause secondary contamination. The byproducts generated by AFI operation (the biomass removed from AFIs) could be used in manufacturing biofuels, organic fertilizer, and animal feed.

Compared to current water treatments, the AFI system is less expensive in terms of installation, operation, and the sustainable use of resources.

This project's research team wants to promote the use of AFIs for water treatment at the regional and national level using Ecuadorian materials and plants. Its goal is to generate a new sustainable product that can improve water quality for country's citizens.


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PHOTOS AND GRAPHICS
1 Average of removal of Nitrates in the system IFA | 2 Average of removal of Phosphates in the system IFA | 3 Average of removal of Cr, Pb and TPH in the system IFA | 4 Current structure of the IFA system | © credits: ???

COASTAL FISHING COMMUNITIES AND CLIMATE CHANGE IN ECUADOR: PRE-ADAPTATION TO CHANGE IN RESPONSE TO EL NIÑO AND LA NIÑIA


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GENERAL INFORMATION

Nikita Gaibor/Instituto Nacional de Pesca

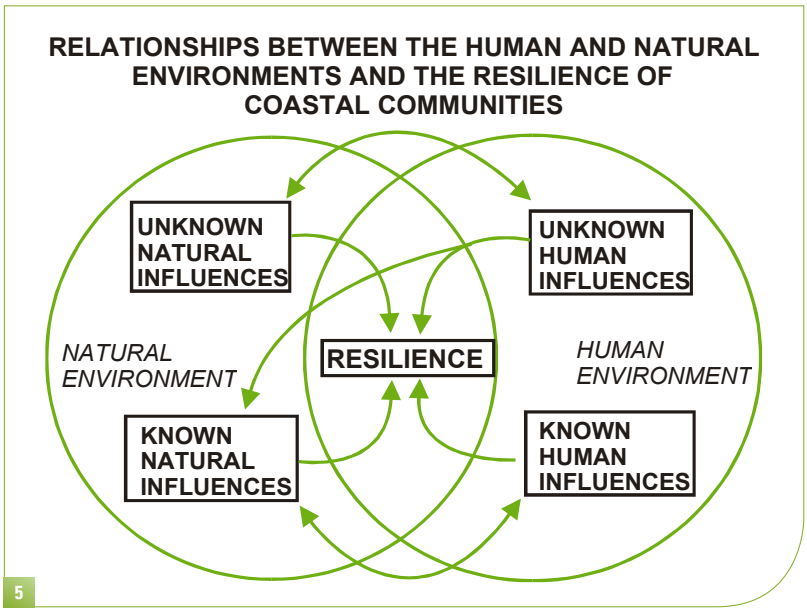
THE CHALLENGE

The purpose of this project is to examine human adaptation to weather extremes that often occur in coastal zones. For hundreds if not thousands of years, human communities in such areas have adopted behaviours that serve to reduce the impacts of these extreme weather events. Even in the global economy today, this innate resilience and adaptive capacity continues to be a feature of life for those communities. An examination of this human adaptability and resilience will enhance our understanding of how human societies cope with environmental dangers and provide information that will be useful in understanding how humans could modify their behaviour to respond appropriately to climate change.

The coastal communities of Ecuador have evolved in an environment of cyclical climatic variations referred to as El Niño-Southern Oscillation (ENSO) and La Niña – climatic events frequently characterized by extreme variations in precipitation, violent storms, and coastal flooding during El Niño and lower sea water temperatures and droughts during La Niña. These climatic events impact coastal geology and many of the characteristics of the complex ecological niche that exists between the land and the sea; coastal morphology including stream beds, lagoons, ponds, beaches, and other coastal features are changed to the extent that they scarcely resemble their past configurations. These changes are accompanied by changes in salinity of coastal lagoons, ponds, and wetlands. All this has a vast impact on coastal ecology and most species – including humans – must adapt or die off. Most available research has focused on the more extreme effects of El Niño, cataloging impacts on the social (housing, health, education), infrastructural (water and sewage, energy and electricity, transportation and telecommunications, urban infrastructure), and economic (agriculture, livestock and fisheries, industry, commerce and tourism) sectors and sub-sectors (Comité Nacional sobre el Clima, 2001). For example, data from the extraordinary 1997-1998 El Niño event revealed nearly $2.9 billion in damage, including destroyed highway infrastructure ($785.1 million), impaired agriculture activities ($1.186 billion), and losses at fisheries ($42.40 million; CAF, 2000). Reports make it clear that social, political, and infrastructural factors influence the severity of the impact (cf. Cornejo-Grunauer et al., N.D.), and recommendations are offered to mitigate it. There are also concerns that the impact of La Niña has not been fully addressed (Cornejo-Grunauer, 1998; Broad, 1998). Thus far, no systematic, comparative efforts have been made to investigate the biological, social, technological, and cul-

tural variables related to community vulnerability and resilience to the impacts of El Niño and La Niña.

El Niño events are associated with physical and biological changes in our oceans that affect fish distribution. Among the variations in oceanographic features that are observed following an El Niño/Southern Oscillation (ENSO) event are changes in sea-surface temperatures; changes in the vertical, thermal structure of the ocean (particularly in coastal regions); and altered coastal and upwelling currents. These changes can directly affect the species composition and abundance of fish. In the southern hemisphere, El Niño events typically result in observations of tropical, warm-water species moving north (thereby extending their range). Cold-water species move south or into deeper water (thereby restricting their range). Surface-oriented, schooling fish often disperse and move into deeper waters. Fish that remain in an affected region experience reduced growth, reproduction, and survival.



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THE APPROACH AND CIENTIFIC COOPERATION

This project's goals are to ensure that fishery policy and practice protect fishery-dependent livelihoods from the adversities of climate change, and that adaptation strategies incorporate improved fishery management so as to harness fishery-based ecosystem services and enhance the resilience of other economically important sectors.


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Resilience will be defined as the capacity of a social system involving multiple levels of government, communities, and individuals to cope with uncertainty and change in the advent of environmental disaster and/or political, social, or economic disturbances (Abesamis et al., 2006; Pollnac et al., 2008).
Individual and social resilience are complicated variables that represent an ability to cope with change. They are related to other social and psychological variables, including social support systems (families, community groups, and social services), self-esteem, and perceived control.

Interrelationships between natural and human environments and resilience are depicted in the figure below. An obvious example of a known human factor that influences resilience would be building construction regulations that reduce or eliminate the risk of damage occurring during an extreme weather event.

THE INNOVATION AND INTENDED IMPACT

The systematic comparative research proposed for this project will help separate out the factors associated with this variance. These findings will be used to provide guidelines for changes that can increase the resilience of the coastal communities of Ecuador. Data and findings will be disseminated throughout workshops in different coastal communities and through a national workshop with government authorities and community leaders. In addition, the results of this project will be published in professional journals.

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PHOTOS AND GRAPHICS
1 © credits: 1:

DEVELOPMENT OF A DECISION SUPPORT SYSTEM FOR CLIMATE RESILIENCE AND NATURE MANAGEMENT AT SANGAY NATIONAL PARK: A PARTICIPATORY AND INTEGRATED ECOSYSTEM ASSESSMENT

GENERAL INFORMATION

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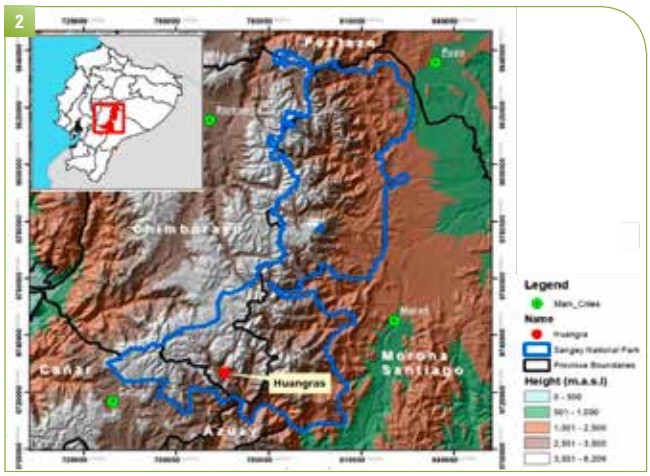
Dr. Pablo Guzman, CELEC EP Unidad de Negocio Hidropaute, Universidad del Azuay

Dr. José Jara, CELEC EP, Universidad del Azuay



THE CHALLENGE

A participatory and integrated model will be developed to support the decision-making process for the preservation and restoration of ecosystem services in the highland evergreen forest and páramo using Sangay National Park (SNP, located in the southern Andes of Ecuador) as a case study.

SNP is characterized by high biodiversity and endemism, which provides for valuable ecosystem services; its sustainability, however, is threatened by climate change and human impact. The indigenous community of Guangras, which lives within SNP's valuable ecosystem, is trapped between the need to improve their quality of life and the restrictions imposed by the presence of this ecosystem.

THE APPROACH AND CIENTIFIC COOPERATION

The project addresses SDGs 1, 12, and 15. Different methods are applied, including remote sensing, GIS, and system analysis. Meanwhile, indigenous communities are also directly involved through a participatory approach. Due to the multi-disciplinary expertise of the project partners, the project aims to sustain SNP's existing resources, prevent further losses, and contribute to a long-term strategy for the ecosystem through an established scientific cooperation between ZFL, the University of Bonn, and the two Ec-

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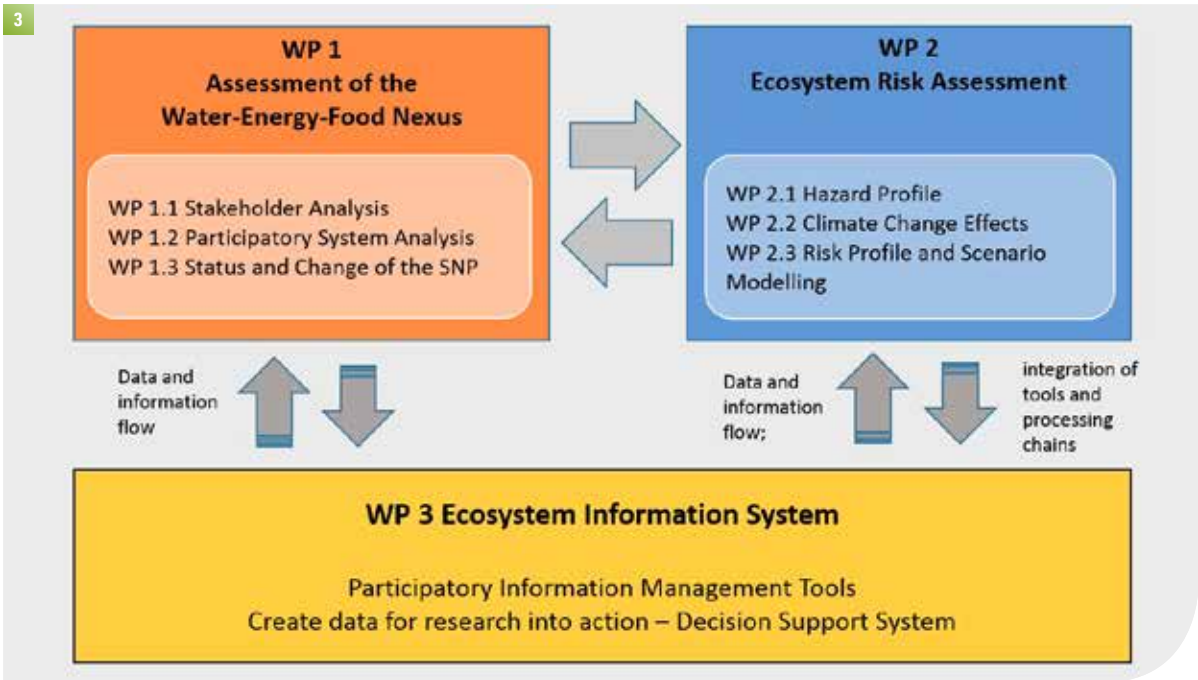

uadorian universities of Azuay and Cuenca. ZFL's expertise is in remote sensing and GIS, including hazard monitoring that is due, for example, to climate change or human impact. The University of Azuay has expertise in environmental analysis, food production, engineering, and participatory system analysis. Finally, the University of Cuenca is well known in the field of energy, the environment, and food and will support the ecosystem risk assessment with its knowledge of data infrastructures.

THE INNOVATION AND INTENDED IMPACT

Understanding complex systems is key to providing adequate advice for action. The SNP ecosystem is highly valuable to Ecuador and to those living in and from the services it provides. Knowing the demands of the local indigenous communities, but also monitoring the impacts of climate change with regard to potential hazards, will support national and local policy recommendations in this area. Drawn from participatory mapping with local authorities and the indigenous peoples themselves, the integration data collated in an information system will further support the sustainability of the project activities described. Local authorities such as the SNP administration and Junta Parroquial de Rivera – which are responsible for the management of the protected area and the territory, respectively – will acquire tools to improve their management. A guide can also be provided to the hydropower generation company to improve the effectiveness of its investment in preserving the ecosystem.

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PHOTOS AND GRAPHICS
1 Guangaras Community | 2 Study Area | 3 WorkPackages | 4 SNP National Parc | 5 SNP | 6 SNP | © credits: all pictures by Dr. Pablo Guzman, figures developed within the team

espol Escuela Superior Politécnica del Litoral

espol Centro nacional de Acuicultura e investigaciones marinas

MODEL STUDY: CLIMATE-CHANGE-RESILIENT MANAGEMENT OF THE BIODIVERSITY OF MARINE INVERTEBRATES FROM THE COASTAL ZONE FROM CABO DE SAN LORENZO TO PUNTILLA DE SANTA ELENA IN ECUADOR

GENERAL INFORMATION

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THE CHALLENGE

The project idea focuses on climate-change-resilient management of the biodiversity of marine invertebrates inhabiting the coastal zone between Cabo de San Lorenzo and La Puntilla de Santa Elena and the identification of potentially invasive species affecting these local ecosystems.

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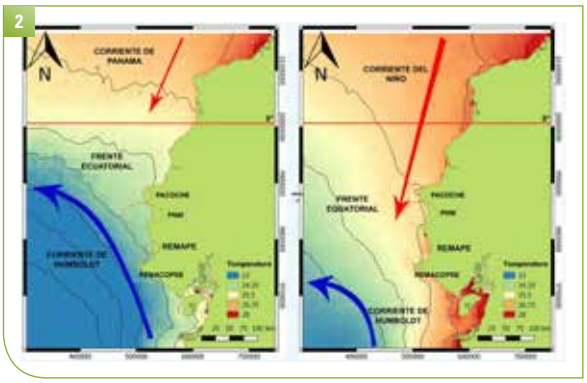
Climate change and invasive species are two main factors that affect the marine ecosystem and lead to the extinction of native species. Additionally, climate change encourages invasive species to spread over different ecosystems and creates an environment conducive to others becoming invasive. The presence of the invasive Caribbean octocoral Carijoa riisei has been reported on the coast of Colombia, the Galapagos Islands, and recently in the El Pelado Marine Protected Area (REMAPE) in Ecuador. A previous study of Carijoa riisei in Colombia highlighted their invasive behaviour due to competition for substrate with local species (particularly native octocorals), which causes severe damage to the ecosystem. Although C. riisei is invading the shallow waters, some marine invertebrates that inhabit these areas – such as the ahermatypic coral Tubastrea coccinea and a member of the phylum Porifera (taxonomy identification in process by CENAIM) – promise to be species potentially capable of stopping the overgrowth of C. riisei and the mortality caused to other marine invertebrate species. Meanwhile, other invasive species such as ascidians of the genus Didemnum have also been spotted on the continental coast of Ecuador. In fact, ascidians have been described as models for invasion studies. The study of invasive ascidians can be addressed using collectors and systems of mollusk culture and completed with molecular tools for species identification, as well as GIS for biodiversity management.



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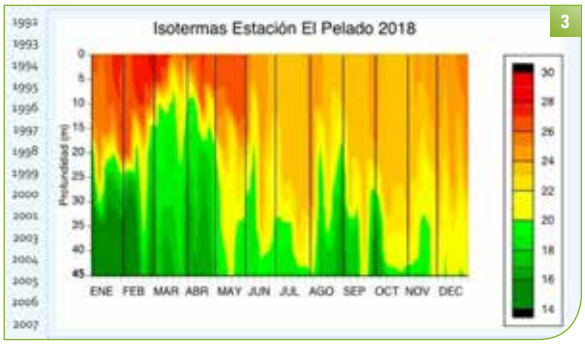
THE APPROACH AND CIENTIFIC COOPERATION

The general objective is to contribute to sustainable, climate-change-resilient management of the marine invertebrates in Ecuador as a model study for other countries.
The first specific objective would be the assessment of the current state of the biodiversity of marine invertebrates from Cabo de San Lorenzo to La Puntilla de Santa Elena. It is necessary to establish effective policies based on the experience of developed countries like Germany that could be applied to maintain healthy marine ecosystems in Ecuador. CENAIM possesses human resources with the scuba-diving skills necessary for sample collection and taxonomical identification of certain groups of marine invertebrates and microorganisms. The application of metabolomics has proven to be a good taxonomic tool for the identification of undescribed species. We would require the collaboration of an institute with analytical equipment such as liquid chromatography/mass spectrometry (LC/MS) to analyse the sample extracts.

The second specific objective focuses on the identification of potential live barriers based on native species that could control the proliferation of invasive ones. The presence of



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the invasive octocoral C. riisei and ascidians of the genus Didemnum represent a great danger to the native species of octocorals and other invertebrates. Therefore, it is necessary to study the natural barrier of ahermatypic corals and sponges that could help prevent the expansion of C. riisei and establish a sustainable mechanism for cultivating the protective species and promoting the development of the local ones. CENAIM has a unique location within REMAPE and the ideal infrastructure for cultivating ex situ and transplanting 1) live barrier species to avoid colonization of invasive ones; and 2) endangered species such as octocorals to specific zones. The expertise of our collaborators will contribute to preserving the biodiversity of marine invertebrates and transferring the generated knowledge to local scientists and policy makers.


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The third specific objective is to evaluate the metabolite profiling of marine invertebrates and invasive species and its relationship to the spatial-temporal variation of sea water temperature.

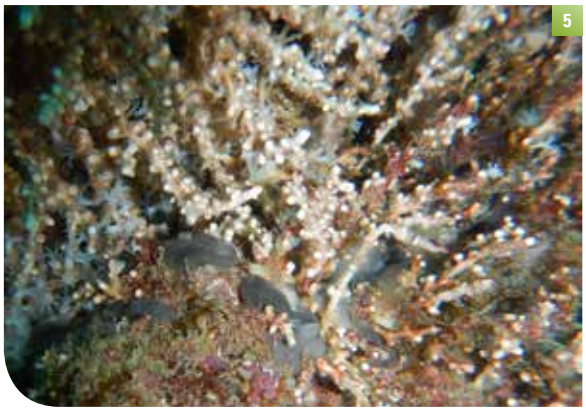
The application of metabolomics will help to understand the physiological responses of the analysed species to extreme temperature conditions. The chemistry department at CENAIM is capable of obtaining the extracts for sample analysis and for further purification of secondary metabolites. To accomplish this objective, we need collaboration with German institutes equipped with hyphenated technologies such as LC/MS or GC/MS and WebGIS.

THE INNOVATION AND INTENDED IMPACT

The impact of this project will contribute to the creation of research-based innovations within the framework of the national marine biodiversity and climate change strategy. This will be reflected by the development of protocols for ex situ cultivation of both live barrier species and endangered ones and subsequent transplantation to specific zones.

The documentation of the biodiversity data is an important step toward a wise and sustainable practice for its conservation and management, which is an emerging global priority. The generated biodiversity data will be systematized in a database (Darwin Core standard) and integrated into a geographic information system that uses WebGIS.

In addition, this information will be published in scientific journals and distributed to national and local agencies via workshops in the field. During these workshops – together with Ecuadorian government agencies like the Ecuadorian Ministry of the Environment (MAE), the National Biodiversity Institute (INABIO), and the German academic experts involved in the project – we will develop a sustainable strategy for climate-change-resilient management of the biodiversity of marine invertebrates and invasive species.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Furthermore, the German scientists will acquire valuable experience not only in development co-operation, but also in developing technical skills in marine conservation in tropical countries with unique environmental conditions and biodiversity.

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PHOTOS AND GRAPHICS
1 National Center of Aquaculture and Marine Investigation (CENAIM; photo credit: ESPOL) | 2 Sampling zone from Cabo de San Lorenzo to La Puntilla de Santa Elena (photo credit: Dr. Jenny Rodriguez) | 3 Spatial-temporal variation of sea water temperature (photo credit: Dr. Stanislaus Sonneholzner) | 4 The invasive octocoral *Carijoa riisei* overgrowing a species of *Muricea* and the ahermatypic coral *Tubastrea coccinea* limiting its expansion (photo credit: Karla Jaramillo) | 5 Marine sponge (taxonomy under study) killing the invasive C. riisei (photo credit: Cristobal Dominguez)

Universität Hamburg
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CeNak
Centrum für Naturkunde

ARACUADOR: ESTABLISHING A PIPELINE FOR THE SUSTAINABLE USE OF ECUADORIAN ARACHNID BIODIVERSITY IN MOUNTAIN FOREST ECOSYSTEMS

GENERAL INFORMATION

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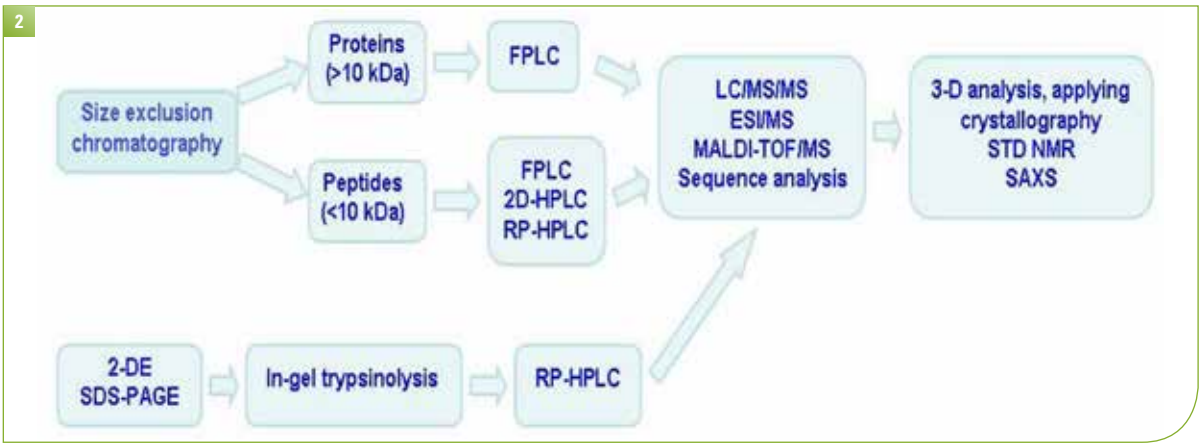
THE CHALLENGE

Arachnids account for a major fraction of Ecuador's biodiversity and deliver important ecosystem services such as insect pest regulation. This fauna is poorly documented, but comprises many venomous species of medical relevance and offers major potential for applied research. Using arachnids as a model, we will develop a pipeline for applied biodiversity research in the mountain forest ecosystems of Ecuador. This pipeline will include the discovery and taxonomic characterisation of arachnid species via a fully automated DNA barcoding approach, the establishment of biobanks to store genetic and venom data for long-term research, and improved data access via the online database BIOWeb Ecuador. We will bring together an international team with recognised experts for multidisciplinary research that has three aims:

i) Establishing the infrastructure and technical skills to gather and use biodiversity data in both national and international networks
ii) Publicising and sharing this data through online repositories
iii) Preserving this information for future generations (through the establishment of biobanks) and applied research

THE APPROACH AND CIENTIFIC COOPERATION

The ARACUADOR project will bridge the gap in the current knowledge of biodiversity in mountain forest ecosystems (species, genetic and chemical), build tools to document



this fauna, generate networks and databases to share the knowledge, and train students and researchers. For this purpose, we will bring together the expertise of four working groups (**Arachnid Systematics Lab**, CeNak in Hamburg; the **Center of Molecular Biodiversity Research**, Bonn; the **Laboratory for Structural Biology of Infection and Inflammation** in Hamburg; and **Museo de Zoología, Pontificia Universidad Católica del Ecuador**, Quito).

THE INNOVATION AND INTENDED IMPACT

For the first time, a project will use an integrative approach to explore an untapped biological resource (venomous arachnids) in Ecuador. The direct outputs will be:

1. Characterisation of arachnids through field collections, molecular barcoding, and taxonomic description of new species
2. Physical infrastructure bBiobanks and specimen collections)
3. Free access to the data via BioWeb Ecuador and other online repositories (e.g. GenBank)
4. Training of students/scientists in three workshops ("Metabarcoding and Biobanking", "Venom Proteomics", and "Arachnid Biodiversity in Ecuador")
5. International exchange and supervision of six students
6. Formation of long-term collaborations between German institutions their Ecuadorian counterparts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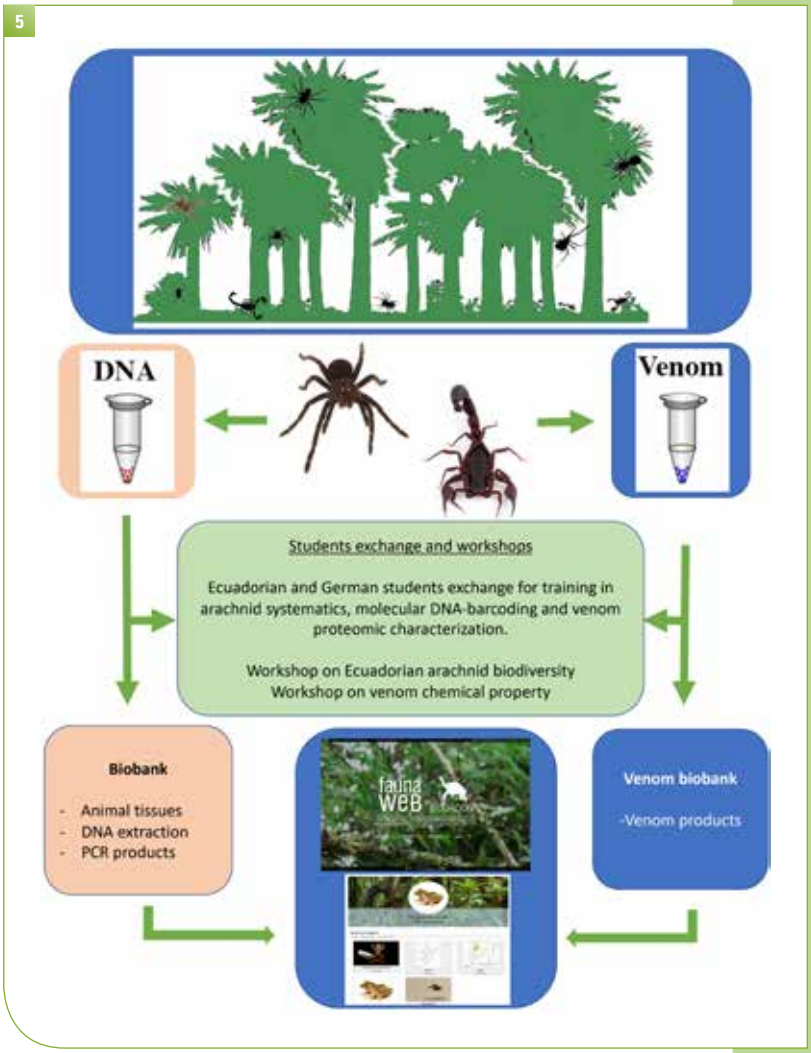


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PHOTOS AND GRAPHICS
1 Cloud forest, Ecuador | 2 Workflow for the project | 3 Molecular lab for workshops and student training | 4 Biobank at the Zoological Museum in Bonn | 5 Venom characterisation | © credits: all images provided by the applicants, Elicio Tapia & Lars Podsiadlowski

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NATIONAL ECOSYSTEM SERVICE ASSESSMENT AND MAPPING AS AN INDICATION OF THE COSTS OF LOSSES OF BIODIVERSITY – A FAST-TRACK STUDY IN ECUADOR

GENERAL INFORMATION

Prof. Dr. Christine Fürst (MLU)
Dr. Janina Kleemann (MLU)
Prof. Dr. Pablo Cuenca (IKIAM)

THE CHALLENGE

Ecuador is rich in biodiversity and endemic species. In contrast, high rates of forest decline and fragmentation have been reported over the last 30 years. Currently, sporadic empirical studies on biological conservation exist, which provides only scattered insights into ongoing losses of biodiversity and ecosystem services in Ecuador.

THE APPROACH AND CIENTIFIC COOPERATION

The goal is to conduct a joint mapping and assessment of the capacities of ecosystems that provide regulating, provisioning, and cultural services as a fast-track study to initiate ecosystem service assessments at the national level. The aim will also be to deepen joint research activities on biodiversity and ecosystem service losses, as well as on their impacts and costs for Ecuador.


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Approach:
Representative forest ecosystems from the main biomes (Amazon area, Andean and coastal area) will be selected and respective indicators identified. As a complement to available quantitative information, we will also conduct workshops and surveys to fill knowledge gaps. The modelling software GISCAME will be used for the interactive mapping and assessment of ecosystem services and for developing land use / land cover change scenarios.

Activities:
1. Strategic coordination meetings at MLU and IKIAM
2. Workshop series with experts, scientists, and local knowledge holders
3. Study missions to representative forest ecosystems in Ecuador and mutual visits of guest lecturers
4. A joint summer school to present the results of the project while also training students in methods and techniques

Partners:
IKIAM has a huge database of biodiversity and ecosystem services provided in particular by forest ecosystems, and MLU is experienced in scenario modelling and ecosystem service assessments.

THE INNOVATION AND INTENDED IMPACT

The primary output of the study will be an overview of (and values for) indicators designed to assess forest ecosystems' capacity to provide services to people.

The potential beneficiaries of the project, especially of the summer school, include master's students, doctoral students, and post-docs. Digitally available outputs – for example, a national map of forest ecosystem service capacity – will inform national environmental authorities and national research institutions. The fast-track study could also form the basis for the second planned IPBES assessment. Therefore, the broader scientific community and political representatives could also be interested.

The first-level outreach effort involves visual and written material to make people aware of the high value of biodiversity and ecosystem services.
The second level is through scientific publications.


6

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PHOTOS AND GRAPHICS
1 | © credits:

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BIODIVERSITY AND CLIMATE CHANGE EFFECTS ON THE EPIDEMIOLOGY OF SNAKE AND SCORPION ENVENOMINGS, TWO OF THE MOST NEGLECTED DISEASES IN ECUADOR

1

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Dr. David Salazar-Valenzuela. Professor, Centro de Investigación de la Biodiversidad y Cambio Climático. Universidad Tecnológica Indoamérica.

Dr. Mario Grijalva. Professor, Centro de Investigación para la Salud en América Latina. Pontificia Universidad Católica del Ecuador.

Dr. Carolina Proaño-Bolaños. Professor, Universidad Regional Amazónica IKIAM.

Dr. Rafael Almeida. Professor, Universidad Regional Amazónica IKIAM.

Dr. Mauricio Ortega-Andrade. Professor, Universidad Regional Amazónica IKIAM.

Dr. Bernhard Spengler. Institute of Inorganic and Analytical Chemistry. Justus Liebig University Giessen.

THE CHALLENGE

Establishing the epidemiological consequences that species and toxin diversity, as well as the highland colonisation facilitated by climate change, have on the incidence and control of snake and scorpion envenomings among the human population of Ecuador. These incidents represent neglected tropical diseases that have a significant impact on society because the most affected groups are young agricultural workers and children.

THE APPROACH AND CIENTIFIC COOPERATION

The real impact of these public health emergencies has not been accurately determined in the country, as the available epidemiological data is limited to incomplete hospital records. Moreover, Ecuador is one of the few Latin American countries that does not produce antivenom locally. Currently, incidents are treated with antivenoms imported from neighbouring countries, but their efficacy in toxin neutralisation has not been fully tested for all the species of medical relevance. We propose to improve this situation by exploring the genetic lineage and toxin diversity present in eight species (table 1), determining the neutralisation of their toxins, modelling their current and projected future distributions in the context of climate change, and establishing the incidence of these diseases through community

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surveys. These activities will bring leading Ecuadorian researchers in climate change, species and toxin diversity, and neglected tropical diseases together with their German counterparts. We would also like to identify new partners who can contribute expertise from related fields.

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THE INNOVATION AND INTENDED IMPACT

One of the unique aspects of our consortium is its pronounced inter- and transdisciplinary character and applied orientation. Our proposal addresses the sustainable use of biodiversity by exploring the genetic sources of toxin diversity and providing much needed information for improving the clinical management of human envenoming; establishing the current and future interactions of humans and venomous fauna to guide public health interventions and resource allocation; and applying biotechnological tools to contribute to the discovery and future use of biotoxin diversity. We see great potential in using this venomous conflict between humans and animals to reach the public with information about neglected diseases and biodiversity/climate impact research, as well as to promote the importance of STEM education and international research collaborations.

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Species (taxonomic group)	Geographic distribution in Ecuador	Medically-important / endemic species
Bothrops asper (Viperidae: Serpentes)	Western Ecuador, 0-2000 masl	Medically-important
Bothrops atrox (Viperidae: Serpentes)	Eastern Ecuador, 0-1300 masl	Medically-important
Bothrops lojanus (Viperidae: Serpentes)	Southern Ecuador, 2100-2800 masl	Endemic
Bothrops pulcher (Viperidae: Serpentes)	Eastern Ecuador, 450-2300 masl	Medically-important
Bothrocophias microphthalmos (Viperidae: Serpentes)	South-eastern Ecuador, 700-1800 masl	Medically-important
Porthidium arcosae (Viperidae: Serpentes)	Central coast of Ecuador, 0-300 masl	Endemic
Tityus asthenes (Buthidae: Scorpiones)	Western and eastern Ecuador	Medically-important
Tityus aff. Obscurus (Buthidae: Scorpiones)	South-eastern Ecuador	Medically-important

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PHOTOS AND GRAPHICS
1 Porthidium arcosae | 2 Kuch Campo Diego Quirola | 3 Bothrops atrox | 4 Tityus sp | 5 Kuch Campo Diego Quirola | 6 Proposed species of medically-important or endemic species of Ecuadorian snakes and scorpions to be included in the project. | © credits: Snake pictures: Diego Quirola; Scorpion picture: Alejandro Arteaga

Universität Hamburg
DER FORSCHUNG | DER LEHRE | DER BILDUNG

BNITM
Bernhard Nocht Institute for Tropical Medicine

LInk Between Bat and viRus biodivErsiTy in the mounTains of EcuadOr (LIBRETTO)

GENERAL INFORMATION

Germany:
Prof. Dr. Dr. Jonas Schmidt-Chanasit
Dr. Renke Lühken
Dr. Daniel Cadar

University of Hamburg, Bernhard Nocht Institute for Tropical Medicine, Hamburg, Germany

Partners in Ecuador:
Dr. Santiago F. Burneo
Dr. Melinda Hofmann

Universidad Católica del Ecuador, Quito, Ecuador

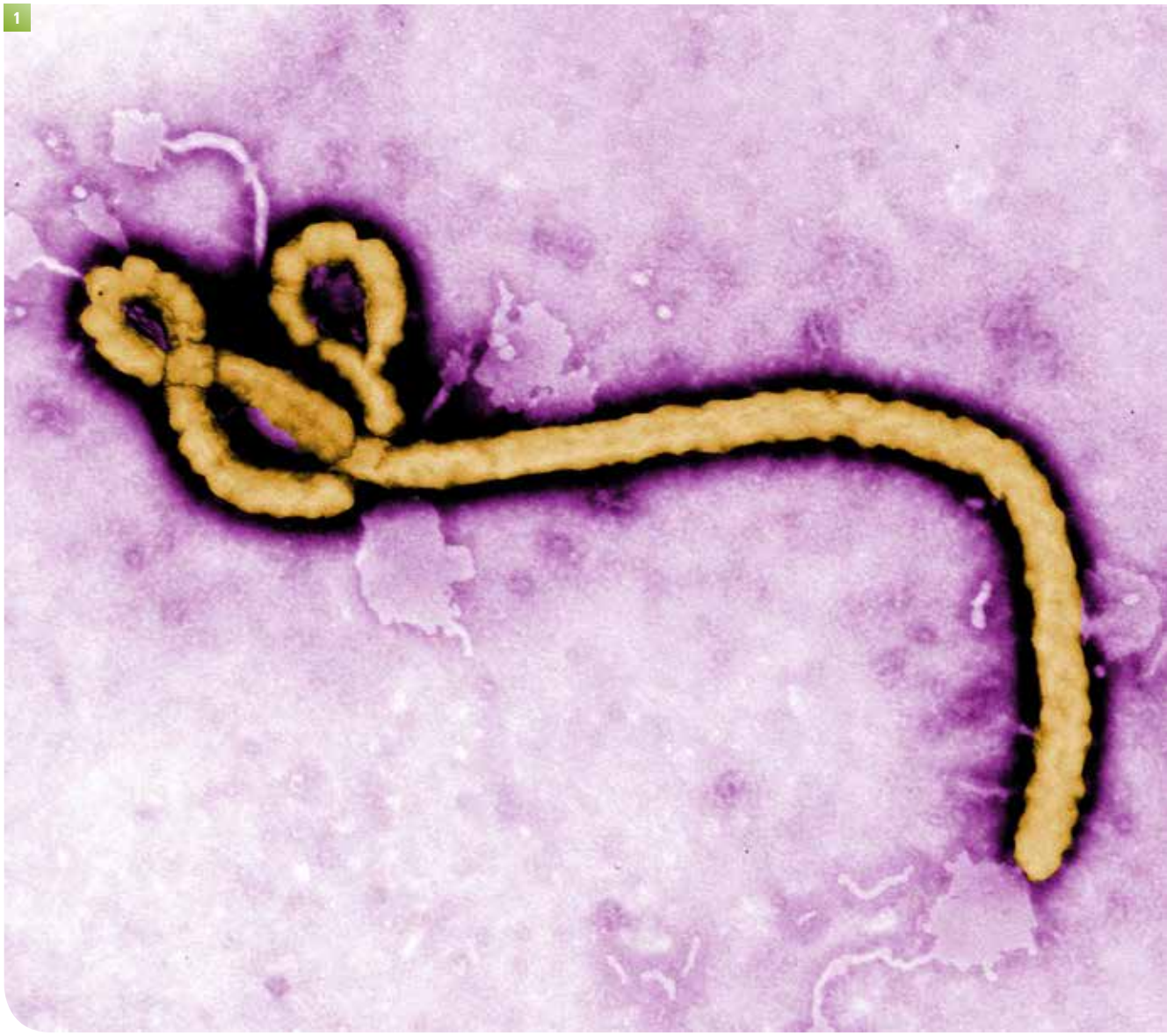
THE CHALLENGE

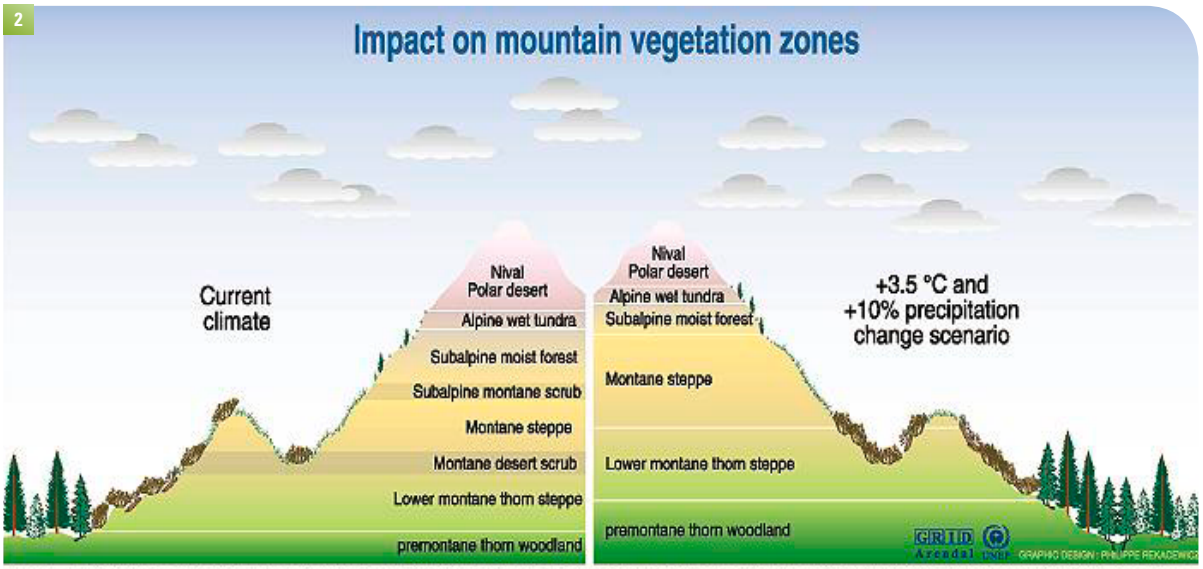
Shifts in climatic regimes can have a direct impact on the distribution of species. Here, climatic conditions also have a significant impact on the local or regional emergence and frequency of zoonotic viruses, which is significantly influenced by the availability of potential host species. Bats are known hosts to a range of zoonotic pathogens and also have a high vulnerability to environmental changes associated with climate change. Therefore, the proposed research project aims to study the diversity of bats and associated viruses in the mountainous areas of Ecuador.

THE APPROACH AND CIENTIFIC COOPERATION

Integrated and multi-disciplinary techniques have to be applied to measure in-situ ecological parameters – hosts,

1





Sources: Martin Benitson, Mountain environments in changing climates, Routledge, London, 1994; Climate change 1995, Impacts, adaptations and migration of climate change, contribution of working group 2 to the second assessment report of the intergovernmental panel on climate change (IPCC), UNEP and WMO, Cambridge press university, 1996.

pathogens, climate, and landscape – along the altitude gradient in the mountainous areas of Ecuador. In the context of the proposed study, strengthening the link between researchers from the field of biodiversity and human health in a single transdisciplinary health project seems advantageous. Dr. Santiago F. Burneo and Dr. Melinda Hofmann (Pontificia Universidad Católica del Ecuador) were identified as potential partners during a stay in 2018. These partners were able to collect and provide samples from different bat species within their ongoing research projects/programmes, which have recently been submitted to our next-generation core facility for virome characterisation. This demonstrates the general functionality of the cooperation between both research groups. The proposed project will further strengthen our partnership through mutual research stays and the sharing and exchange of knowledge in a more systematic way.

THE INNOVATION AND INTENDED IMPACT

Emerging or re-emerging viruses have reached the forefront of medical research at the global scale due to prominent outbreaks in recent years (of the Ebola and Zika viruses, for example). However, the overall knowledge of these viruses' biodiversity is very limited. Joint integrated data analysis of host community compositions and virus sequences will help to understand the spatio-temporal variability of the risk of virus transmission along the altitudinal gradient and to estimate potential changes in the causes of environmental shifts associated with climate change.

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PHOTOS AND GRAPHICS
1 CDC Global | 2 United Nations Environment Programme / GRID-Arendal | 3 Trisha Shears | © credits:

TECHNISCHE UNIVERSITÄT BERGAKADEMIE FREIBERG
Die Ressourcenuniversität. Seit 1765

EcoBIOCEG: ECOSYSTEM SERVICES – BIODIVERSITY – CLIMATE CHANGE – ECUADOR – GERMANY

GENERAL INFORMATION

Prof. Dr. Jörg Matschullat
Interdisciplinary Environmental Research Centre
TU Bergakademie Freiberg

THE CHALLENGE

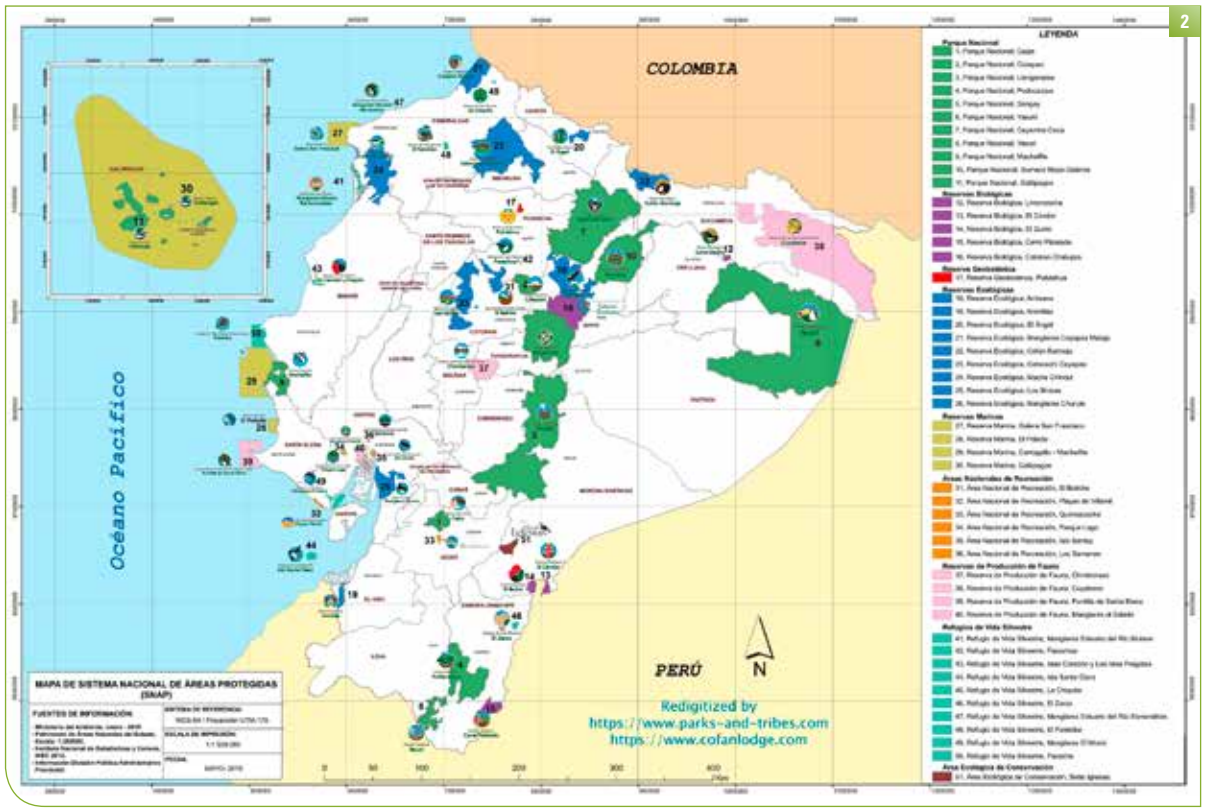
Deforestation is detrimental to the resilience and elasticity of biomes and to biodiversity. With land-use changes already straining ecosystems and biomes, climate change is adding additional stress. Yet, how exactly do ecosystems react? To what extent is that reaction dependent on bound-ary conditions such as average temperature, pre-cipitation, and soil quality?

THE APPROACH AND CIENTIFIC COOPERATION

Locations are targeted along a country-wide tran-sect from the Amazon basin via the Andes down to the coastal lowlands on the Pacific Ocean. At each location, barely disturbed forests will be compared to neighbouring deforested sites. Sites are selected for maximum spatial representativity of related ecosystems and biomes. Repeated study (dry season/wet season) will assess intra-annual dynamics and improve the robustness of the results.

Along with pedogeochemistry, soil and ecosystem respiration serve as proxies for assessing and qualifying the sites in each field campaign. Our partners focus on biodiversity at those sites, and we work together on analysing and interpreting all the resulting data.

Respiration is determined repeatedly on-site with proven, manual, closed-chamber systems. Field parameters (including soil samples) are being collected to determine carbon and nitrogen pools, quantify macro- and micronutrients, and complete biodiversity investigations. The latter will be per-formed by Selene Baez and David Donoso from Escuela Politécnica Nacional in Quito, and by Wilfredo Ramos from Universidad Regional Amazónica (IKIAM) in Tena.



THE INNOVATION AND INTENDED IMPACT

No large-scale transect work with related studies has been performed in Ecuador, and very few have been carried out in the equatorial region. A global review of soil respiration shows climate zone differentiation, but no elevation-related dis-tinction. We aim to produce added value through our approach by following a large-scale transect with various climate zones along the Equator.

We expect novel results that will allow for better assessment of ecosystem vulnerability not simply in terms of longitudinal climate zones, but differ-entiated by elevation gradients. This will lead to a more robust understanding of climate-change-related processes. We will also deliver high-quality data on soil chemistry and new insights into biodiversity variation between largely undisturbed and disturbed neighbouring sites under boundary conditions with maximum variability.

The results will be helpful to decision makers, farmers, and nature protection agencies. The out-comes will be disseminated in workshops and conferences, publications, and public media, as well as through our website and targeted reports for stakeholders.

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PHOTOS AND GRAPHICS
1 Photo collage. Impressions from the Ecorespira-Amazon project (NoPa2) in Amazonas state, Brazil. © Jörg Matschullat | 2 Map of the Ecuadorian national system of nature-protected areas. © Ecuadorian Ministry of the Environment, January 2015 | 3 Butterfly sucking blood at a dead freshwater stingray (Aripuana River, Amazon basin, Amazonas state, Brazil) © Jörg Matschullat | 4 Soil respiration determination. Two students working with a SEMACH-FG unit in an Amazon basin capoeira forest, Amazonas state, Brazil. © Jörg Matschullat

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Technology
Arts Sciences
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NATURE-BASED SOLUTIONS FOR COASTAL AREAS OF ECUADOR

GENERAL INFORMATION

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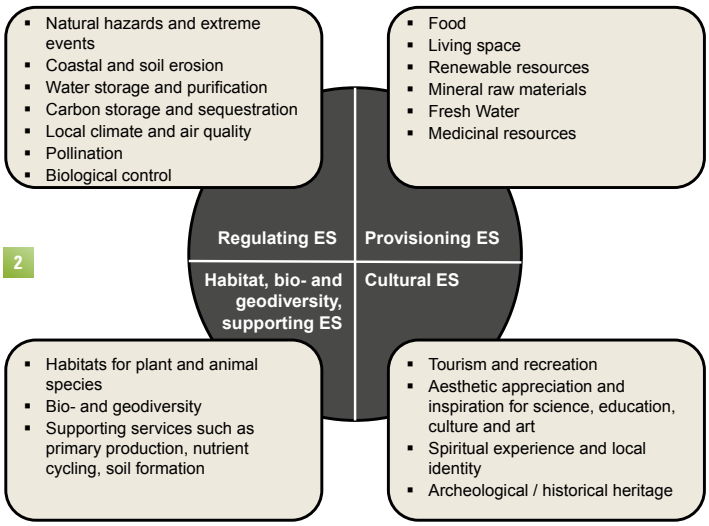
Institute for Technology and Resources Management in the Tropics and Subtropics
TH Köln - University of Applied Sciences, Cologne, Germany

Potential partner:
Dr. Maria del Pilar Cornejo de Grunauer
DECANA FIMCM

1

THE CHALLENGE

Around the world, coastal zones are exposed to demographic and economic pressures that result in the degradation of ecosystem services and biodiversity loss.[1,2] In many countries (including Ecuador), this pressure is exacerbated by the effects of global climate change, which threatens the social-ecological system as a whole and undermines sustainable development.[3,4]



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THE APPROACH AND CIENTIFIC COOPERATION

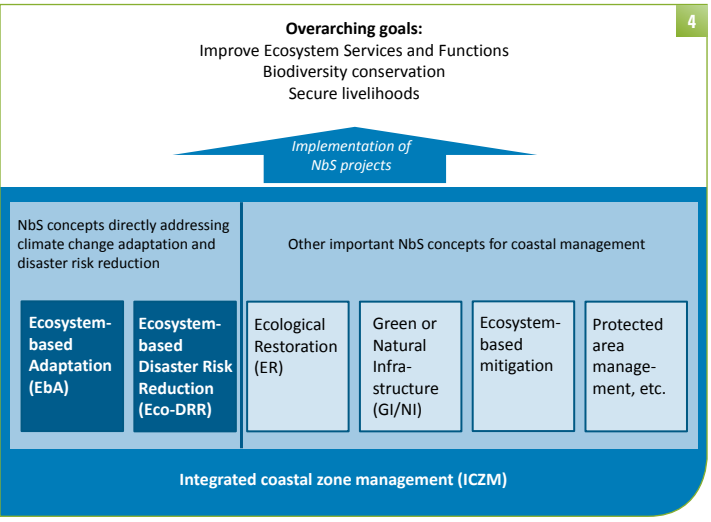
Nature-based solutions (NbS) are proposed to adapt to the impacts of climate change and protect coastal areas from natural hazards (sea level rise, coastal erosion, storm surges, etc) while supporting ecosystem services and biodiversity conservation (fig. 1). NbS is an umbrella term for several concepts[3] and also includes hybrid solutions that combine ecosystems and technical measures. Important NbS approaches are shown in fig. 2, while figs. 3-5 provide some examples of coastal NbS projects around the world.
In this context, our objectives are to:

1. Assess services of coastal ecosystems in southern Ecuador (mangroves, coastal wetlands, etc)
2. Develop a portfolio of NbS that address climate change adaptation, disaster risk reduction, and biodiversity conservation
3. Analyse how NbS will likely improve coastal ecosystem services
4. Prioritise NbS on the basis of economic, ecological, social, and institutional criteria and select potential sites for implementation
5. Establish "open science labs" in select coastal ecosystems to conduct long-term participatory environmental monitoring in cooperation with Ecuadorian partner universities, local communities, stakeholders and government institutions

3

THE INNOVATION AND INTENDED IMPACT

- Mapping coastal ecosystem services, estimating the costs and benefits of NbS, and assessing the potential improvement of ecosystem services after NbS implementation is a new concept for Latin America; it refers to the Aichi Targets, the Sendai Framework for Disaster Risk Reduction, and the SDGs.
- Open science labs allow long-term monitoring and data collection and provide a space for Ecuadorian and German researchers and students to gain prac-



tical experience in cooperation with local stakeholders, communities, and institutions.

Decision-makers, local stakeholders, and communities are part of the development process. Acquiring better knowledge of values pertaining to coastal ecosystems and decision-making and planning procedures will foster more sustainable coastal management.

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[5] Cohen-Shacham, E., Walters, G., Janzen, C. and Maginnis, S. (eds.) (2016): Nature-based Solutions to address global societal challenges. Gland, Switzerland: IUCN. xiii + 97pp.

[6] Nehren, U., Hoang H.D.T., M.A. Marfai. C. Raedig, S. Alfonso de Nehren, J. Sartohadi & C. Castro (2016): Assessing ecosystem services and degradation status of coastal dune systems for Eco-DRR and EbA: Case studies from Vietnam, Indonesia, and Chile. In: F. Renaud et al. (eds.): Ecosystem-based Disaster Risk Reduction and Adaptation in Practice, Springer Series: Advances in Natural and Technological Hazards Research 42: 401-434.

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PHOTOS AND GRAPHICS

1 Reforestation of coastal dunes and sandy shores with native species in central Vietnam | 2 Ecosystem services provided by coastal dune systems in Chile, Indonesia, and Vietnam[6] | 3 Integrated coastal zone management in the Netherlands | 4 NbS for coastal management; author's own elaboration | 5 Training on Eco-DRR; focus on mangrove restoration in Java, Indonesia | © credits: 1 Photos by Hoang Ho Dac Thai; authorised | 2 Author's own elaboration, published in: Nehren, U., Hoang H.D.T., M.A. Marfai. C. Raedig, S. Alfonso de Nehren, J. Sartohadi & C. Castro (2016): Assessing ecosystem services and degradation status of coastal dune systems for Eco-DRR and EbA: Case studies from Vietnam, Indonesia, and Chile. In: F. Renaud et al. (eds.): Ecosystem-based Disaster Risk Reduction and Adaptation in Practice, Springer Series: Advances in Natural and Technological Hazards Research 42: 401-434 | 3 Photos by U. Nehren | 4 Author's own elaboration for matchmaking workshop; not published | 5 Brochure from Gadjah Mada University; authorised

PALM-POLLINATOR NETWORKS VARIABILITY IN AN ANDEAN-AMAZONIAN ELEVATION GRADIENT: INSIGHTS FOR FUTURE CLIMATE RESPONSE

GENERAL INFORMATION

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THE CHALLENGE

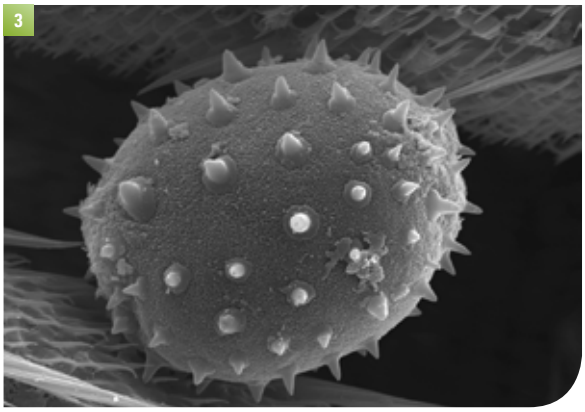
To predict the impact of climate change on economically important pollinator-plant tropical systems.

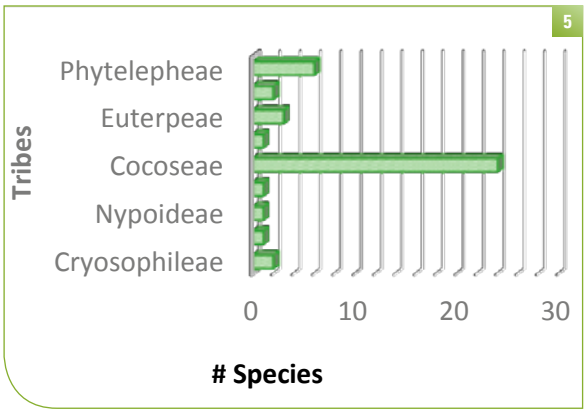
Research questions

Does elevation influence the community structure of pollinators and floral visitors of palm species?
Are there differences in the thermogenesis of inflorescences of palm-species in the elevation gradient?

Introduction

Insect pollinators are under threat globally and their decline is predicted to have profound implications for ecosystem function, particularly in the tropics.
No studies in the communities of pollinators, nor has thermogenesis been studied in any species of Iriarteeae palms across an elevation gradient. Our studies focus in the Colonso Chalupas Biologic Reserve, which spans from 600 to 4200 m. asl.





THE APPROACH AND CIENTIFIC COOPERATION

Main objective

To determine the effects of the elevation on the structure of the community of pollinators and floral visitors of species of Andean-Amazonian palms of the tribe Iriarteeae and, on the thermogenesis of their inflorescences.

Scientific collaboration structure

Directors and co-directors/researches/ students from Ecuador and Germany.

Methodology

To monitor palm´s flowering and thermogenesis at 3 different elevations; to collect inflorescences with their communities of insects and analyse them in terms of richness, abundance, diversity and related to different climatic variables.

THE INNOVATION AND INTENDED IMPACT

To increase the knowledge of biodiversity in Ecuador in a biodiversity hot-spot as the Andean-Amazon piedmont fringe.

Strength bioclimatic research groups from both German and Ecuadorian universities.

The results will be useful for the national and international governmental institutions whose objectives revolve around the conservation of biodiversity or the ecosystem restauration, and they will be disseminated through talks, reports, research articles and the web pages of the universities and interested institutions.

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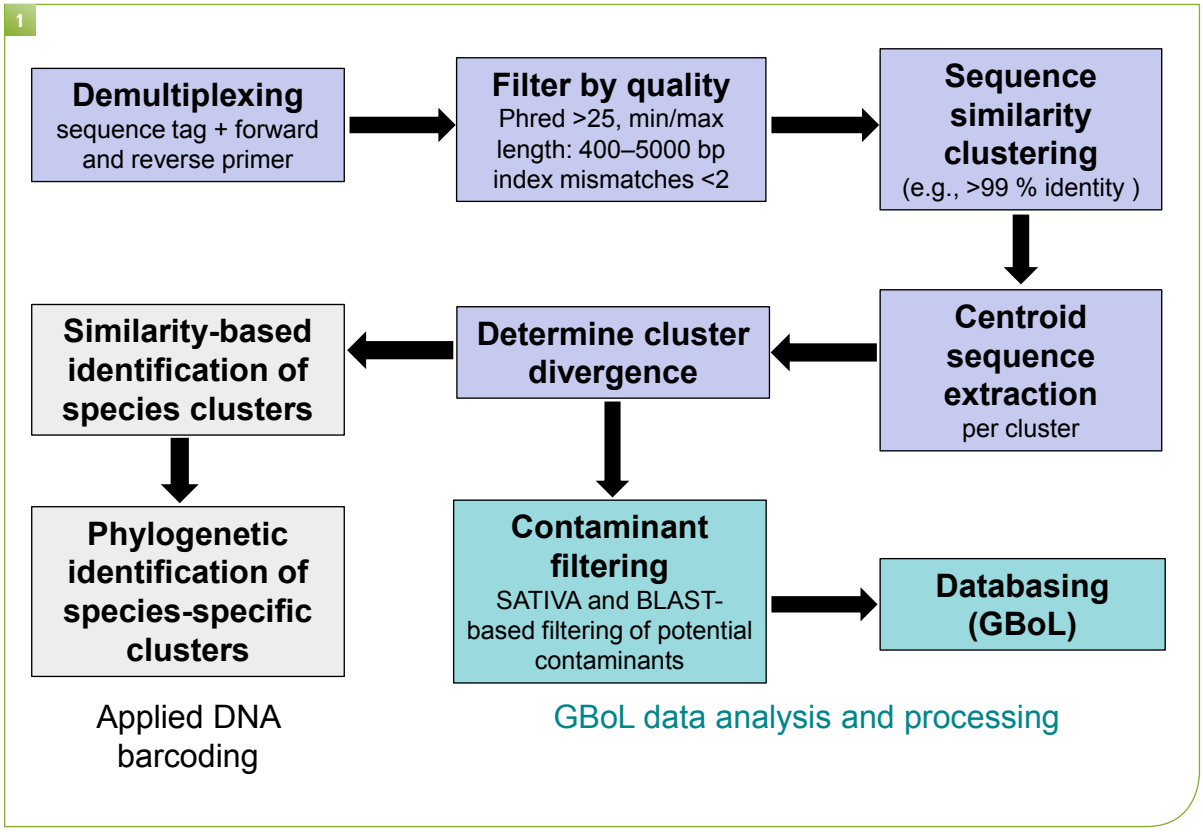
PHOTOS AND GRAPHICS
1 ???| 2 Stilt roots of S. exorrhiza | 3 Floral visitors of S. exorrhiza | 4 ???? | 5 Species of palms with studies in thermogenesis| 6 ????? | 7 ?????
| © credits: 1 ???? | 2 Peñuela, M.C | 3 Sara Álvarez & Maria Cristina Peñuela | 4 ???? | 5 Peñuela, M.C | 6 ???? | 7 ?????

TAXONOMIC IDENTIFICATION OF PLANTS AND PLANT TISSUE CONTAINING MIXTURES (DRUGS) USING SINGLE-MOLECULE REAL-TIME SEQUENCING



GENERAL INFORMATION

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Prof. Dr. Kai Müller
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Westfälische Wilhelms-Universität Münster


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THE CHALLENGE

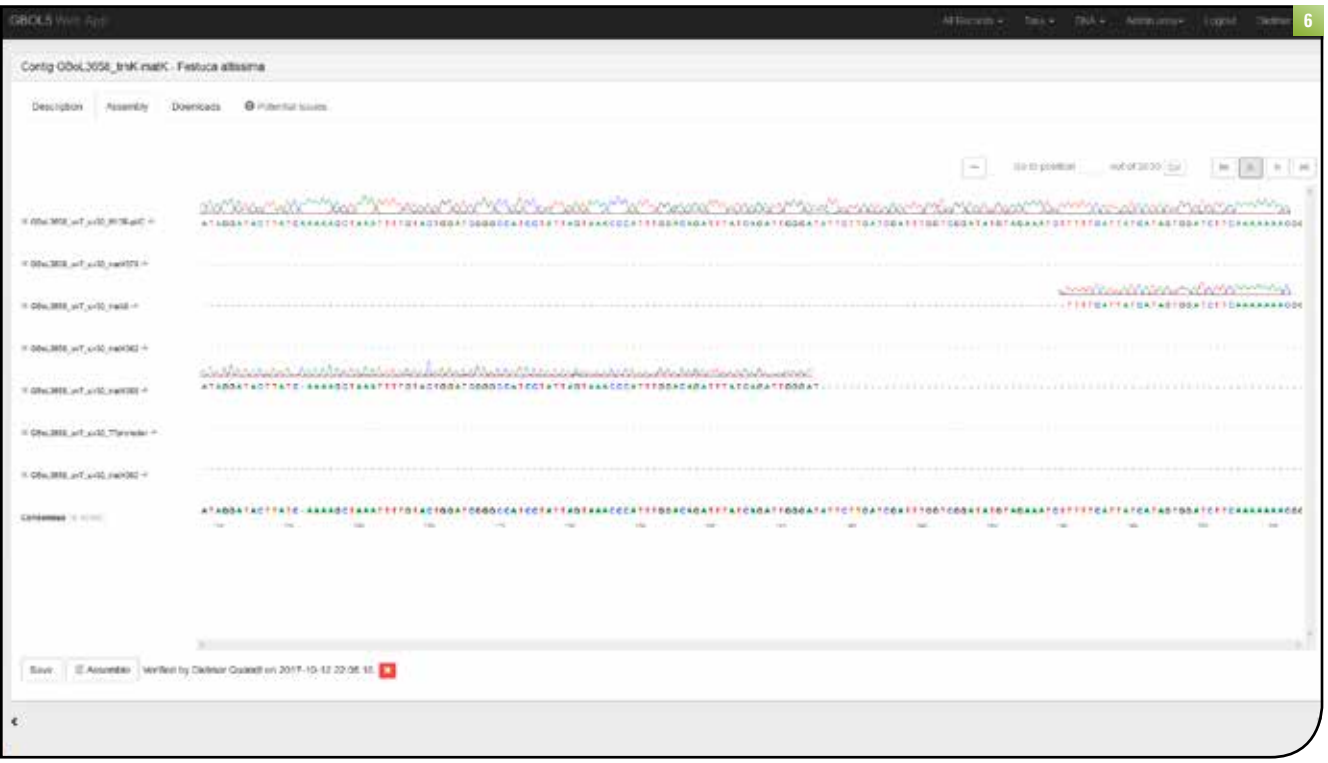
To predict the impact of climate change on economically important pollinator-plant tropical systems.

Research questions

Species identification is often a challenging and time-consuming enterprise that requires both taxonomic expertise (especially in the case of young species' rich radiations) and most often well-developed fertile specimens. Considering this, an exact identification of plant fragments, pollen, seeds, or roots at the species level using traditional methods (microscopes, phytochemistry, etc) is nearly impossible. Genetic barcoding, however, can help address this challenge.

THE APPROACH AND CIENTIFIC COOPERATION

In recent years, DNA barcoding has revolutionised taxonomic identification using specific regions of the genome that are able to discriminate species. The main advantage is not only the underlying option of a fast, cost-effective, high-throughput process, but also the fact that any kind of tissue can be analysed. However, the problem arises with admixtures – for example, environmental samples, or any biological admixture – as the standardised DNA barcoding routine can no longer be applied. Instead, additional methodological steps (i.e. cloning) need to be introduced, which are time-consuming and costly due to the large amount of clones required to statistically represent the taxonomic components of the sample under study.



THE INNOVATION AND INTENDED IMPACT

In the frame of GBoL5, we developed a strategy that will allow for precise species-level identification of admixtures using the proclaimed, established full-length DNA barcoding regions via single-molecule real-time (SMRT) sequencing – which provides full-length sequences of the DNA barcode regions (irrespective of their length) and coverage for statistical analyses. At the same time, it facilitates fast generation of the desired reference sequences.

The developed molecular standard operation protocols (SOP) for DNA barcoding via single-molecule real-time (SMRT) sequencing, combined with the Docker Container-based web app, represents an ideal tool for national biodiversity strategies, biomonitoring, and consumer protection that also combats the illegal trade of plants and animals (CITES). We aim to establish the developed SOPs/web app at interested Ecuadorian partner institutions with an eye towards providing a national tool that aids research and applications in consumer protection, forensics, customs, and biodiversity monitoring.

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PHOTOS AND GRAPHICS
1 Workflow of the automated data analysis pipeline for single-molecule real-time sequencing (Wicke et al., in prep.)| 2 Dietmar Quandt | 3 Kai Müller | 4 Species table. More details on every species can be obtained from the database| 5 Interactive progress visualisation. On the left, the number of planned marker sequences is shown; on the right, the number of already finished sequences per taxon is shown | 6 Contig. view. Assembled sanger reads can be viewed, edited, and verified by users here. Parameters for automatic assembly can be changed in this view, as well | © credits: Photos: Kai Müller/Dietmar Quandt, Photos of web app: www.gbol5.de

AGROBIODIVERSITY, CONSERVATION, AND REVALUATION OF THE ANDEAN TUBER *OXALIS TUBEROSA* AND ITS WILD RELATIVES IN ECUADOR

GENERAL INFORMATION

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Micaela Navarrete-Mier
Universidad Yachay Tech, Urcuquí, Ecuador

Álvaro Monteros-Altamirano
Instituto Nacional de Investigaciones Agropecuarias, Ecuador

POTENTIAL SUGGESTED PARTNER:
In Germany, we would be particularly interested in creating links with the Berlin Botanical Garden and the Plant Biology Group at the Institute of Biology of Freie Universität Berlin.


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2

THE CHALLENGE

Oxalis tuberosa, or "oca", is an Andean tuber that has served as a staple food for millennia. In Ecuador, however, human migration from the countryside to the city, accompanied by the devaluation of native crops, has dramatically reduced the production, consumption, and diversity of oca cultivars. Our challenge is to reverse this trend, as losing genetic diversity can increase the vulnerability of this crop to unanticipated threats, including climate change. Genes from oca's wild relatives could help to relieve this problem. We propose to assess the diversity of extant oca varieties in Ecuador and their wild relatives, along with thorough bromatological analyses and activities to strengthen current ex-situ conservation efforts at Yachay Botanical Garden and the National Institute of Agropecuary Research (INIAP).

THE APPROACH AND CIENTIFIC COOPERATION

Objective 1: To characterise the phenotypic and genotypic diversity of oca cultivars found in the three-year, ex-situ collection of oca (approx. 300 accessions; figure 1) at Yachay Botanical Garden, and in the 25-year in-vitro collection of oca (approx. 90 accessions) maintained at the National Institute for Agropecuary Research (INIAP). For the phenotypic characterisation, we will apply standard protocols. To characterise genetic diversity, we will use previously tested microsatellite primers.

Objective 2: To collect wild relatives of oca that are present in Ecuador. Based on locations provided by herbarium specimens, we will explore different regions of the country in search of the some 40 species of wild Oxalis that exist in Ecuador. These will be maintained in a full-grown state at Yachay Botanical Garden.

Objective 3: To strengthen the in-vitro collection of oca varieties and complement it with wild relatives. We will follow standard protocols for micropropagation and slow growth storage.


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To characterise the variation of micro- and macronutrients, oxalate and common antioxidants among select varieties of ocas. These bromatological analyses will be conducted using specialised chemo-analytical equipment.

We look forward to obtaining support to fulfil all these objectives. In particular, we would appreciate having access to funds to conduct the genetic and bromatological analyses.

THE INNOVATION AND INTENDED IMPACT

This project can produce several important outputs. First, the genetic, morphological, and biochemical characterisation of the oca accessions will provide valuable information to show the potential of oca as a nutritious food alternative. Second, strengthening the ex-situ collection of oca and its wild relatives will represent an important action in biodiversity conservation. In fact, it can become the basis for ambitious in-situ conservation initiatives designed to guarantee Ecuador's food security and sovereignty. To this long-term end, we plan to organise one-day workshops and gastronomic oca "fairs" in different regions of Ecuador among indigenous or peasant farmers.


4

6

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PHOTOS AND GRAPHICS
1 Sampling *Oxalis tuberosa* around Ecuador | 2 Sampling *Oxalis tuberosa* around Ecuador ©Hugo Romero-Saltos | 3 *Oxalis tuberosa* field at Tungurahua province- Ecuador. ©Micaela Navarrete Mier | 4 Kids showing ocas ©Hugo Romero Saltos| 5 *Oxalis tuberosa* -oca plant ©Micaela Navarrete Mier | 6 Map *Oxalis tuberosa* collection sites

BIOPROSPECTING OF MICROBIAL DIVERSITY IN THE COASTAL MARINE AREA OF THE PROVINCE OF SANTA ELENA (SE PACIFIC) FOR IN-SITU BIOREMEDIATION OF HYDROCARBONS

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GENERAL INFORMATION

Max Planck Institute for Marine Microbiology
Germany

Erika Alexandra Salavarría Palma, UPSE
Ecuador

Maria del Carmen Gamboa Palacios, INOCAR
Angel Erazo Bone Romel, UPSE

THE CHALLENGE

Oil spills are a constant threat to the Ecuadorian ocean. In 2010, the first discovery of major oil pollution was made in the province of Santa Elena. Pollution arose from salt production pools that were transferred through drainage channels, generating a significant environmental impact. The effluent continued towards the sea, affecting the marine ecosystem. This sector has been declared a wildlife reserve zone (REMACOPSE), so the pollution has affected several species in the area.

For the first time, Germany has succeeded in deciphering the genome of a micro-organism that breaks down oil. This is the cosmopolitan habitat bacterium *Alcanivorax borkumensis*, which was discovered in Braunschweig and is found in large quantities in seawater contaminated with oil. It decomposes a broad spectrum of hydrocarbons.

THE APPROACH AND CIENTIFIC COOPERATION

This research has led to a cooperation between Germany and Ecuador through the Max Planck Institute for Marine Microbiology (MPI) and the Center for Biotechnological Research (CEB) of the State University Peninsula de Sta. Elena (UPSE). This will be one of the first efforts in the province to generate useful biological information for both cooperating countries. Its aims will include the characterisation of genetic biodiversity through metagenomic analysis of marine bacteria, its application in the bioremediation of coastal marine environments contaminated by hydrocarbons, and a comparative genomic analysis of genetic biodiversity in

environments contaminated by hydrocarbons in Germany. The private Ecuadorian company ECUASAL will also be involved in the project in handling logistics, training technical personnel, applying the results achieved, and potentially putting them into practice.

THE INNOVATION AND INTENDED IMPACT

This initiative constitutes a scientific effort to strengthen technical capacities for generating and compiling the information of both countries, which are interested in scientific cooperation with an eye towards development. Here, they are supporting the creation of a national and international network of cooperating partners and propagating scientific and technical experiences not only to UPSE, but also to MPI through mutual contributions to related research. These efforts include training young research personnel from Germany and Ecuador, generating bacterial genomic information from marine environments, and submitting scientific publications to ISI-indexed journals.

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PHOTOS AND GRAPHICS
1 Entrance to ECUASAL, Salinas plant, Prov. Sta. Elena, Ecuador ©E. Salavarría, June 2019 | 2 Rainwater channel. Evaporator 2. ECUASAL, Salinas plant, Prov. Sta. Elena, Ecuador ©E. Salavarría, June 2019 | 3 Evaporator 1. ECUASAL, Salinas plant, Prov. Sta. Elena, Ecuador ©E. Salavarría, June 2019 | 4 Pumping station #1. ECUASAL, Salinas plant, Prov. Sta. Elena, Ecuador ©E. Salavarría, June 2019 | 5 Edge of the discharge chute. ECUASAL, Salinas plant, Prov. Sta. Elena, Ecuador ©E. Salavarría, June 2019 | 6 Laboratory Molecular Biology (LBM), Biotechnology Research Center (CEB), Peninsula de Santa Elena University (UPSE), Ecuador ©E. Salavarría. February 2019 | 7 Geographic location of the study area ©E. Salavarría.

HIGH-ALTITUDE ANDEAN SEED BANK (HANS-BANK) – PHASE 1

GENERAL INFORMATION

Claudia Segovia-Salcedo
UNIVERSIDAD DE LAS FUERZAS ARMADAS ESPE
FONAG

THE CHALLENGE

Páramos and high-elevation ecosystems are considered one of the hotspots of biodiversity due to their high levels of endemism, but they also have high levels of deforestation (Myers et al., 2002). Biodiversity is diminishing on an unprecedented scale across the world, and the Ecuadorian Highlands are no exception. Therefore, storing and cataloguing viable seeds and genetic material has a fundamental purpose nowadays, including for both governments and the realm of academia. Andean plants face peculiar conditions that limit seed germination and establishment, such as the frequent occurrence of freezing overnight temperatures, excessive daily solar irradiation, strong winds, and short growing seasons. Seed germination is the first step of the plant life cycle, but to date, very few studies have focused on the seed biology of high-altitude Andean species in Ecuador. In this context, seed banks and related research are a way to combat some of the threats against biodiversity. Seed banks protect and save plant genetic diversity (which is important for new adaptations) and food security. In addition, seed banks allow for faster recovery from environmental or natural disasters. In the future, the HANS BANK wants to become a repository for all the seeds required for reforestation and restoration in the Ecuadorian Highlands.

THE APPROACH AND CIENTIFIC COOPERATION

The objectives of this project's first phase are to evaluate the dynamics of a seed cohort of three species from different growth forms (10) with a total of 27 species and different altitudes over a one-year period, and then to characterise its germination requirements under laboratory conditions. Although the population dynamics of some of the Andean species are well known, the basic features of their seed biology have remained unstudied in Ecuador. To reach our goals, collaboration is needed and the exchange of knowledge is fundamental. International collaboration can help us improve our scientific capacities and generate a strong network of academics and practitioners.

Tentative methodology

Seeds will be collected from 25 randomly selected fruiting individuals for each species (27). Mean seed weight will be measured.

Seed viability

Initial seed viability will be assessed through tetrazolium testing (Hendry and Grime, 1993) before the initiation of experiments. Four replicates of 50 seeds each – from each population (4) and for each species (15) – will be placed on moist filter paper at room temperature for 24 hours and then sliced along the longitudinal axis with the aid of a scalpel. Seed sections will be incubated in

a 0.1% aqueous solution of tetrazolium chloride for 24 hours at 25 degrees (C) in darkness. Seeds showing a strong red-stained embryo will be considered viable.

Stratification
Another collection will be carried out, with an average of 100 seeds per population and species. These seeds will be stored in humid and dark conditions at four degrees (C) in a laboratory refrigerator using petri dishes. To maintain humidity, seeds will be covered on white paper towels. To ensure darkness, the petri dishes will be covered in aluminium foil. Seeds will be maintained in these conditions for one to six months. As a control, around 100 seeds per population per species will be stored in


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cool, dry conditions at room temperature in paper bags in the laboratory, and will be maintained in those conditions for one to six months. Seeds will be tested once each month for six months to assess any loss of viability.

Thermoperiod
Two growth chambers with a controlled thermoperiod and photoperiod (12/12 hours of light/darkness) will be used for germination assays. The chambers will be set to 20 degrees (C) during the day and five degrees at night. They will be illuminated with cool white fluorescent light with an average photosynthetic photon flux density of 25 µmol m–2s–1 (Cavieres and Arroyo, 2000).

Germination assays
Filled and empty seeds will be distinguished by applying light pressure to each seed. The seeds will be stored in paper bags at room temperature (Guariguata and Azocar, 1988).
Seed dormancy will be analysed. Seed dormancy can be relieved through cold stratification or coat scarification (Li, Nnogaki, and Barreno, 2019).

Implementation of the outcome
FONAG will provide logistical support for the collection and socialisation of the information through workshops with people who work in the field, such as nursery managers.

THE INNOVATION AND INTENDED IMPACT

Our group of participants combines the academic expertise at ESPE with a leading agency in high Andean ecosystem restoration: Quito's Water Fund, FONAG. This group, which has collaborated extensively in the last few years, is concerned about the immediate needs of their Andean community. It also generates crucial information for restoration programmes in the Andes and about the impact of climate change in seed germination and viability. Our approach is multi-faceted in that we hope to not only generate scientific data, but also promote scientific accessibility, skills, and literacy and apply the knowledge gained in promoting sustainable practices. Our target audiences in accomplishing this goal will include researchers, college and graduate students, forest practitioners, Andean communities, and decision-makers.

Expected outcomes
- Open access reports and guides about Andean seeds of highland ecosystems
- Seed germination protocols of 30 Andean plants
- Seed bank for 30 Andean plants from high-altitude ecosystems
- Three workshops with Andean communities and nursery managers, forest technologists, and technicians
- Two academic presentations on local and international flora
- Two academic articles
- One graduate student from Ecuador and one graduate student from Germany
- Open database about seed morphology, germination, and protocols

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PHOTOS AND GRAPHICS
1 Seeds | 2 Anthropogenic | 3 Andean páramos | 4 Andean reforestation | 5 Gentianella sp. | 6 Desertification areas of the páramos © credits: Claudia Segovia Salcedo

Pontificia Universidad Católica del Ecuador | SEDE ESMERALDAS

CLIMATE CHANGE AS A RISK FACTOR IN THE IMPLEMENTATION OF AGREEMENTS ON USE AND CUSTODY OF MANGROVES IN THE SOUTHERN PART OF THE PROVINCE OF ESMERALDAS

1

GENERAL INFORMATION

Vinueza Rubén
Sanchez Estefania
Vernaza Lucia
Rebolledo Eduardo

Pontificia Universidad Catolica del Ecuador Sede Esmeraldas

2

AMENAZAS	ALCANCE	SEVERIDAD	IRREVER-SIBILIDAD	CRITICALIDAD ACTUAL	MANEJABILIDAD	CONOCIMIENTO
Contaminación de agua	2	2	1	2	1	1
Deforestación/tala de manglar	4	4	2	3	2	1
Sobreexplotación de recursos	4	4	3	4	3	1
Cambio climático	4	3	4	4	2	2
Uso inadecuado de redes (artes de pesca)	3	3	3	3	2	1
Fauna urbana	3	3	3	3	3	1
Aumento de la erosión costera	3	3	3	3	4	2
Introducción de especies exóticas	2	2	3	3	3	2
Compactación de suelos	2	2	2	2	2	1

Threat is considered any anthropic factor that exerts a pressure on the ecosystem, direct or indirect altering its dynamics

THE CHALLENGE

Coastal marine ecosystems in the southern Esmeraldas harbour great biodiversity, and mangroves and beaches provide ecosystem services: food, habitat, CO2 absorption, and a natural barrier against sea erosion. For the communities that inhabit them, there is also space for their culture. In 2003, this area was declared a protected area called Refugio de Vida Silvestre Manglares y estuarios Rio Muisne (RVSMERM).

In 2018, PUCE Esmeraldas carried out a socio-environmental diagnosis of the RVSMERM using the methodology MARISCO (in Spanish, this stands for Adaptive Management of Risk and Vulnerability in Conservation Sites). It resulted in increased appreciation of the value of investigating the effect of climate change on mangroves and the ecological dynamics of estuaries and beaches. In addition, each community has its own interaction with the ecosystem and can determine its culture and lifestyle, which can be affected by changes in the natural environment (fig. 2).

This research asks the following question: How does climate change affect the conservation process of RVSMERM?

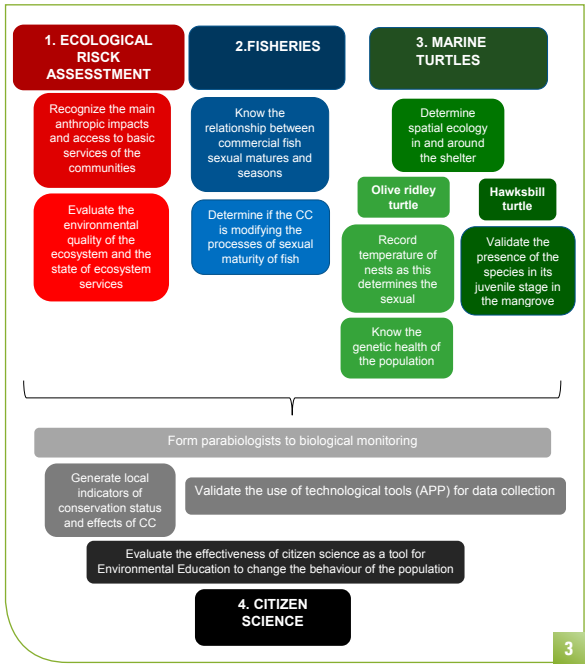
THE APPROACH AND CIENTIFIC COOPERATION

The objective of the research is to evaluate the ecological components of the ecosystem and its reaction to climate change. In this project, the structure of scientific cooperation will be formed by four researchers with experience in marine-coastal ecosystems and environmental education from PUCE Esmeraldas, with the possible participation of the Faculty of Marine Biology of the University of Rostock.

This project needs universities that work in coastal marine ecosystems and can generate modelling programmes

within the scope of climate change and spatial ecology.

The methodology of this project is based on the following four axes (fig. 3):



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THE INNOVATION AND INTENDED IMPACT

Because of the methodology this project uses, it can be a pilot for the collection of information that helps conservation. The corresponding app, which is designed to collect data on morphometric geometry, can be used by the community in general, park rangers, national and international research centres, and the relevant authorities.

The diffusion will take place through:
Development app: data collection regarding geometric morphometry, which will feed an information platform
Informative brochure: compendium of knowledge and commitments of the communities

Documentary film: will record the evolution of the project and the perceptions of the communities

Murals: pedagogical and information instruments on sea turtles and their characteristics

Turtle map: will show the spatial ecology of the species

Scientific articles: will aim to disseminate the methodology of the research and the results obtained in this project


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PHOTOS AND GRAPHICS
1 Babies Olive ridley turtles of Portete beach | 2 MARISCO - Threats Identified in the RVSMERM | 3 Axes of action and activities | 4 Muisne mangrove women | 5 Gonadal index | 6 Map of Refugio de Vida Silvestre Manglares y Estuarios Rio Muisne © credits: ????

CLIMATE CHANGE MITIGATION STRATEGY: MICROORGANISM BIOPROSPECTING FOR THE RECOVERY OF A PÁRAMO AFFECTED BY FOREST FIRES

GENERAL INFORMATION

Santiago Zarate, Carla Sandoval, Cristina Echeverria, Andrea Chiliquinga, Sania Ortega, Pedro Barba, Gabriel Chimbo, Esteban Yepez.

Universidad Tecnica del Norte

THE CHALLENGE

The following project is focused on assessing potentially useful microorganisms from a pristine Andean páramo in terms of its recovery following fire incidents (fig. 1). Since these fragile ecosystems play an important role in climate regulation and water and carbon cycles (among other phenomena), their restoration is a critical point that requires the attention of different social stakeholders.

THE APPROACH AND CIENTIFIC COOPERATION

The microbiology of soil is essential for mediating feedback between terrestrial ecosystems and climate change. Therefore, this study will start by attempting to understand

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Physical, physico-chemical, and mineralogical properties	Chemical properties	Biological properties
✓ Water repelience ✓ Structure stability ✓ Bulk density ✓ Particle size distribution ✓ Mineralogical assemblage ✓ Colour ✓ Temperature regime	✓ Quantity of organic matter. ✓ Quality of organic matter. ✓ Availability of nutrients. ✓ Exchangable capacity. ✓ Base saturation.	✓ Microbial biomass. ✓ Composition of microbial community. ✓ Soil-dwelling invertebrates biomass. ✓ Composition of soil dwelling Invertebrate community.

how its biodiversity could contribute to the rescue of areas affected by forest fires (table 4). To achieve this, an applied study will first be conducted to better analyse what it is known about these ecosystems (table 5). It will consider areas with and without a history of forest fires. The place of the study will be the El Angel Páramo because of its natural and economic importance to local communities in the north of Ecuador. Then, a soil sampling will be performed to analyse its physicochemical properties and microbial metabolic activity. Third, a molecular and taxonomic characterisation of isolated microorganisms will be carried out to describe and quantify its biodiversity. Finally, a restoration strategy design in burned soil using potential microorganisms previously identified will be assessed at laboratory scale. Due to the extent of the study, vegetable diversity and its contribution to restoration will not be considered. However, a complementary study could be performed in a second phase in the future. The scientific cooperation will be designed to work at two levels: first by improving the laboratory methodologies and technology, and second through joint development of integrated strategies to recuperate burned soil through the use of potential microorganisms.

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	Direct *short term*	Indirect *long-term and recovery*
Soil	Sterilization effect, damage in cell components	Modification on physicochemical properties (high pH). High content of ash and carbon. Hydrophobic biofilms.
Bacterial population	Gram (-) more sensitive *Bacillus* and *Clostridium* more resistant.	Proliferation of heterotrophic bacteria Change in symbiosis patterns with vegetation.
Actinomycetes	Thermoresistant spores	Increase during first few weeks Abundant in alkaline soils with low moisture soils
Fungi	More affected than bacteria Filamentous fungi more susceptible than others	Pioneer to recolonize the soil in absence of others light-dependant organisms.
Photoautotrophic	Same effect that fungi	Saprophytic fungi is killed Ectomycorrizas more susceptible than arbuscular mycorrizas
Biomass diverstity	Fungi decrease 30-80% in soil abundance	Different recolonization pattern for fungi, non/ heterotrophic bacteria Slow growth for fungi due to content of organic fractions
Enzymes	Thermal denaturaturation	Limited activity

THE INNOVATION AND INTENDED IMPACT

Research studies on microbial soil biodiversity and its potential applications from Ecuadorian páramos are scarce, so the project represents an opportunity to generate not only new scientific knowledge, but also valuable technologies for the restoration of fragile ecosystems. This proposal will consolidate the cooperation between local communities, academia, and governmental and international institutions. Their collaboration will result in innovative technological strategies and remarkable impacts such as: new insights into microbial strains and consortia from páramo soil; enhanced productivity from these ecosystems; environmental conservation; and an improved quality of life for local communities.

6

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PHOTOS AND GRAPHICS
1 Universidad Tecnica del Norte_UTN_Campus El Olivo_Ibarra-Ecuador | 2 Researcher_Campus San Vicente_UTN_Ibarra-Ecuador | 3 Biotech Laboratories_Campus San Vicente_UTN_Ibarra-Ecuador | 4 Soil properties modifiable by fires (Certini, 2005) | 5 Direct and indirect effects on microbiology of soil after fire. Summarized from (Bárcenas-Moreno et al., 2011) | 6 Indigena from local paramo community | © credits: ????

Martha
ARIZAGA

Undersecretariat of Scientific Research
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Martha Arízaga completed a master's programme in social sciences with a major in sociology at the Latin American Faculty of Social Sciences. She also earned a diploma in development studies with a focus on development programmes and projects from the Catholic University of Louvain-la-Neuve in Belgium.
Ms Arízaga's professional experience has mostly been in the public domain. She works for the municipality of Quito and at the Ministry of Public Health, as well as for the Vice Minister of Culture, the Ministry of Economic and Social Inclusion, and the Ministry of Policy Coordination. Currently, she is the Undersecretary of Scientific Research in the Secretariat of Higher Education, Science, Technology, and Innovation of Ecuador.

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Short Profile of institution

The Secretariat of Higher Education, Science, Technology, and Innovation is the guarantor of the application of the principles that govern higher education in Ecuador. It thus promotes scientific research, technological innovation, and ancestral knowledge. The Secretariat's work focuses on improving the capabilities and potential of citizens, as well as on the efficient and effective use of resource management. Its results, however, serve as the seed from which the country's development grows.

Dr Jenny Marcela
ÁVILA VELEZ

Researcher
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Jenny Ávila Vélez is a professor at Escuela Politécnica Nacional. She is an agropecuarian engineer (Escuela Politécnica del Ejercito, Ecuador) with a master's degree in food science (Escuela Politécnica Nacional). She has researched the effect of abiotic stress conditions on phenolic compounds during pre-harvest periods and also on the antioxidant capacity of some fruits of Ecuador. She has also done research on biorefineries and worked on using agricultural waste to obtain compounds of nutritional interest.

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Short Profile of institution

Escuela Politécnica Nacional (EPN) is a leading public university in Ecuador that is consistently recognised as such by the national accreditation board. Since 1869, it has remained the country's reference point for teaching and research in science, technology, engineering, and mathematics. The Department of Food Sciences and Biotechnology (DECAB, part of the Faculty of Chemical and Agro-Industrial Engineering) has carried out research on several native food plants for decades.

Stefan
BIENEFELD

Head of Division
Development Cooperation and Transregional Programmes
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Germany

Stefan Bienefeld is the head of Division P3 (Development Cooperation and Transregional Programmes) at the German Academic Exchange Service (DAAD). He holds a master's degree in psychology from the University of Bielefeld, Germany.
Prior to joining DAAD in 2009, Mr Bienefeld worked for the German Rectors' Conference and the National Association of German Universities as a programme manager on issues linked to the Bologna process. He also headed a project dealing with quality assurance in Germany and Europe.
At DAAD, Mr Bienefeld started as the head of Division 435, which made him responsible for large-scale university cooperation programmes between German universities and partner HEIs in developing countries, as well as for programmes designed to promote the worldwide mobility of German university teaching staff. Starting in June 2011 he then served as the head of Division 43. In this capacity he was in charge of all DAAD programmes with funding from the German Federal Ministry for Economic Cooperation and Development, including financial and strategic issues with the ministry and cooperations with external partners such as GIZ, KfW, UNESCO, the World Bank, and civil society organisations. Since January 2015 he has been the head of Division P3, where he deals with

Short Profile of institution

The German Academic Exchange Service (DAAD) is a registered association of German higher education institutions and student bodies. It promotes their international relations abroad through the exchange of students and scientists as well as through international programs and projects. Financed by different federal ministries, it represents foreign cultural policy, educational policy and development cooperation in the academic sector.

Prof Dr María Elena
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Professor
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María-Elena Cazar, a full professor at Universidad de Cuenca, started the Biotechnology and Biodiversity Group in 2014 with a focus on the study of bioactive plants and microorganisms in Ecuador. In collaboration with Osnabrück University, she coordinated the project Teaching and Understanding Biodiversity from a Northern and Southern Perspective, which was funded by DAAD. María-Elena Cazar studied for her Ph.D in natural product research at Universidad de Talca (Chile, 2006). In 2002, she completed a scientific stay at the Institut für Biotechnologie und Wirkstoff-Forschung at TU Kaiserslautern (Germany), and added a post-doc stay at Leiden University (the Netherlands) in 2007. Currently, María-Elena Cazar serves on the University Council of Universidad de Cuenca and is the chairperson of the VII Latin-American Congress of Medicinal Plants.

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Short Profile of institution

Universidad de Cuenca, founded in 1867, offers high-quality education with a scientific and humanistic orientation. The university focuses its paradigms on research by means of collaborative work with universities from Ecuador and countries abroad. Currently, Universidad de Cuenca is developing research and postgrads on different topics and gathering resources in order to set up doctoral programmes.

Claudia
CORAL

Research Associate
Humboldt University of Berlin

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Claudia Coral is an associate researcher at the Humboldt University of Berlin. She has a Ph.D in agricultural economics and an M.Sc degree in integrated natural resource management from HU-Berlin. Currently, she is conducting research in Ecuador, where she has developed a framework for analysing the drivers and dynamics of land-use change and a theory of human and land transformations.
Since 2012, Dr Coral has collaborated with international organisations such as FAO, GIZ, and the Impulse Institute and conducted research in Germany, Madagascar, and Tanzania on topics related to sustainable land management, biodiversity, and climate change. She is an active member of the IRI THESys Postdoc and Young Researchers Network, an interdisciplinary platform for sustainability research.

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Short Profile of institution

The Albrecht Daniel Thaer-Institute of Agricultural and Horticultural Sciences is part of the Faculty of Life Sciences at the Humboldt University of Berlin. It conducts transdisciplinary research on environmental protection, rural development, and political consulting. The institute also incorporates biodiversity and climate change into its university's curricula and research as transversal topics while building international cooperation and synergies among university communities and other societal stakeholders.

Ilona
DAUN

Program Manager
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Ilona Daun is a senior desk manager in the Institution Building in Higher Education section, which is part of the division of development cooperation at the German Academic Exchange Service (DAAD).
Since 2012, Ilona Daun has been coordinating higher education cooperation projects carried out with GIZ in the department "Development Cooperation – Institution Building in Higher Education / P 31". She was responsible for the German-Brazilian research cooperation programme NoPa, as well as the Higher Education Cooperation Programme on Renewable Energies in Senegal (PESEREE). She is now managing the German-Bangladesh Higher Education Network for Sustainable Textiles (HEST) programme, as well as the German-Ecuadorian Research Cooperation Program (CoCiBio). Upon joining DAAD in 2008, she was responsible for study and research programmes for Germans in South Asia.
Ilona Daun studied Spanish and English at Technische Hochschule Köln and holds a diploma in translation. She grew up in southern Switzerland and is also fluent in Italian and English.

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Short Profile of institution

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Ana
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Ana Del Hierro is an Ecuadorian biotechnology engineer specialised in waste management. She is a researcher at the National Institute of Biodiversity, where she directs the bioconversion of organic solid waste and plastic through invertebrates of Ecuador. Her work at INABIO focuses on providing an environmental perspective on implementing resource-efficient, circular-economy principles to reduce environmental footprints and biodiversity loss. Ms Del Hierro is interested in not only finding ways to preserve the environment, but also helping to improve the social inequities in developing countries. She is passionate about bio-entrepreneurship as a bridge between science, politics, and business and about research on environmental science and waste management.

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Short Profile of institution

The National Institute of Biodiversity (INABIO) is one of the 13 Public Research Institutes of Ecuador. It is a knowledge-generating institution that was created to develop science, technology, and innovation as required by the Ecuadorian state. INABIO focuses on ensuring the conservation of Ecuador's natural heritage through the sovereign, strategic, and sustainable use of biodiversity and its components in order to secure a high quality of life in Ecuadorian society.

Fabian
ENGLERT

Senior Adviser for Climate Change
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Germany

Fabian Englert is a national senior adviser on climate change at Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH in Ecuador. He completed his university studies of forest science and forest ecology at Georg-August-University Göttingen in its tropical and international forestry programme (M.Sc). He then moved to Peru to work towards the establishment of a local payment system for hydrological ecosystem services as a development worker (2007-2012). Later, he concentrated his vocational activity specifically on REDD+ in Ecuador, working at first for the Ministry of Environment (MAE, 2012-2013) and then for GIZ (2014-2017). Currently, Mr Englert is supporting two GIZ programmes (ProCamBío II and CoCiBio) on issues related to climate change and finance.

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Short Profile of institution

Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH is a German governmental institution in the field of international cooperation for sustainable development. GIZ is dedicated to contributing to the process of shaping a future worth living around the world. It works in around 120 partner countries, mainly on behalf of the German Federal Government and with a variety of governmental and non-governmental partners. GIZ has been working in Ecuador since 1962.

Dr Miriam
FACTOS

Operational Coordinator at German-Ecuadorian Research Cooperation Programme (CoCiBio) and Senior Advisor on Biodiversity and Nagoya Protocol ProCamBío II Programme
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Miriam Factos holds a doctorate degree in biology and an M.Sc in regional development and territorial planning. She has over 20 years of professional experience in fields related to biodiversity, forest management, protected areas, sustainable development, climate change, and scientific disclosure. She has a remarkable amount of teaching experience at several Ecuadorian universities and has been highly involved in designing strategies for biodiversity conservation – including the creation of the National Biodiversity Institute (INABIO), a current partner of CoCiBio. As a contact person for the Forest Stewardship Council, Dr Factos was one of the pioneers in promoting forest certification in Ecuador. She has been part of the expert Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services for the past six years.

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Short Profile of institution

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Andrés
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National Biosafety Coordinator
Ministry of Environment

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Andrés Factos is a biotechnology engineer with a master's degree in GM plant biosafety. He has been working at the Ministry of Environment for seven years on various issues, including: biotechnology, GMOs, capacity building for science topics, agriculture, synthetic biology, gene drives, genome editing, international cooperation, and negotiation in spaces such as COP-CBD, COP-MOP (Cartagena Protocol), and international scientific groups. Nowadays, he is also working as a focal point from the ministry on scientific topics with the National Biodiversity Institute and its international programmes.
Mr Factos' academic and professional interest all relates to the sustainable use of biodiversity and precision agriculture with modern biotechnology tools.

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Short Profile of institution

The Ministry of Environment is the Ecuadorian national authority responsible for biodiversity issues. It is a government institution where all the politics, laws, and technical norms in the field of biodiversity are applied.

Regine
FEHLINGS DE ACURIO

Representante del DAAD en Ecuador
German Academic Exchange Service (DAAD)

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Since August 2018, Regine Fehlings de Acurio has been a DAAD lecturer with an office at the Catholic University in Quito (PUCE), where she holds courses in German culture, politics, and economics. Meanwhile, her main focus is on informing students and scientists all over Ecuador about possibilities to study and perform research in Germany.
Regine Fehlings de Acurio studied German (including as a foreign language), Romanistic philology, and pedagogy in Cologne and Bonn (Germany) and finished her studies with a master's degree. She was a representative of the DAAD in Albania and Romania from 1998 to 2000 and went on to found an intercultural center in Cologne that focuses on multilingual and transcultural education.

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Short Profile of institution

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Carlos
FIERRO

Independent Facilitator

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Carlos Fierro is a conservation biologist from Ecuador. He has extensive experience both in biodiversity management and conservation programmes, as well as in workshop facilitation and conflict management in Ecuador and other countries. He is fluent in both Spanish and English.

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Short Profile of institution

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Prof Kalina
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Professor of Environmental Engineering
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Kalina Fonseca is currently a professor of environmental engineering at the Technical University of Cotopaxi, Ecuador. Before joining the university, Prof Fonseca won an international scholarship to complete her postgraduate studies in natural resource management at the Russian State Hydrometeorological University. She is an expert in nonconventional water treatment and has authored publications in high-impact journals on environmental sciences in Latin America and Russia.
Prof Fonseca's research achievements include a first-place finish in the National Agroeconomic Research Contest (organised by Ecuador's Ministry of Agriculture). She was also one of the 10 winners in the international mentoring initiative "Women4Climate" with her Artificial Floating Islands project, which was chosen as one of the best projects about climate change.

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Short Profile of institution

The Technical University of Cotopaxi (UTC) is at the forefront of research in Ecuador. More than 25 research and collaboration networks with national and international institutions have been established. The university includes the Faculty of Agricultural and Natural Resource Sciences. Here, it works with the Department of Environmental Engineering, which trains professionals capable of solving problems related to pollution and environmental degradation and proposing alternatives to mitigate climate change.

Dr Nikita
GAIBOR

Subdirector
Instituto Nacional de Pesca

Ecuador

Nikita Gaibor has been the Technical-Scientific Director of the National Fisheries Institute of Ecuador since August 2017. He is in charge of developing and supervising fisheries and environmental research projects. He is also responsible for establishing cooperations with other national and international organisations to develop and execute marine research projects. He received his doctoral degree in marine affairs at the University of Rhode Island in May 2016.
Dr Gaibor's research focuses on management aspects and the transfer of circle hook technology to the artisanal fisheries of Ecuador. His areas of interest include fishery management and policy, the socio-ecological resilience of fisheries, climate change, and the conservation of marine species. He speaks Spanish, English, and Portuguese.

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Short Profile of institution

El Instituto Nacional de Pesca (INP) is a research centre that conducts studies on bio-aquatic resources based on knowledge of the environment and the organisms that inhabit it. In doing so, it seeks to evaluate potential, diversify production, foster the development of fishing activity, and optimise rational use. INP also issues recommendations to policymakers regarding sustainable exploitation while drawing on fishery science and following the principle of precaution.

Dr Valerie
GRAW

Senior Researcher
Center for Remote Sensing of Land Surfaces (ZFL)
University of Bonn

Germany

Valerie Graw is a senior researcher at ZFL who earned her Ph.D in geography on the interlinkages of environmental change and socio-economic development at ZEF in 2015. She has worked in a number of projects at ZFL and ZEF in rural areas of sub-Saharan Africa and has key expertise in applied Earth observation and GIS in coupled human-environmental systems.
Currently, Dr Graw is leading two projects: SE4Amazonian, which involves providing renewable energy to indigenous communities in the Ecuadorian Amazon; and SPEAR, where she is developing space-based applications for disaster risk reduction and prevention in close collaboration with UN-SPIDER. Her role as a university representative includes teaching and project management, but also active research and continuous exchanges within interdisciplinary networks.

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Short Profile of institution

The German Academic Exchange Service (DAAD) is a registered association of German higher education institutions and student bodies. It promotes their international relations abroad through the exchange of students and scientists as well as through international programs and projects. Financed by different federal ministries, it represents foreign cultural policy, educational policy and development cooperation in the academic sector.

Katrin
GOTHMANN

Head of Programme
Deutsche Gesellschaft für Internationale Zusammenabeit (GIZ) GmbH

Germany

Katrin Gothmann has 20 years of professional experience in international cooperation. She has worked in many areas of environmental and climate protection, but mainly on environmental policy, the conservation of natural resources, industrial environmental protection, sustainable production and consumption, environmental education, and sustainability standards. She has been working for GTZ/GIZ since 2002 and has been in Ecuador with her husband and two children since 2019. On behalf of BMZ, she heads a bioeconomy project at the Ministry of the Environment. She holds a master's degree in philosophy from the University of Freiburg and an MBA in sustainability management from Leuphana University Lüneburg.

Contact details
www.giz.de/de/weltweit/73634.html | www.ambiente.gob.ec/programa-conservacion-y-uso-sostenible-del-patrimonio-natural/

Short Profile of institution

Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH is a global service provider in the field of international cooperation for sustainable development and international education. GIZ has 20,726 employees and over 50 years of experience in a wide variety of areas, including economic development and employment, energy and the environment, and peace and security. As a German federal enterprise that serves the public good, its business volume is around €2.6 billion.

Paúl Orlando
GUILLÉN MENA

Natural Product Chemist
National Center of Aquaculture and Marine Investigations (CENAIM-ESPOL)

Ecuador

Paúl Guillen is a fourth-year Ph.D student of chemistry in the Marine Biodiscovery Group at the National University of Ireland (Galway), which collaborates with the National Center of Aquaculture and Marine Investigations (CENAIM, part of ESPOL Polytechnic University). In his doctoral research, he is investigating the chemical diversity of marine invertebrates from the Marine Protected Area El Pelado and the potential applications of isolated natural products in animal and human health. He is also exploring the isolation and structural elucidation of natural products from marine organisms, microorganisms, and plants. In addition, he is interested in studying the chemical diversity of invasive species and the ecological role of natural products in marine ecosystems.

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Short Profile of institution

The National Center of Aquaculture and Marine Investigations (CENAIM), an integral part of ESPOL Polytechnic University, is a research centre dedicated to marine and aquaculture research. It seeks to foster the improvement and sustainable development of Ecuador's aquaculture and marine biodiversity through scientific research, technological development, training, and the dissemination of knowledge.

Dr Danilo
HARMS

Head, Dept. of Arachnology
Center of Natural History (CeNak)
Universität Hamburg - Zoological Museum

Germany

Danilo Harms is the head of the Department of Arachnology and the curator of the Arachnida and Myriapoda Collection at the Zoological Museum of Universität Hamburg. Since 2016, he has been leading a team of national and international students, postdocs, and volunteers in the study of arachnids (spiders, scorpions, and their kin) and multipedes (millipedes and centipedes). The research in Dr Harms' group spans diverse topics ranging from molecular phylogenetics, DNA barcoding, taxonomy, and systematics to ecosystem analyses and conservation studies using arachnids as proxies. The group uses its specimen collections as a reservoir for such projects, which usually involve international collaborators.

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Short Profile of institution

The Center of Natural History (CeNak) brings together the work of three museums at Universität Hamburg: the Zoological Museum, the Mineralogical Museum, and the Geological-Paleontological Museum. Each museum houses a number of scientific collections and an exhibition. CeNak's research programme is dedicated to the study of biodiversity and includes three core areas: Ecosystem Dynamics, Evolutionary Systematics, and Organismic Structure & Function.

Dr Diego
INCLÁN

Director Ejecutivo
INABIO

Ecuador

Diego Javier Inclán Luna was born in Quito. He obtained his degree in agricultural sciences at Earth University in Costa Rica. He completed his master's degree in biological sciences at Wright State University in Daytona (United States). He earned his Ph.D in plant protection and entomology at the Universitá degli Studi di Padova (Italy) in 2015 and also holds a post-doctoral degree in entomology. Dr Inclán has extensive professional experience as a researcher and university professor at various national and international institutions. He is the author and co-author of important publications in areas such as biology, entomology, biotechnology, ecology, and biodiversity. Currently employed as the executive director of INABIO, his fields of interest include landscape ecology, parasitoids, systematics, and the *Tachinidae* family.

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Short Profile of institution

The National Institute of Biodiversity (INABIO) is one of the 13 Public Research Institutes of Ecuador. It is a knowledge-generating institution that was created to develop science, technology, and innovation as required by the Ecuadorian state. INABIO focuses on ensuring the conservation of Ecuador's natural heritage through the sovereign, strategic and sustainable use of biodiversity and its components in order to secure a high quality of life in Ecuadorian society.

Dr Janina
KLEEMANN

PostDoc / Researcher
Martin-Luther-University Halle-Wittenberg,
Institute for Geosciences and Geography, Dept. Sustainable Landscape Development

Germany

Janina Kleemann is researcher in the Department of Sustainable Landscape Development at Martin-Luther-University Halle-Wittenberg. She received her diploma in landscape ecology and nature conservation from the University of Greifswald. Her dissertation was about expert-based ecosystem service assessment during changes in land use / land cover and different climate scenarios in northern Ghana.
Dr Kleemann's research focuses on ecosystem services, socio-ecological systems, mixed methods, participatory approaches, sustainable development, land use change, and peri-urban conflicts and modelling. She is a member of the European Land-Use Institute, the European Nodal Office of the Global Land Programme, and the German Chapter of the Ecosystem Services Partnership.

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Short Profile of institution

Martin-Luther-University Halle-Wittenberg is one of the oldest universities in Germany and the largest university in the state of Saxony-Anhalt. It has more than 20,000 students, over 250 subjects in nine faculties, and more than 15 interdisciplinary research centres and specialised thematic facilities. The university invests in renowned scientists, high-tech equipment, and a modern research environment to foster research, training, and cooperation with industry, policymakers, and public actors.

Dr Ulrich
KUCH

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Short Profile of institution

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Dr Renke
LÜHKEN

PostDoc
University of Hamburg

Germany

Renke Lühken (Ph.D) is a postdoctoral researcher in the Arbovirology research group at the University of Hamburg and the Bernhard Nocht Institute for Tropical Medicine (Hamburg). His research focuses on the spatial-temporal distribution of vectors and associated pathogens. This includes field studies on the prevalence of viruses in arthropods and vertebrates, but also concentrates on the factors driving the emergence of pathogens (e.g. host-feeding patterns). Dr Lühken's efforts also apply state-of-the-art statistical modelling approaches to analyse field data and produce risk maps.

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Short Profile of institution

The Arbovirology research group at the University of Hamburg and the Bernhard Nocht Institute for Tropical Medicine (Hamburg) works on emerging and re-emerging viruses (e.g. Ebola, Borna, Zika, and Usutu). In this context, one of its main focuses is on viruses that are transmitted by mosquitoes. In particular, the group investigates the interaction among viruses, hosts, and their vectors. The group has also developed models to better predict virus epidemics.

Prof Dr Jörg
MATSCHULLAT

University Professor
TU Bergakademie Freiberg

Germany

Jörg Matschullat studied geoscience as his main subject while also adding biological sciences, psychology, and cultural anthropology as electives. After earning his Ph.D from Göttingen University, he spent his post-doc years at various universities. Environmental and ecosystem research were his primary focus, with biogeochemistry and analytical geochemistry serving as a backdrop. In geographic terms, his projects range from polar regions to humid tropical biomes and are characterised by transdisciplinary approaches. One of his recent ongoing projects is EcoRespira-Amazon.
Dr Matschullat works for a governmental think tank and is a member of the Leibniz-Sozietät Academy of Science. He has published numerous papers in international journals and books and makes an effort to share important results with the general public, as well. His current Scopus Hirsch Index is 25.

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Short Profile of institution

Founded as a mining school more than 250 years ago, TU Bergakademie Freiberg is now a small, yet very modern technical university. Its faculties deliver research and education in six fields: 1) Mathematics and Informatics; 2) Chemistry, Physics, and Life Sciences; 3) Geoscience, Geoengineering, and Mining; 4) Machine and Process Engineering; 5) Material Sciences and Engineering; and 6) Business Administration and Management. The university has roughly 4,500 students (B.Sc/B.Eng, M.Sc/M.Eng/Diplom-Eng, Ph.D).

Anja
MUNZIG

Project Manager
Institution Building in Higher Education
Development Cooperation and Transregional Programmes
German Academic Exchange Service (DAAD)

Germany

Anja Munzig is a project manager in the development cooperation division at DAAD. She graduated with a degree in education and Latin American literature from Freie Universität Berlin.
Mrs Munzig joined DAAD in 2008 and has been responsible for scholarship holders from Pakistan and Brazil. Since 2013, she has been working as a project manager in higher education cooperation projects carried out with GIZ in the department "Development Cooperation – Institution Building in Higher Education / P 31."
In the past, Mrs Munzig worked for the German-Brazilian research cooperation programme NoPa and the Higher Education Cooperation Program on Renewable Energies in Senegal (PESEREE). She is now involved in the German-Bangladesh Higher Education Network for Sustainable Textiles (HEST) and in CoCiBio.

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Short Profile of institution

The German Academic Exchange Service (DAAD) is a registered association of German higher education institutions and student bodies. It promotes their international relations abroad through the exchange of students and scientists as well as through international programs and projects. Financed by different federal ministries, it represents foreign cultural policy, educational policy and development cooperation in the academic sector.

Dr Udo
NEHREN

Researcher and Lecturer
TH Köln - University of Applied Sciences

Germany

Udo Nehren is a researcher and lecturer in ecosystem management at the Institute for Technology and Resources Management in the Tropics and Subtropics at TH Köln (Germany). He received a diploma in physical geography from the University of Trier, a master's degree in engineering and technology in the tropics from TH Köln, and a Ph.D in geography from University of Leipzig. He completed his post-doctoral degree at the University of Passau with a dissertation on the sustainable management of tropical and subtropical landscapes based on the concept of ecosystem services.
Dr Nehren's research emphasises environmental change, ecosystem-based disaster risk reduction and adaptation, and ecosystem management with regional focuses in Latin America and southeast Asia. He has published several books and articles on these topics.

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Short Profile of institution

The Institute for Technology and Resources Management in the Tropics and Subtropics (ITT) at TH Köln – University of Applied Sciences aims to enable people of various technical and cultural backgrounds to address complex environmental challenges through an interdisciplinary and intercultural approach at the graduate and postgraduate level. The ITT cooperates with key regional, national, and international organisations on research and capacity development.

Dr Àngel
ONOFA

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Ecuadorian Ministry of Environment (MAE)

Ecuador

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Short Profile of institution

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María de los Ángeles
PACHECO

Coordinator of the direction of public politics in scientific research
Senescyt

Ecuador

María de los Ángeles Pacheco has a master's degree in applied sociology from the Complutense University of Madrid (Spain) and a degree in sociology with specialisation in international relationships from the Pontifical Catholic University of Ecuador.
Ms Pacheco's professional experience has mostly been in the public domain. Having previously worked at the Ministry of Public Health and the Ministry of Education, she is currently employed in the direction of design of public politics in scientific research at the Secretariat of Higher Education, Science, Technology, and Innovation of Ecuador.

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Short Profile of institution

The Secretariat of Higher Education, Science, Technology, and Innovation is the guarantor of the application of the principles that govern higher education in Ecuador. It thus promotes scientific research, technological innovation, and ancestral knowledge. The Secretariat's work focuses on improving the capabilities and potential of citizens, as well as on the efficient and effective use of resource management. Its results, however, serve as the seed from which the country's development grows.

Dr María Cristina
PEÑUELA MORA

Lecturer and Researcher Coordinator of the research group Ecosistemas Tropicales y Cambio Global EcoTroCG
Universidad Regional Amazónica ikiam

Ecuador

María Cristina Peñuela Mora was born in Colombia. She studied biology at the Universidad de Los Andes in Bogotá. She then worked for nine years with the Puerto Rastrojo Biological Foundation on conservation projects in the Amazon, where she contributed to vegetation studies for the management plans of the Cahuinarí and Chiribiquete national parks.
Dr Peñuela Mora then went on to complete a specialisation in environmental management at the National University of Colombia, a master's degree in forest resource management at Syracuse University and the State University of New York (SUNY), and a doctorate at Utrecht University.

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Short Profile of institution

IKIAM is an Ecuadorian public university that began operating in October 2014. Its lines of research include hydrography, earth sciences, alternative energies and climate, ecosystems, biodiversity and conservation, biotechnology, health and the environment, ethnobiology, and participatory community research. IKIAM's mission is "to provide quality scientific training and production while focusing on the conservation and use of biological resources.

Francisco
PRIETO ALBUJA

Deputy Director
National Institute of Biodiversity INABIO

Ecuador

Francisco Prieto Albuja is a biologist (B.Sc) at the Pontifical Catholic University of Ecuador who has more than 15 years of experience in projects seeking to manage and preserve the natural heritage of Ecuador. Between 2013 and 2017, he was the Undersecretary of Natural Heritage and the National Director of Biodiversity at the Ministry of Environment. Since July 2017, he has been the Deputy Technical Director of the National Institute of Biodiversity, where he is responsible for activities related to scientific research, knowledge transfer, innovation, and specialised services. He also promotes and monitors the implementation of the National Biodiversity Research Agenda in coordination with both the Ecuadorian Government and the academy to strengthen RDI processes in Ecuador in terms of biodiversity.

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Short Profile of institution

The National Institute of Biodiversity (INABIO) is one of the 13 Public Research Institutes of Ecuador. It is a knowledge-generating institution that was created to develop science, technology, and innovation as required by the Ecuadorian state. INABIO focuses on ensuring the conservation of the country's natural heritage through the sovereign, strategic, and sustainable use of biodiversity and its components in order to secure a high quality of life in Ecuadorian society.

Prof Dr Dietmar
QUANDT

Professor
Nees Institute for Plant Biodiversity

Germany

Dietmar Quandt (executive director of the Nees Institute for Biodiversity of Plants, head of the herbarium BONN, and head of the joint GMO labs) combines deep knowledge of plant phylogenetics with globally recognised expertise in molecular evolution. His central research interests comprise the morphological plasticity of plants and their adaptations, as well as the evolution of life and growth forms. His second main field of competency includes the applicability of DNA stretches for species identification (DNA barcoding), population genetics, and phylogenetic inferences, as well as the principles and mechanisms of molecular evolution. He is involved in several international cooperations concerning the evolution of land plants and global biodiversity assessments.

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Short Profile of institution

The Nees Institute carries out research and education on plants, including their diversity, phylogenetic relationships, phytogeography, distribution, taxonomy, evolution, ecology, and function in close collaboration with the Botanical Gardens of Bonn. In addition, it trains future secondary-school biology teachers and offers further education courses for teachers. The institute is also involved in various large-scale projects, such as the CRC1211 (Earth: Evolution at the Dry Limit) and GBoL (gbol5.de).

Wilson
ROJAS

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Ecuadorian Ministry of Environment (MAE)

Ecuador

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Short Profile of institution
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Dr Cristina
ROMERO GRANJA

Researcher
Escuela Politécnica Nacional

Ecuador

Cristina Romero Granja is an agro-industrial engineer (Escuela Politécnica Nacional, Ecuador) with a master's degree in sustainable international agriculture (Göttingen University, Germany; Talca University, Chile) and a Ph.D in agricultural economics and rural development (Göttingen, Germany). She has done research on the sustainability and impact of high-value chains in Ecuador and Costa Rica. She also worked at a brewing factory, where she was involved in the fermentation process.

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Short Profile of institution
Escuela Politécnica Nacional (EPN) is a leading public university in Ecuador that is consistently recognised as such by the national accreditation board. Since 1869, it has remained the country's reference point for teaching and research in science, technology, engineering, and mathematics. The Department of Food Sciences and Biotechnology (DECAB, part of the Faculty of Chemical and Agro-Industrial Engineering) has carried out research on several native food plants for decades.

Dr Hugo
ROMERO-SANTOS

Professor
Yachay Tech University

Ecuador

Hugo Romero-Saltos, an Ecuadorian, is a tropical plant ecologist and biology professor at Yachay Tech. As the mentor of Yachay Botanical Garden, he has started an ex-situ effort to conserve varieties of *Oxalis tuberosa*. He is also starting a vegetation dynamics project for a tropical rainforest in Chocó and collaborating on a project that will use isotopic signatures of *frailejón* leaves (*Espeletia pycnophylla*) as proxies of past climates.
He holds M.Sc and Ph.D degrees in biology from the University of Miami (USA) with a focus on plant functional ecology and ecophysiology. He has co-authored two books (*Libro Rojo de Plantas Endémicas del Ecuador and Árboles emblemáticos de Yasuní*), several book chapters, and over 10 journal articles related to the diversity and functioning of tropical ecosystems.

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Short Profile of institution

Yachay Tech (YT) is a young public university that was created to foster education and science of international excellence. More than 90% of its faculty members, who come from more than 25 countries, hold a Ph.D degree. YT is organised in five Schools – Biological Sciences, Chemical Sciences, Physical Sciences, Earth Sciences, and Mathematical and Computational Sciences – which embody the concept of close interaction between fundamental discovery and subsequent application.

Dr Erika A.
SALAVARRÍA PALMA

Profesora Investigadora
Universidad Estatal Península de Santa Elena

Ecuador

Erika Salavarria Palma teaches in the Faculty of Marine Sciences at the State University Peninsula of Santa Elena (UPSE) in the Chairs of Molecular Biology and Marine Ecology II. She is also responsible for one of the laboratories of the Biotechnological Research Centre within her faculty.
Dr Salavarría Palma's specialty is genomic research, with emphasis on the study of gene expression (transcriptomics). She obtained her doctoral degree in biological sciences and engineering with mention in biotechnology. Her biological model of study comprises macroalgae, and considering that the techniques are the same for different hydrobiological resources, she has begun organising the Coastal Bioeconomy research group at UPSE.

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Short Profile of institution

The State University Peninsula of Santa Elena (UPSE) carries out activities designed to shape research, strengthen its system of exploration, propagate science and technology, and develop scientific activities that focus on communities. It does so through its different faculties and the groups in which its research is organised, such as the Coastal Bioeconomy group (which is affiliated with the Faculties of Marine Sciences and Industrial Engineering).

Maria Claudia
SEGOVIA SALCEDO

Associate Professor
Universidad de las Fuerzas Armadas - ESPE

Germany

Claudia Segovia-Salcedo was born in Cuenca, Ecuador, but spent her childhood in the capital city of Quito. She obtained her bachelor's degree at the Pontifical Catholic University of Ecuador and her M.Sc in environmental and plant biology at Ohio University. In 2014, she earned her Ph.D in the biology department at the University of Florida. She is interested in high-elevation Andean páramos and is researching the genetic composition of Polylepis as an essential component of comprehensive conservation planning. Her research focuses on the use of genetic divergence and uniqueness to identify areas of conservation importance in Ecuador. Currently, she is an associate professor at Universidad de las Fuerzas Armadas (ESPE).

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Short Profile of institution

Universidad de las Fuerzas Armadas (ESPE) is considered one of the most emblematic academic institutions of Ecuador. Founded in 1922, the university distinguishes itself by providing practical solutions to the needs and concerns of Ecuadorian society and contributing to the generation of new knowledge through teaching, research, and links with society. It has approximately 13,000 students, including civilians (75%) and military officers (25%), of which 8,309 are men and 5,606 are women. More information can be found at: www.espe.edu.ec

Alexis
VELA ARIAS

Biosafety Specialist
Ministry of Environment of Ecuador

Ecuador

Alexis Vela Arias has been a biosecurity specialist in the National Biodiversity Direction at the Ministry of Environment of Ecuador since 2017.
Mr Vela Arias is a biotechnology engineer who has worked in areas such as the genetic improvement of vegetable crops, the molecular diagnosis of pests and diseases in crops, and bioinformatics, including at both national and international research centres.
In his current role, his work profile focuses on developing and proposing public policy on biotechnology, the biosafety of GMOs, and invasive exotic species.

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Short Profile of institution

Ecuador's Ministry of Environment is the state agency in charge of designing environmental policies and coordinating strategies, projects, and programmes for the care of ecosystems and the sustainable use of natural resources. It proposes and defines norms in order to achieve adequate environmental quality through development based on the conservation and appropriate use of biodiversity and Ecuador's own resources.

Erika Sofia
VILLAGOMEZ TENE

Analyst
Secretariat of Higher Education, Science, Technology and Innovation

Ecuador

In her previous position as a biotechnology engineer, Erika Sofia Villagomez Tene participated in research projects in the area of life sciences. In this sense, she is familiar with the roles of both scientists and the productive sector.
Currently, she is working for a governmental instance on elaborating rules and policies that favour research and innovation processes, specifically in biodiversity. For example, she participated actively in the construction of the new ABS norm "Reglamento que regula la investigación científica de la biodiversidad y el acceso a los recursos genéticos", which will be issued soon. This norm implements both national and international regulations to which Ecuador is a party.
Ecuadorian Alternative Focal Point on Access and Benefit Sharing

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Short Profile of institution

The Secretariat of Higher Education, Science, Technology, and Innovation is the guarantor of the application of the principles that govern higher education in Ecuador. It thus promotes scientific research, technological innovation, and ancestral knowledge. The Secretariat's work focuses on improving the capabilities and potential of citizens, as well as on the efficient and effective use of resource management. Its results, however, serve as the seed from which the country's development grows.

Prof Rubén
VINUEZA

Professor and Reseacher
Pontificia Universidad Católica del Ecuador sede Esmeraldas

Ecuador

Rubén Vinueza has been a research professor in the School of Environmental Management at PUCESE since October 2016. Among other subjects, he is in charge of conservation management and Ecuadorian fauna. His line of research and proposal at PUCESE is biological oceanography, with a focus on the importance of conserving resources like water and related ecosystems (marine and coastal).
Prof Vinueza's academic and professional achievements include a master's degree in conservation biology and a degree in marine biology from PUCE (at its main campus in Manabí). He also has more than five years of professional experience at different national and international organisations in various projects, consultancies, research, and field work related to these subjects.

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Short Profile of institution

Pontificia Universidad Católica del Ecuador has trained biologists in Quito, marine biologists in Bahía de Caraquez, and environmental managers in Esmeraldas. In Esmeraldas, its School of Environmental Management promotes lines of research in biological oceanography, environmental education, river ecology, waste management, and environmental economics with a staff of six full-time research professors and two associated professionals in Spanish universities.

Prof Mario
YANEZ-MUÑOZ

Investigador agregado
Instituto Nacional de Biodiversidad

Ecuador

Mario Yánez-Muñoz is part of the team of researchers at the Instituto Nacional de Biodiversidad (INABIO). He obtained his degree in environmental sciences at Universidad Central del Ecuador and his master's degree in conservation biology at Pontificia Universidad Católica del Ecuador. His research focuses on the systematics, taxonomy, and evolution of amphibians and reptiles; patterns of biological diversity in environmental and ecological gradients; and the population ecology of endemic and threatened species. Prof Yánez-Muñoz has published around 70 scientific articles in indexed journals and several chapters in more than six books. He has also described a total of 50 species of amphibians, reptiles, and invertebrates.

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Short Profile of institution

The Instituto Nacional de Biodiversidad (INABIO) is a public research institute whose missions include planning, promoting, coordinating, executing, and transferring processes of research, science, technology, and innovation related to biodiversity and its components. It also seeks to develop knowledge and strengthen the conservation and sustainable use of this strategic resource.

Prof Santiago
ZARATE BACA

Teacher and Researcher
Universidad Tecnica del Norte

Ecuador

Santiago Zarate Baca is a young researcher and teacher of industrial biotechnology at Universidad Tecnica del Norte (Ibarra, Ecuador). He received his B.Sc in biotechnology from Universidad de las Fuerzas Armadas (Quito) and his M.Sc in bioprocess technology from Wageningen University (the Netherlands). Both studies were fully financed by national academic scholarships.
Before studying abroad, Prof Zarate Baca started a business in a fish hatchery near the Amazon region. This experience prompted his decision to study biotechnological processes in order to improve the environment and the quality of life for local communities. His is interested in circular economies, bioprospecting, bioprocess design, and biorefineries. He is currently working on extracting high-added-value molecules from agro-industrial waste and microalgae.

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Short Profile of institution

Universidad Tecnica del Norte (UTN) is a public university in Ibarra, Ecuador. A higher education reference in the north of the country, UTN trains specialists (B.Sc and M.Sc) in social, economic, health, technological, and life sciences. The university has around 12,000 students from all over the country. Its social and cultural diversity (afro, mestizo, indigenous) enables UTN to have a valuable impact by solving local problems. Moreover, it is part of the CEDIA, RedCLARA, REDU, and VLIRuos research networks.

Jörg
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Since 2018, Joerg Zeilinger has been a GIZ development worker at the Instituto Nacional de Biodiversidad (INABIO), where he has provided support while working in the CoCiBio programme. After concluding his studies in geoecology at the University of Bayreuth (Germany), he worked as a research assistant in soil physics at the same institution.
From 2007 to 2017, Mr Zeilinger worked as a local coordinator for the University of Marburg in different interdisciplinary German-Ecuadorian research programmes about biodiversity, climate change, and sustainable land use in southern Ecuador. He therefore has ample experience in international cooperations involving science and higher education.

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Short Profile of institution

Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH is a German governmental institution in the field of international cooperation for sustainable development. GIZ is dedicated to contributing to the process of shaping a future worth living around the world. It works in around 120 partner countries, mainly on behalf of the German Federal Government and with a variety of governmental and non-governmental partners. GIZ has been working in Ecuador since 1962.

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Layout and Typesetting
onegraphic, Berlin (Andreas Felgner)
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Print
DAAD Bonn

Print run
June 2019 – 60

Photo credits
Cover © Alex Boas

Logo
TBC

www.daad.de