



PONTIFICIA
UNIVERSIDAD
CATÓLICA
DE CHILE

SCIENTIFIC RESEARCH
FROM NORTH TO SOUTH

FIELD SCIENCE IN CHILE



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SCIENCE IN
CHILE



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FIELD SCIENCE IN CHILE. SCIENTIFIC RESEARCH FROM NORTH TO SOUTH.

EDITORIAL COMMITTEE. Pedro Bouchon, Vice President for Research. Paulina Gómez, Vice President for Communications. Patricio Bernedo, Dean of the Faculty of History, Geography and Political Science. Juan Correa, Dean of the Faculty of Biological Sciences. María Elena Boisier, Director of Research. Verónica Guarda, Director of Communications.

GENERAL SUPERVISION. Nicole Saffie, Chief of Communications Projects. **EDITING.** Adrián Puentes and Constanza Martínez. **TRANSLATION.** Miriam Heard, Paula Gaete and English UC.

PHOTO EDITING. Hans Mühr, Director for Heritage. **PHOTOGRAPHY.** Daniel Casado, César Cortés, Karina Fuenzalida, Germán Guzmán, Tomás Ibarra, Alice Nerr, Pablo Osses, Nicole Saffie, Alejandro Salazar and Cristóbal Saavedra. **ART DIRECTION.** Soledad Hola, Corporate Design. **BOOK DESIGN.** Claudia Brenning, Corporate Design. **PRINTING.** Fyrma Gráfica.

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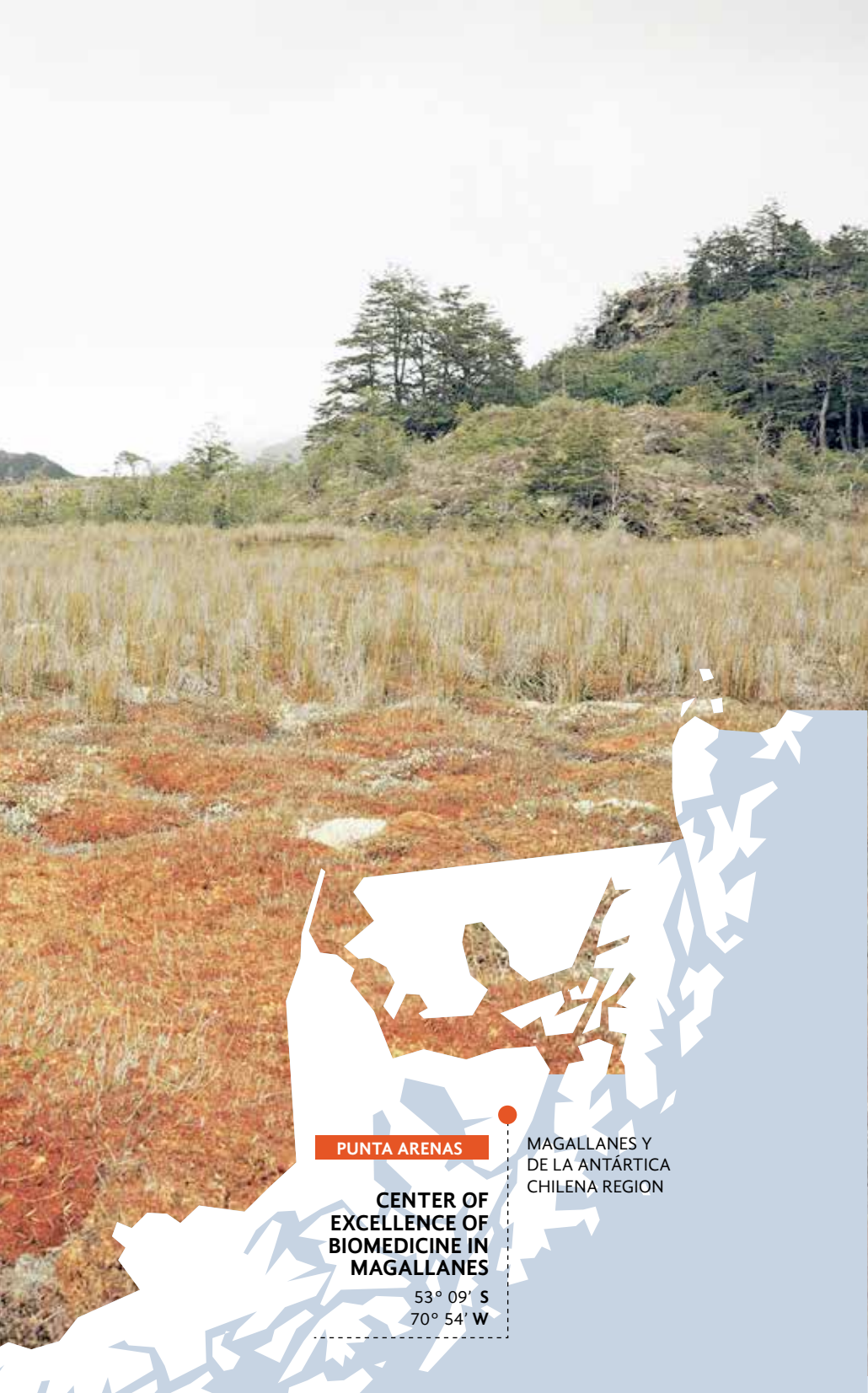
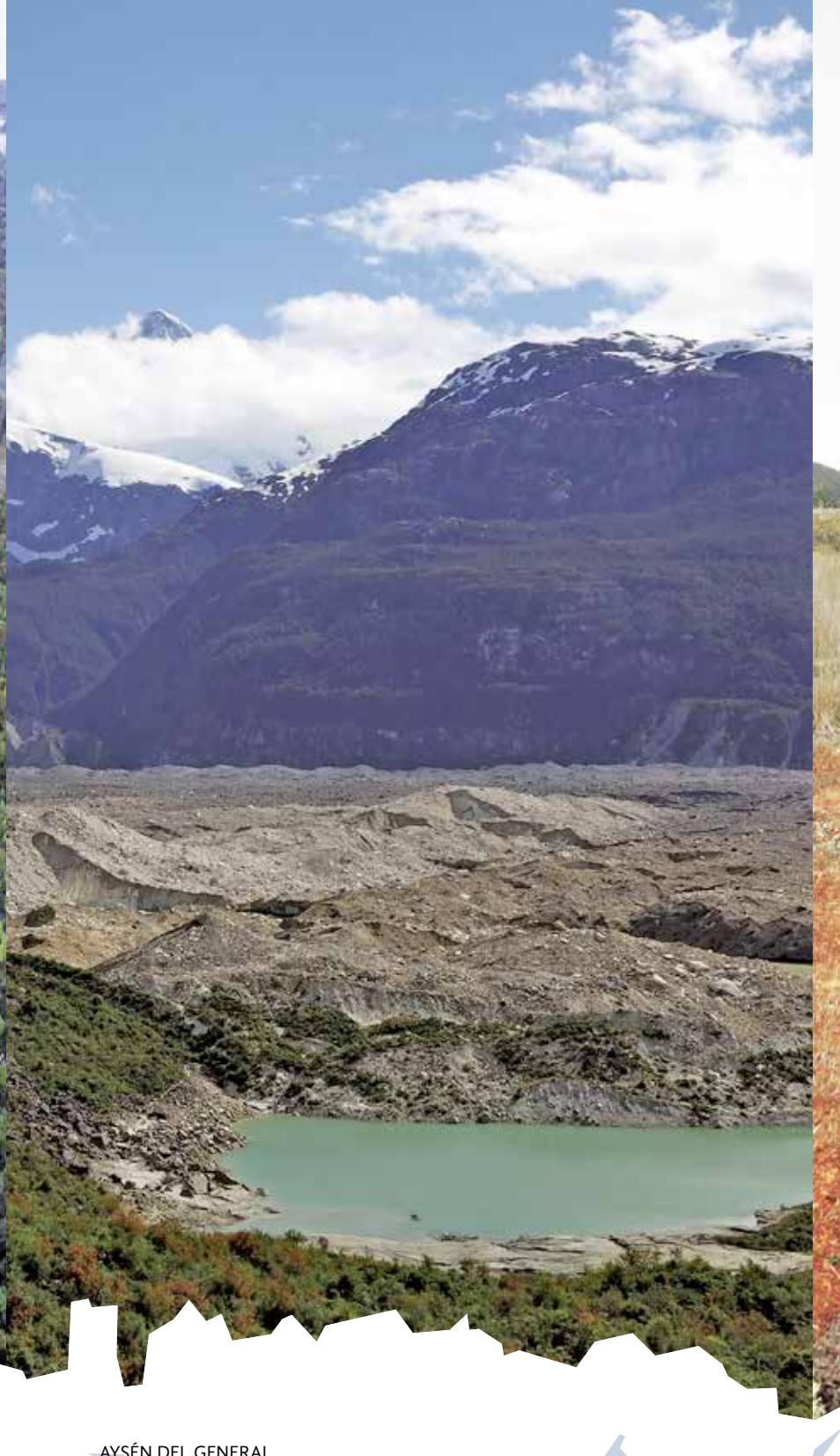
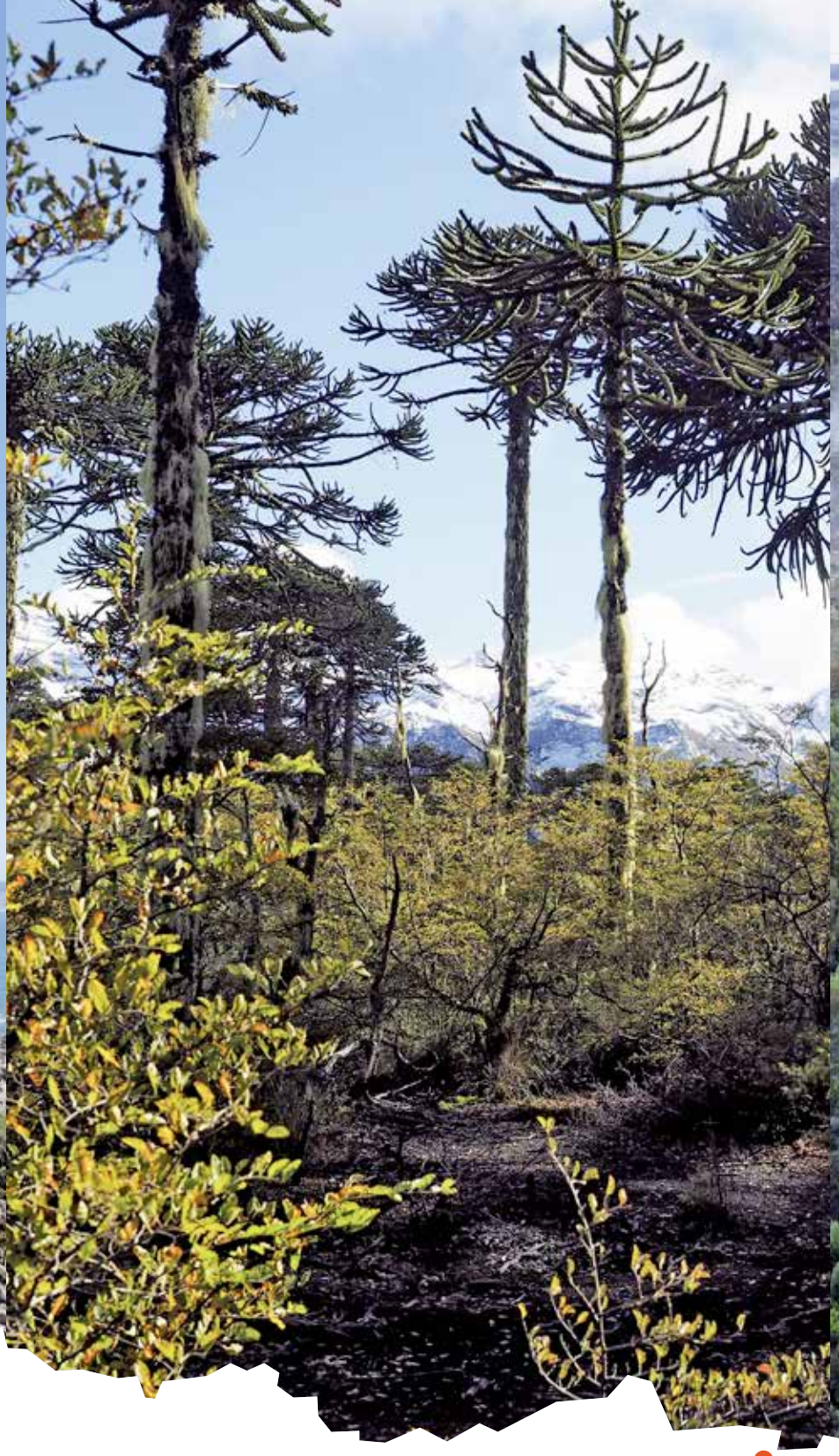
SCIENTIFIC RESEARCH
FROM NORTH TO SOUTH

FIELD SCIENCE IN CHILE



TO THE NORTH, THE ATACAMA DESERT; TO THE SOUTH, PATAGONIA; TO THE EAST AND WEST, THE ANDES AND THE PACIFIC OCEAN. THESE ARE CHILE'S NATURAL BORDERS. THE LONGEST AND NARROWEST COUNTRY IN THE WORLD OFFERS AN IDEAL TERRAIN FOR SCIENTIFIC RESEARCH: THE VARIETY OF ITS CLIMATES AND THE DIVERSITY OF ITS LANDSCAPES MAKE CHILE A PARTICULARLY RICH COUNTRY WITH A WIDE ARRAY OF ECOSYSTEMS AND NATURAL RESOURCES.

RESEARCH CENTERS AND FIELD STATIONS OF PONTIFICIA UNIVERSIDAD CATÓLICA DE CHILE



REGION OF TARAPACÁ
ALTO PATACHE
ATACAMA
DESERT
RESEARCH
STATION
20° 49' S
70° 09' W

SANTIAGO

REGION OF VALPARAÍSO
LAS CRUCES
COASTAL MARINE
RESEARCH STATION
33° 30' S
71° 37' W

ARAUCANÍA REGION
VILLARRICA
CENTER
FOR LOCAL
DEVELOPMENT
39° 16' S
72° 13' W

LOS LAGOS REGION
CHILLOÉ
SENDA DARWIN
BIOLOGICAL STATION
41° 53' S
73° 39' W

AYSÉN DEL GENERAL
CARLOS IBÁÑEZ DEL CAMPO REGION
BAHÍA EXPLORADORES
PATAGONIA
STATION FOR
INTERDISCIPLINARY
RESEARCH
46° 17' S
73° 24' W

PUNTA ARENAS
CENTER OF
EXCELLENCE OF
BIOMEDICINE IN
MAGALLANES
53° 09' S
70° 54' W

MAGALLANES Y
DE LA ANTÁRTICA
CHILENA REGION



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SCIENTIFIC RESEARCH
FROM NORTH TO SOUTH

**FIELD
SCIENCE IN
CHILE**

FROM THE CAMPUS TO THE REGIONS

Ignacio Sánchez

*President of
Pontificia Universidad
Católica de Chile*

The geography of Chile is exceptional due to its diversity. While there are many other countries with similar landscapes of extreme desert or icy tundra, what makes Chile unique is the concentration of environmental diversity within a relatively small area, within only one meridian line. We must learn how best to live in this habitat of interconnected elements, and as academics fascinated by the challenges stemming from this reality we are driven to find innovative solutions to the many and ever-changing issues we are confronted with.

At Pontificia Universidad Católica de Chile (UC) we have created a network of research centers and stations located in the most iconic ecosystems of our country. Starting in the north, we find the Atacama Desert Research Station where fog-catchers retain the water of a unique mist oasis, drop by drop, obtaining water in the driest desert in the world. They also research non-conventional renewable energy, biodiversity and coastal climates. In the center of the country, on the coast of the Pacific Ocean, is the Coastal Marine Research Station, the first protected marine area created to study the effects of fishing and tourism on marine ecosystems.

In the south of Chile, at our Villarrica campus, the only campus outside our capital, is the Center for Local Development, which aim is to contribute to the sustainability of socio-ecological systems, tourism and local economy, regional planning and

governance, and education on sustainability. Further south we find the natural and cultural riches of the island of Chiloé, where researchers at Senda Darwin study animal species such as the “monito del monte”, birds like the “chucao” and the “rayadito”, and plant species like the “ulmo” tree. They also study the ecosystem, observing how forests respond to climate change, or how a specific type of wetland called “mire” behaves. In the heart of Patagonia, an area difficult to access and with little human intervention, is Bahía Exploradores, where the Patagonia Interdisciplinary Research Station focuses on the biological history of the valley by studying its moss and lichen, river water, glaciers, and tree rings in order to determine the effects of a higher production activity in the area. At the southernmost tip of the American continent, along with Universidad de Magallanes in the city of Punta Arenas, we are part of the project of the Center of Excellence of Biomedicine in Magallanes (CEBIMA). In its laboratories scientists will study extracts from natural products, such as algae or lichens from the Sub-Antarctic and Antarctic regions that could help in the treatment of degenerative diseases like Alzheimer’s. In Puerto Williams, thanks to the collaborative work done with Fundación Omora, we have contributed to studying the ecology and biodiversity of the region.

At each of these centers and stations we aim to develop one of the primary tasks we have as a university: generating pioneering research that

responds to our country’s needs. Here the pioneering scientist pushes the boundaries of geography and knowledge. As this book attests, Chile is a country in constant dialogue with the concept of isolation; as the photographs show, this means isolation in locations of extraordinary natural beauty. Our centers and stations allow researchers and future scientists to connect with an often-challenging reality, testing their knowledge and skills, and broadening their understanding. We focus on a dual benefit: both Academia and local communities grow thanks to the close and mutually beneficial interactions. Engaging profoundly with our country’s geographical diversity requires determination and embodies one of the university’s main goals: The encouragement of interdisciplinary work. We have benefited significantly from government institutions such as the Ministry of National Assets, as well as international research centers. We are also grateful for the support from many regional universities that have collaborated in one or more research projects in their respective regions. Thanks to these universities, the generation of knowledge, which is one of the mission pillars of Pontificia Universidad Católica de Chile, has been able to expand from our campus and engage with the country as a whole.

OUR COMMITMENT TO FIELD SCIENCE

Pedro Bouchon
Vice President for Research

The consolidation of research at Universidad Católica is the result of the hard work done by renowned professors, researchers, graduate and undergraduate students, who embody our vocation for the creation of knowledge.

This is not a new trend in our University: since the 1940's experts in medicine such as Héctor Croxatto and Joaquín Luco, along with professors Raúl Devés from the School of Engineering, and Ricardo Krebs from the Department of History, have been setting the tone for the importance of research in our institution.

We have a reputed academic staff, strong doctoral programs and a well-developed research focus, including the arts and humanities, which translates into more than 2,200 Scopus articles per year. This adds to a growing number of patent registration requests and licensing, the creation of spin-offs, as well as the development of strategic alliances with companies and foundations.

In recent years we have placed a strong emphasis on interdisciplinary research. At present, we participate in 22 research centers of excellence and we host 40 Universidad Católica research centers, most of them devoted to interdisciplinary research, allowing us to address problems from various perspectives, thus reaching original and fascinating conclusions.

Among these initiatives, I would like to highlight the research stations that the University

has established in several regions across Chile. The Atacama Desert Research Station, the Coastal Marine Research Station, the Center for Local Development, the Senda Darwin Biological Station, the Patagonia Station for Interdisciplinary Research, and the Center of Excellence of Biomedicine in Magallanes are all site-specific projects that constitute excellent platforms for collaborative research, which increase the visibility of the University and its commitment to local communities across Chile.

The following pages describe some of the activities developed in these centers. We want to highlight the lines of research undertaken at every center and the publications that have arisen from the work that has been done. But more importantly, we want to draw attention to the valuable bonds generated with the surrounding communities. The hallmark of our educational vocation is apparent in the open courses we offer to local communities, ranging from weather measurement to marine ecosystems and forest regrowth after fire.

Above all, we want to acknowledge the people behind these projects: their directors and administrative teams; the professors and researchers from Universidad Católica, and from local and foreign universities; together with graduate and undergraduate students. They are at the core of our commitment to science.

FIELD RESEARCH

Patricio Bernedo
Dean of the Faculty of History, Geography and Political Science

Since its establishment in 1982 the Faculty of History, Geography and Political Science has focused its academic, research and extension activities on studying mankind and the historical, territorial and political phenomena in which they participate.

This book seeks to highlight one of our fundamental concerns: the relationship between mankind and our environment. This relationship is particularly relevant in Chile, a country marked by its landscape: from the driest desert in the world to the coldest forests; from the longest coast facing the Pacific Ocean, to the everlasting snows of the Andes Mountains; from the towns of the central valleys to the small villages and fishing harbors. This diversity marks us as a country, and consequently as a University and a Faculty.

We are compelled to pay attention to the environment surrounding us and we are determined to take our academic work out of the classroom and to different parts of the country, to undertake scientific and teaching activities that connect us with our surroundings and communities.

Through the Institute of Geography our Faculty is linked to two of the centers that appear in the following pages: the Atacama Desert Research Station and the Patagonia Station for Interdisciplinary Research.

The first is a unique place for research in the Atacama Desert where the potential of solar energy,

of fog and its associated ecosystems as a water source, and the specific features of the local flora and fauna are all researched. The station permanently offers courses for local schoolchildren to learn firsthand how science is developed in the desert.

The Patagonia Station, on the other hand, is located at the opposite end of the country and is nestled among the fjords in the Aysén Region, in the south of Chile. Here more than 5,000 hectares of forests, rivers and lakes are being systematically investigated for the first time. We have focused research on measuring the rivers' discharge, studying climatic history in tree rings, and through the analysis of pollen accumulated at the bottom of a lake, exploring species that have inhabited the region for hundreds of years.

Each of these initiatives originate from the effort and skills of the professors, the administration, and undergraduate and graduate students from our Institute of Geography, with the active participation of other Faculties. They are the driving force behind these pioneering initiatives, which also gather foreign researchers and students.

Through two of its stations our Faculty can perform its duty not only in the classrooms of our campus, but also throughout the country, thereby addressing the University's fundamental goal of outreach and knowledge sharing.

FIELD LABORATORIES

Juan Correa

*Dean of the Faculty of
Biological Sciences*

Our Faculty is characterized by its strong ties to scientific research. Thanks to the work of Faculty professors and researchers, support personnel and students, the cutting-edge research developed here has had a profound and lasting impact on the national and international scientific community. This strong vocation for research has also affected undergraduate and graduate education in Chile. In addition to the Biology, Biochemistry and Marine Biology majors we offer a Doctoral degree in Biological Sciences, currently the largest program at the University and the second oldest after Theology.

The regional centers and field stations presented here bring to life two challenges that we have undertaken not only as a Faculty, but also as a University: interdisciplinary work and internationalization. The diversity of professionals and researchers that participate strengthens the work carried out at each site and notably improves the quality and impact of our research output. Both our Faculty and the University have emphasized these values in their respective Strategic Planning goals, acknowledging thereby that this is the right path for tackling complex global problems that concern society, specifically one issue that particularly affects us as biologists: the sustainability of our production systems. We are also aware that interdisciplinary work is recognized internationally as an important responsibility of the scientific communities.

Moreover, these field stations allow us to address specific issues at each site. For example, Senda Darwin Biological Station has become key for investigation into forests and their response to human activity and

climate change, especially as water suppliers for rural settlements. Other studies have investigated, over a period of 10 years, the behavior of the “chucazo,” an endemic bird species that is threatened as a result of the fragmentation of its forest habitat.

The Coastal Marine Research Station, on the other hand, has developed valuable work for more than 35 years, contributing studies on ecology and conservation of marine diversity, which has had tangible applications in designing sustainable resource management plans. Scientists also study the ocean through different approaches, including those that go beyond traditional biology. Currently, research topics range from evaluating the energy potential of waves to the genetic characterization of vertebrates, invertebrates and seaweed populations.

Lastly, the Center of Excellence of Biomedicine in Magallanes (CEBIMA), which will soon begin operations, will undertake research into neurodegenerative, muscular and other diseases. It will research new treatments based on natural components that can only be found in species from the southernmost regions of Chile.

I have only mentioned a few of the research initiatives developed in each of the centers and stations. There are many more lines of research underway and we are confident that there will be a greater diversity over time. Research is at the heart of our work, both in the classroom and in these “field laboratories” that receive our scientists and students from across the country, providing attractive and stimulating places to visit and work for researchers from around the world.

THE DESERT, THE ISLANDS, THE NATIVE FORESTS AND THE MORE THAN 4,000 KILOMETERS OF COASTLINE PRESENT UNIQUE CONDITIONS FOR STUDYING CLIMATE CHANGE, THE DEVELOPMENT OF MEDICINAL COMPOUNDS, AND BEHAVIORAL STUDIES OF ANIMAL AND PLANT SPECIES IN INTERACTION WITH HUMANS. THANKS TO ITS GEOGRAPHY, CLIMATE, AND ABOVE ALL ITS SCIENTISTS, CHILE HAS BECOME A LIFE-SIZE NATURAL LABORATORY.

CENTERS,
FROM
NORTH TO
SOUTH

ATACAMA A DESERT FULL OF DISCOVERIES DESERT RESEARCH STATION

1.

ATACAMA DESERT RESEARCH STATION

A DESERT FULL OF DISCOVERIES



In the world's driest desert, Universidad Católica has established the country's first research center focused on the components of this unique ecosystem: the sun, fog, land and vegetation.

Since the 1980s, researchers at the Institute of Geography have been investigating using fog as a viable source of water. In 1997, they discovered an area 56 km south of the city of Iquique and 7 km north of a small fishing village called Chanavaya in the Tarapacá Region, which made up what we called a fog oasis. The area, which is state-owned, presented valuable features for research in the desert, especially the presence of dense fog, which supports the formation of a unique ecosystem.

In 2007 Universidad Católica obtained the concession of the land from the Ministry of National Assets, and the 1,114 hectares were passed on to the University administration for 25 years, with the objective of environmental conservation as well as the development of research and education into this local phenomenon. Professor Pablo Osses, from the Institute of Geography, coordinates the different activities carried out there and currently directs the station.

After a decade of operations, the station has an infrastructure that meets its needs: six domes which house bedrooms, bathrooms, storage, teaching and dining areas, as well as an office for administrative and IT work. The installations are self-sufficient,

using solar energy and water extracted from fog. The facilities allow Chilean and foreign scientists to investigate in the desert in excellent conditions.

Solar energy research by a team from the Universidad Católica's Engineering School is just one example of the work undertaken at the station and encompasses research into the sun's behavior as well as specific issues such as the corrosion of materials used in building photovoltaic plants. This is a particularly significant question, given the energy potential of the Atacama Desert, the driest place on earth and with one of the highest solar radiation levels.

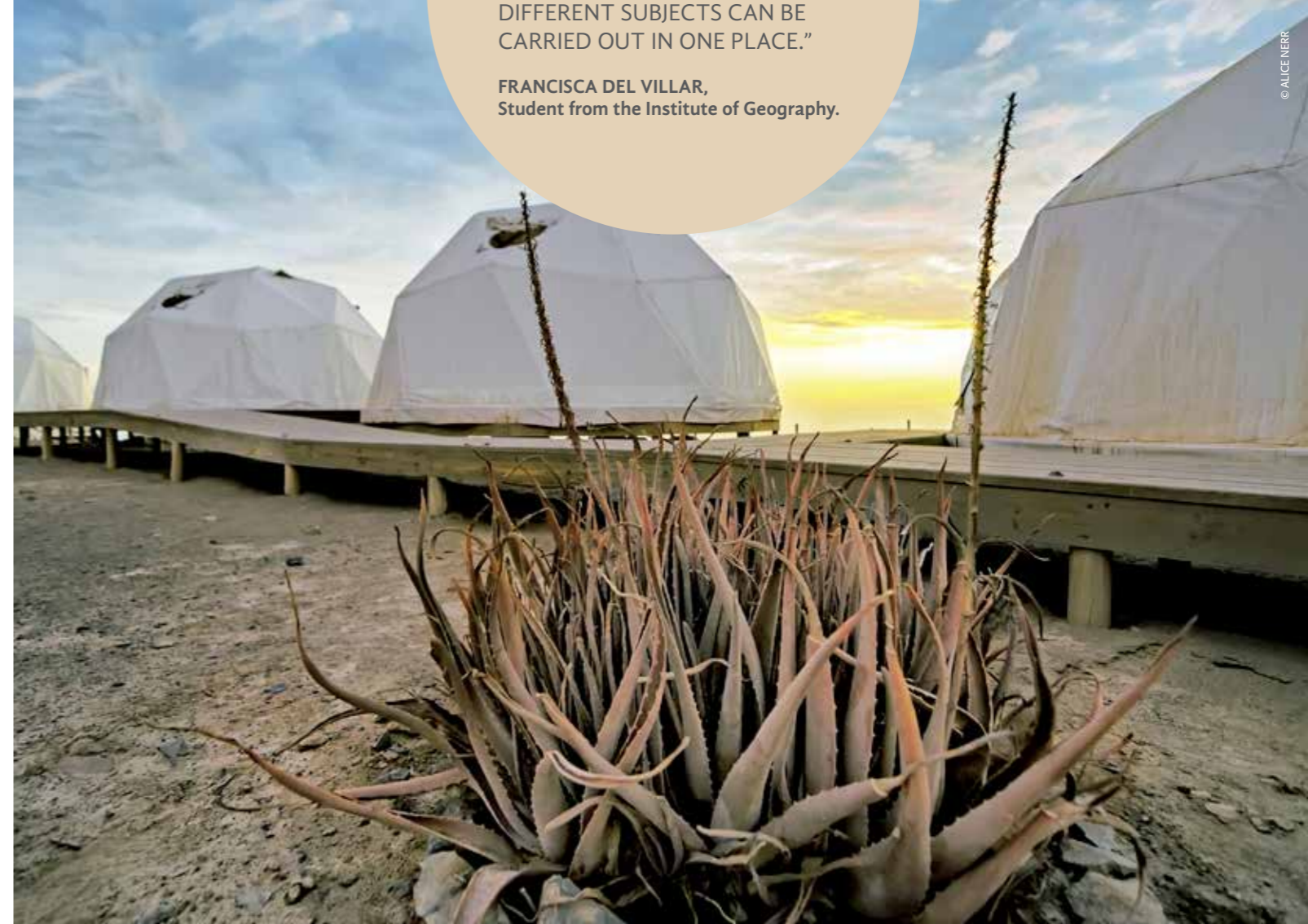
There has also been research on lichens, an ancient form of life. In fact, researchers discovered *Santessonia Cervicornis*, an endemic species that can only be found in the area around the field station.

Researchers also observe and measure the fog that covers the oasis: it is a cloud that sits over a large part of the southwest Pacific, from central Perú to Pichilemu, a coastal town located in the Sixth Region of the country (35°S). The aim of this research is to verify the effect of climate change on this cloud, as well as the potential of fog as a source of water for human use. Based on this research, scientists have



"THANKS TO THIS EXPERIENCE, I STRENGTHENED MY TEAM RESEARCH WORK SKILLS. I ALSO REALIZED THAT SEVERAL PROJECTS FOCUSED ON DIFFERENT SUBJECTS CAN BE CARRIED OUT IN ONE PLACE."

FRANCISCA DEL VILLAR,
Student from the Institute of Geography.



© NICOLE BARTIE

© PABLO OSSES

© ALICE NERR



ROTATING SHADOWBAND Radiometer (RSBR) set in Alto Patache.

“WORKING AT THE ATACAMA STATION GIVES YOU TIME TO THINK, TO UNDERSTAND HOW PRIVILEGED WE ARE AND TO BECOME MORE AWARE OF HOW FRAGILE AND VULNERABLE THE PLANET IS. MOREOVER, INTERACTION WITH OTHER COLLEAGUES NOURISHES YOUR WORK BY PROVIDING DIFFERENT POINTS OF VIEW AND PROMOTES INTERDISCIPLINARY WORK BY INCORPORATING OTHER PERSPECTIVES.”

RODRIGO ESCOBAR,
Professor from the School of Engineering.

IMAGE OF THE Camanchaca Documentary, Clío Simon, France.



DESERTA BOOK, by Pedro Alonso, Architecture academic.



TO DATE, NEARLY 30 NEWS ARTICLES AND DOCUMENTARIES have been produced about Alto Patache's work.

THREE SPECIES OF INSECTS, previously unknown to science, have been discovered in Alto Patache.

MORE THAN 20 BOOKS AND SCIENTIFIC PAPERS have been published concerning the research carried out here.

“ALTO PATACHE TEACHES YOU THE ESSENTIAL LESSON THAT THE DESERT IS ALIVE AND FILLED WITH THINGS. IT'S NOT A BARREN OR EMPTY PLACE: IT'S BURSTING WITH LIFE, WATER AND ENERGY. THIS GUIDES OUR WAY OF UNDERSTANDING URBAN DESIGN AND ARCHITECTURE IN WAYS THAT OTHER GEOGRAPHICAL LOCATIONS CAN'T.”

PEDRO ALONSO, Professor from the School of Architecture.

designed “fog-catchers” that collect water in a clean, permanent and sustainable way, and have exported this technology to countries like Namibia, Yemen, Haiti, Nepal, Perú and Guatemala, among many others.

Researchers at the station will also explore building techniques and the suitability of different materials and how best to use them in these types of environments, in harmony with the location. The research team from the University's School of Architecture will study the effects of wind, humidity, sand and the sun on the construction of buildings. Likewise, a team from the School of Engineering will experiment with new materials that could resist these conditions.

By becoming a place of research unique in the hyper-arid coastal area, the Atacama Desert Research Station has also undertaken a committed role in educating and maintaining a relationship with neighboring communities.

The small nearby inlets of Chanavaya and Chanavayita provide resources and technical support for the station. Meanwhile, educational work has been geared towards the design and development of guided tours for schools. To this date, around 500 children from schools in Iquique and other nearby towns have visited the station where they have been able to see the researchers' work, instruments and routines. Thanks to the guided tours, these children have been able to witness the scientific potential of their land, the driest desert in the world.



“THE STATION GIVES YOU THE OPPORTUNITY TO FIND A FOCUS FOR YOUR INVESTIGATION THAT ISN'T NECESSARILY RELATED TO ONE RESEARCH TOPIC, BUT TO A COMBINATION OF SEVERAL DIFFERENT AND INTERRELATED ONES. THIS IS VERY POWERFUL IN ACADEMIC TERMS.”

JUAN LUIS GARCÍA, Professor from the Institute of Geography.

2.

COASTAL
THE OCEAN
UNDER THE
MICROSCOPE
MARINE
RESEARCH
STATION

AERIAL VIEW of the Station in Las Cruces.

COASTAL MARINE RESEARCH STATION

THE OCEAN UNDER THE MICROSCOPE

LAS CRUCES
20° 49' S
70° 09' W • SANTIAGO

In the small town of Las Cruces, Universidad Católica set up a research center to investigate the challenging scientific questions posed by the immense and productive Pacific Ocean, from its natural resources to ecosystem conservation, to the possibilities the ocean offers as a potential source of energy.

The nearly 6,500 kilometers of Chile's coastline had no protected areas for scientific research until 1982, when the Coastal Marine Research Station (in Spanish, ECIM) was created. Thanks to the initiative of Juan Carlos Castilla and Patricio Sánchez, professors of the Faculty of Biological Sciences, Universidad Católica purchased a 2.5-hectare plot of ocean-front land to become a "living laboratory" in the traditional coastal town of Las Cruces located in the Region of Valparaíso. The government then granted a concession to the University, allowing it to protect a 1 km-long section of coast with adjacent shallow marine habitat. In order to understand the effects of human-mediated processes such as fishing and tourism on marine ecosystems, humans were excluded from the area, which had previously experienced strong artisanal fishing activity. This was an unprecedented move in the country and provided one of the first bodies of scientific evidence in the world for the effects of humans on benthic marine ecosystems. The research led by Professor Castilla laid the foundations for a novel approach to marine resource management which was later incorporated into the Chilean fishing legislation.

With a continuously growing permanent presence of leading professors and researchers, ECIM has since become a world-class marine science center that includes the training of young professionals (national and international), outreach education for school-children, teachers, and the general public, as well as creating bonds with the local community. Research disciplines have also diversified in recent decades, attracting researchers and professors from other faculties and universities. For example, the Coastal Marine Research Station houses an interdisciplinary center on biodiversity conservation lead by diverse teams of ecologists, oceanographers, conservation biologists and sociologists, whose efforts have led to the creation of new marine reserves in the country. Likewise, recent scientific exploration of waves and currents as renewable energy sources or farming of native marine species as food-sources for humans has built new connections with members of the faculties of Engineering and Agriculture. Thus, ECIM fosters a collaborative, multi-disciplinary approach to address challenging questions of the rapidly changing land-sea interface.

"THE TEACHING ACTIVITIES OFFERED TO CHILDREN HELP THEM USE THE KNOWLEDGE ACQUIRED IN THE CLASSROOM. FOR ME, AS A TEACHER, IT'S BEEN A GREAT WORK TOOL BECAUSE I ADJUST ELEMENTS IN THE CURRICULUM TO THE WORK UNDERTAKEN AT THE COASTAL STATION."

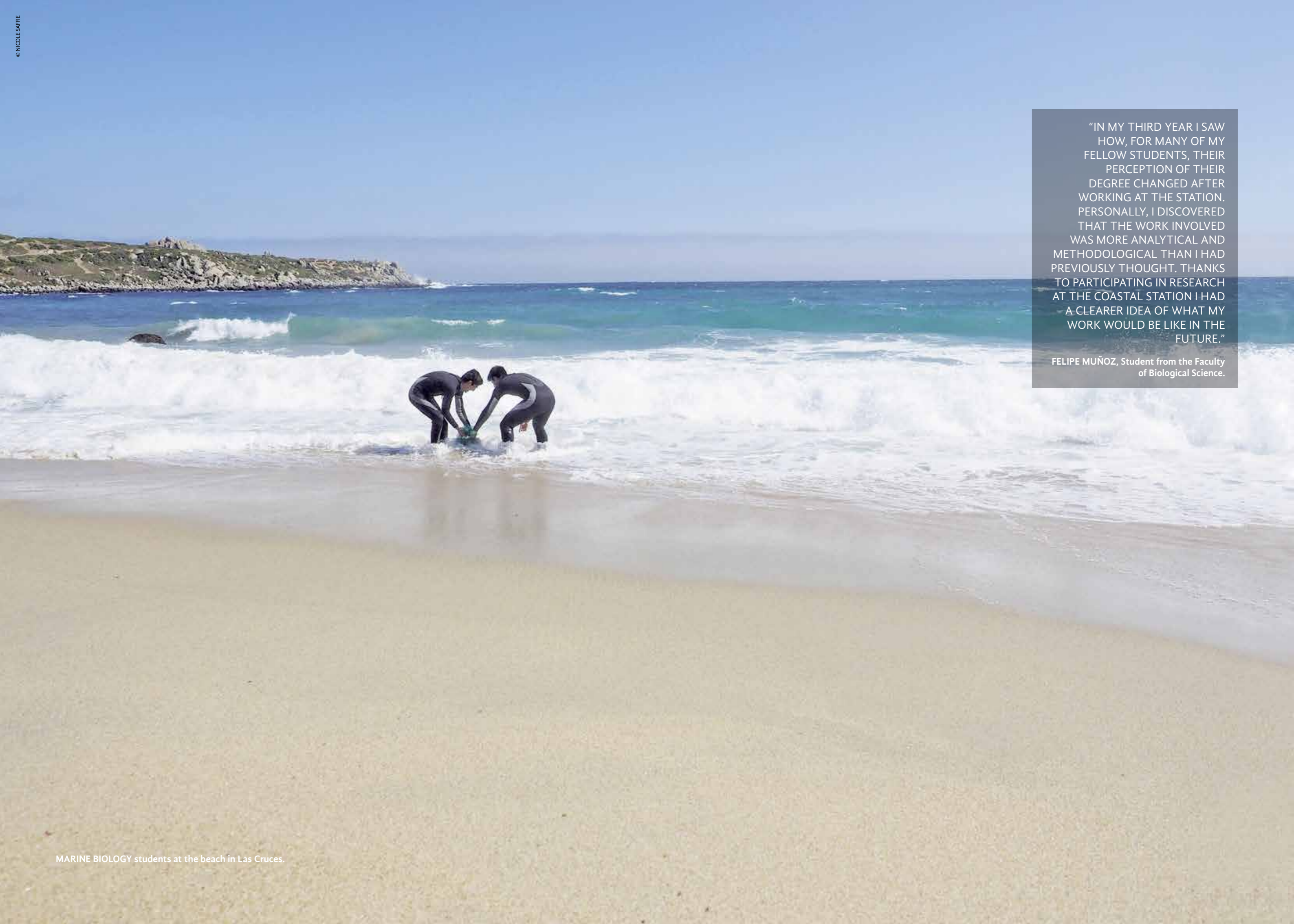
JESSICA ESPINOZA, Professor at the Las Cruces Primary School.



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“IN MY THIRD YEAR I SAW HOW, FOR MANY OF MY FELLOW STUDENTS, THEIR PERCEPTION OF THEIR DEGREE CHANGED AFTER WORKING AT THE STATION. PERSONALLY, I DISCOVERED THAT THE WORK INVOLVED WAS MORE ANALYTICAL AND METHODOLOGICAL THAN I HAD PREVIOUSLY THOUGHT. THANKS TO PARTICIPATING IN RESEARCH AT THE COASTAL STATION I HAD A CLEARER IDEA OF WHAT MY WORK WOULD BE LIKE IN THE FUTURE.”

FELIPE MUÑOZ, Student from the Faculty of Biological Science.



© ARCHIVE ECIM

© ARCHIVE ECIM

“THE COASTAL STATION IS A GREAT CONTRIBUTION. IT’S A CENTER THAT TRAINS NEW GENERATIONS OF CHILE’S MOST PROMISING STUDENTS, IT’S SURROUNDED BY ONE OF THE OLDEST PROTECTED MARINE AREAS IN OUR COUNTRY, AND IT HAS HUGE POTENTIAL TO BECOME A BENCHMARK FOR ENVIRONMENTAL EDUCATION.”

MIRIAM FERNÁNDEZ, Researcher from ECIM.

Along with the diversification and growth of scientific activities, the Coastal Marine Research Station has progressively built state-of-the-art infrastructure that today houses well-equipped wet and dry laboratories, scientific diving facilities, meteorological and oceanographic measuring stations, small research boat operations and remotely operated ocean-exploration vehicles.

In addition, the field station has teaching classrooms and laboratories, auditorium, conference rooms, offices, as well as dorm-like housing. It also has permanent administrative and academic staff, led by Professor Sergio Navarrete, and it serves as an “extension campus” for Marine Biology students, a degree that was created in 2008.

Award-winning outreach and education programs have also originated and been cultivated here. Undeniably, one of the most important projects is “Chile es Mar”, which includes guided tours for children, young people and their families, to see the scientific activities undertaken at the station. Here, they learn about biodiversity, conservation, endemic species, ocean behavior and other subjects through direct observation of organisms and experiments. In addition, the station established a “Biblioteca Escolar Futuro”, an Universidad Católica project that seeks to promote reading and to provide access to books throughout Chile.



“THE STATION HAS PLAYED AN IMPORTANT ROLE IN THE DEVELOPMENT OF RESEARCH IN CHILE. SCIENTISTS AT THE STATION ESTABLISHED MECHANISMS FOR COASTAL MANAGEMENT OF THE MARINE ENVIRONMENT, AND HAVE BEEN A FUNDAMENTAL PILLAR IN MARINE EDUCATION AND AWARENESS BUILDING.”

ALEJANDRO MATUS, Researcher from ECIM.

SCHOOL CHILDREN
learning about
different species.



WITH ITS PROGRAM “CHILE ES MAR” the coastal station has hosted visits from more than 12,000 children and almost 1,000 teachers.

AN ARTICLE IN PNAS MAGAZINE, from September 2010.



UP TO 2017, NEARLY 500 SCIENTIFIC ARTICLES have been published in ISI magazines thanks to research performed at ECIM.



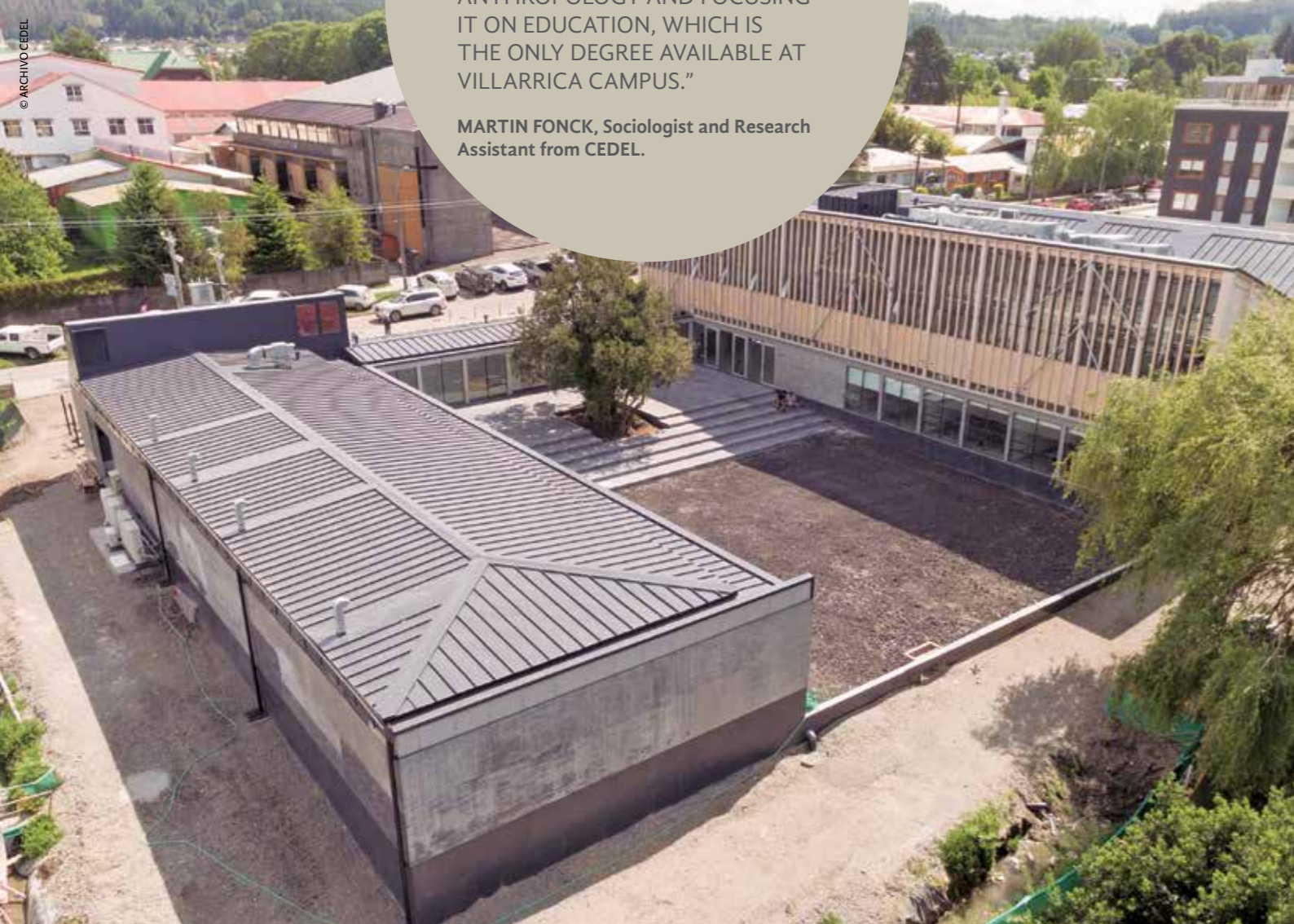
ON AVERAGE, 18 RESEARCH projects take place annually at the coastal station.

IN 2017, 13 COURSES AND 7 NATIONAL and international workshops were taught.

3.

CENTER FOR LOCAL DEVELOPMENT

INTERDISCIPLINARY
SUSTAINABILITY



CENTER FOR LOCAL DEVELOPMENT

INTERDISCIPLINARY SUSTAINABILITY

SANTIAGO •
VILLARRICA •
39° 16' S
72° 13' W



"I WOULD LIKE TO HIGHLIGHT THE CENTER'S GREAT POTENTIAL FOR EDUCATING IN SUSTAINABILITY, BRINGING TOGETHER RESEARCH ON ECOLOGY AND ANTHROPOLOGY AND FOCUSING IT ON EDUCATION, WHICH IS THE ONLY DEGREE AVAILABLE AT VILLARRICA CAMPUS."

MARTIN FONCK, Sociologist and Research Assistant from CEDEL.

The Center for Local Development focuses its endeavors on sustainability and territorial planning in an area particularly rich in cultural, demographic and natural elements. It will soon be opening a new building.

The Center for Local Development (in Spanish, CEDEL) is in the central-south region of Chile, an area with vast natural richness, with a strong presence of Mapuche communities, and with the highest levels of poverty in the country. CEDEL is affiliated to UC's Villarrica Campus, and is made up of five Faculties at the University. Since its inception in 2010 it has sought to encourage research, development projects and training practices that contribute to a sustainable development of the area. It works from an integral, intercultural and interdisciplinary perspective to plan and manage local territory. Thanks to the success that its initiatives have had over time, the center has become a key platform in bringing the University closer to complex socio-ecological issues in the central-south region of Chile.

Today, in addition to administrative personnel, teachers' aides, and students, the center has 27 professors from six Faculties at the University. Over the past four years the center has been awarded more than 30 projects, all of them with an interdisciplinary approach and directly associated with researchers from areas like environmental science, social science and humanities, urban and territorial studies, and medicine.

Development, training and research projects carried out at the center sit within the framework of four lines of action that are vital for the sustainability of the central-south region of the country. The first, Sustainability of Socio-Ecological Systems, combines ecology with social sciences and humanities. This interdisciplinary approach aims to address the challenges of the ecological and heritage conservation of a territory without excluding the communities that live and work there. The center has been able to carry out projects in collaboration with ecologists and anthropologists, and with the active participation of the Mapuche and non-Mapuche communities in the area.

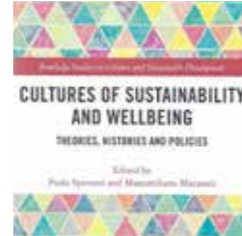
The second line of action is called Sustainable Tourism and Local Economy. The center seeks to understand how tourism works, as it is one of the main forces of territorial transformation in the area. Considering in particular the interaction between visitors, residents and the territory, this pursues the development of a more sustainable tourism. In turn, through community training, it contributes in designing and managing projects that promote the local economy and the value of natural and cultural heritage.



“CEDEL IS A RESEARCH CENTER WITH A BROAD DISCIPLINARY FOCUS THAT ALLOWS YOU TO WORK ALONGSIDE ANTHROPOLOGISTS, SOCIOLOGISTS, DESIGNERS, AGRICULTURAL ENGINEERS, AND OTHERS. WORKING THERE GIVES YOU THE CHANCE OF ADDRESSING PROBLEMS FROM A MORE COMPLEX AND SYSTEMATIC POINT OF VIEW.”

GONZALO VALDIVIESO,
Professor from Villarrica Campus and
Former Director of CEDEL.

MODEL OF THE MICHEL DURAND INTERDISCIPLINARY
Complex for Sustainable Development.



THE NEW APPROXIMATELY 3,900 SQUARE METER BUILDING where CEDEL will operate includes an auditorium, meeting rooms, a laboratory, a documentation center and administrative offices.

BETWEEN 2010 AND 2017 CEDEL was granted 88 research, development and training projects.

THERE WERE 107 PUBLICATIONS WRITTEN based on research performed at CEDEL, including papers published in ISI, Scopus, Scielo and Latindex magazines, as well as books, chapters in books, records and others.

The third line of action, Territorial Planning and Governance, aims to understand the socio-spatial complexities of the urban-territorial systems of the region, as well as facilitating their governance processes. The central-south region of Chile is an area with strong intercultural tensions, where the Mapuche, Chileans and immigrant settlers interact. In this context, the center tries to contribute by helping to coordinate the different actors of the territory, with the purpose of reaching inclusive governance for the multiple communities that coexist in the region.

Finally, the fourth line of action is called Education for Sustainability, and seeks to develop sustainable educational initiatives, based on a strong interdisciplinary research basis, that can be carried out together with University students, school students and other actors from the territory.

According to Gonzalo Salazar, director of CEDEL, one of the fundamental challenges of the center has been to question what can be understood by sustainable development and how it can be undertaken while considering diverse local dynamics in a global era. For this reason, in addition to leading an in-house research line specifically dealing with this issue, CEDEL maintains a constant collaboration with the area's community, different actors of the civil society, local

businesses and the government. Likewise, the other cornerstone of CEDEL's practice is interculturality. All projects carried out under the four above-mentioned lines of action are developed in intercultural systems, where there is exchange between Mapuche and non-Mapuche people, settlers and non-settlers.

CEDEL will soon have a new location. In late 2018 the new Michel Durand Interdisciplinary Complex for Sustainable Development will be inaugurated, which will also house other departments and areas of the campus. Located on the shore of Lake Villarrica and with CES certification (the only existing national sustainable architecture certification), it will allow CEDEL to organize research, training and extension activities for both students at the university and for other people.

In addition, this new facility is planning to develop, among other initiatives, a master plan for the lakeshore of the city of Villarrica, a project for lake natural habitat recovery and the creation of community urban gardens for the local cafeteria. The new building will also be the headquarters for undergraduate and graduate programs in sustainability that are currently in their curricular planning process. The aim is that one building will house research processes, education and extension activities that foster CEDEL's values: interdisciplinary research, sustainability and interculturality.



"IN ADDITION TO FULFILLING THEIR ROLE AS EDUCATORS, IT'S IMPORTANT THAT UNIVERSITIES ALSO CREATE BONDS WITH THE COMMUNITY. A UNIVERSITY SHOULD WORK COLLABORATIVELY WITH ITS LOCAL COMMUNITY, NOT ONLY IN RESEARCH, BUT ALSO TO ENSURE A MUTUALLY BENEFICIAL AND SUPPORTIVE RELATIONSHIP AND ENVIRONMENT."

CHRISTIAN CARTES, DIDECO Curarrehue (Director of Community Outreach)

SENDA DARWIN BIOLOGICAL STATION

THE BIOLOGICAL
WEALTH OF THE
CHILEAN FOREST

4.

SENDA DARWIN BIOLOGICAL STATION

THE BIOLOGICAL WEALTH OF THE CHILEAN FOREST



Since 1996, this site has fostered research into the natural and human ecosystems on the Chiloé archipelago. More than 20 years after its establishment the field station has become not only a renowned center for encouraging and contributing to knowledge and education about southern temperate forests, but also a support to local development.

The history of this field station is linked in two ways to the British naturalist Charles Darwin. Firstly, because all biological and ecological research today is connected necessarily to Darwin's discoveries. Secondly, and more importantly, when Darwin visited the island of Chiloé in 1834 and 1835, as described in his book *The Voyage of the Beagle*, he is presumed to have traveled on foot or on horseback along a trail from Ancud to Chacao, where today's field station stands. Scientists at Senda Darwin Biological Station work and investigate along the very path that the famous evolutionist traveled, where he observed, took notes, and posed critical questions.

When the field station was created (along with the Fundación Senda Darwin) by professors Juan Armesto and Mary Wilson, their primary goal was to increase scientific knowledge of the temperate rainforests of Chiloé. In 1996, when they began their research, there were no long-term measurements of ecological processes, nor was there an appropriate place to develop research in the area. The founders also wanted to establish a research center to contribute to the promotion of scientific education among students and local communities. In addition,

they hoped to contribute to local development by suggesting sustainable public policies to authorities in Chiloé, a territory with a particularly rich natural and cultural heritage.

The land of the Foundation is about 100 hectares, located 15 kilometers south of the city of Ancud. Today, the site hosts a laboratory, a guesthouse, a visitor's center with an auditorium for 40 people, a plant nursery with native flora, a small library, and the park ranger's house. The Foundation's land also includes a native forest (that has been kept free of human intervention since the foundation of the station), where several scientific measuring instruments have been set up.

Since 1996, the Foundation has run its operations autonomously, headed by a Board of Directors, an independent team of researchers and an administrative team. It has always been open to receiving those interested in using the facilities for educational or research purposes. In 2016 the station signed a collaboration agreement with Universidad Católica in order to formalize an academic relationship that has existed since the Foundation's establishment, and that has allowed for long-term collaborative efforts



"AN ON-GOING CONCERN HAS BEEN TO ENSURE A DIRECT AND PERMANENT LINK BETWEEN THE SCIENTIFIC COMMUNITY AND CHILOÉ'S LOCAL COMMUNITY."

JUAN ARMESTO, Founder and President of Fundación Senda Darwin.

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“THE FACILITIES AT SENDA DARWIN ARE EXTREMELY SUITABLE FOR RESEARCH. THERE ARE AREAS OF FOREST AND SHRUB-LAND FOR INVESTIGATION AND THE NEARBY GUESTHOUSE PROVIDES ACCOMMODATIONS AS WELL AS LABORATORY SPACE TO PROCESS COLLECTED SAMPLES.”

FRANCISCA DÍAZ, Researcher from Universidad Andrés Bello.

SENDA DARWIN, Chiloé, Los Lagos Region.

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“WHAT I LIKE THE MOST ABOUT MY WORK AT SENDA DARWIN IS THE WORK I DO WITH STUDENTS AND VOLUNTEERS. BY CO-OPERATING TO PROTECT THE NATIVE FOREST WE ESTABLISH EXCELLENT AND DYNAMIC RELATIONSHIPS.”

JUAN VIDAL, Park Ranger at the Senda Darwin Nursery of Native Plants.

BOOK “CHUCAO y otras aves del bosque templado lluvioso de Sudamérica”, Mary F. Wilson et al.



SINCE 1998 MORE THAN 50 RESEARCH projects have been developed, led by both local and international scientists, including graduate students' theses.

IN ADDITION TO PUBLICATIONS in academic journals and specialized magazines, work at Senda Darwin has led to the publication of 7 books focused on biological and scientific research.

SINCE 2005 AN ANNUAL MONITORING program of the “monito del monte” (*Dromiciops gliroides*) population has been in place, unraveling the life of this tiny marsupial endemic to the temperate rainforests of the southern region of South America.

between professors and students through thesis work and projects on biodiversity and ecological issues.

The research undertaken at the station is categorized under either “strictly biological” or “ecosystem science.” The first category includes monitoring of the “monito del monte” population (an endemic arboreal marsupial) that inhabits the forests, and of flagship forest bird species such as the “Chucaos” or “Rayadito”; it also includes a 20-year study of networks of interaction of tree species, such as “Ulmo”, with pollen and nectar-feeding insects. The second area of research focuses, for example, on carbon fluxes and storage in different ecosystems, such as rainforests and moorlands, which may constitute relevant carbon sinks, modulating global climate warming.

Over the past decade the station has encouraged the application of policies resulting from research on the island. One of the most important projects was developed in collaboration with the Provincial Government of Chiloé to promote a continuous water supply for rural communities in crisis due to seasonal drought. This initiative has educated local communities on effective actions to enhance water efficiency and the protection of forests and bogs in a region where, despite abundant rainfall, water is scarce during the summer months.

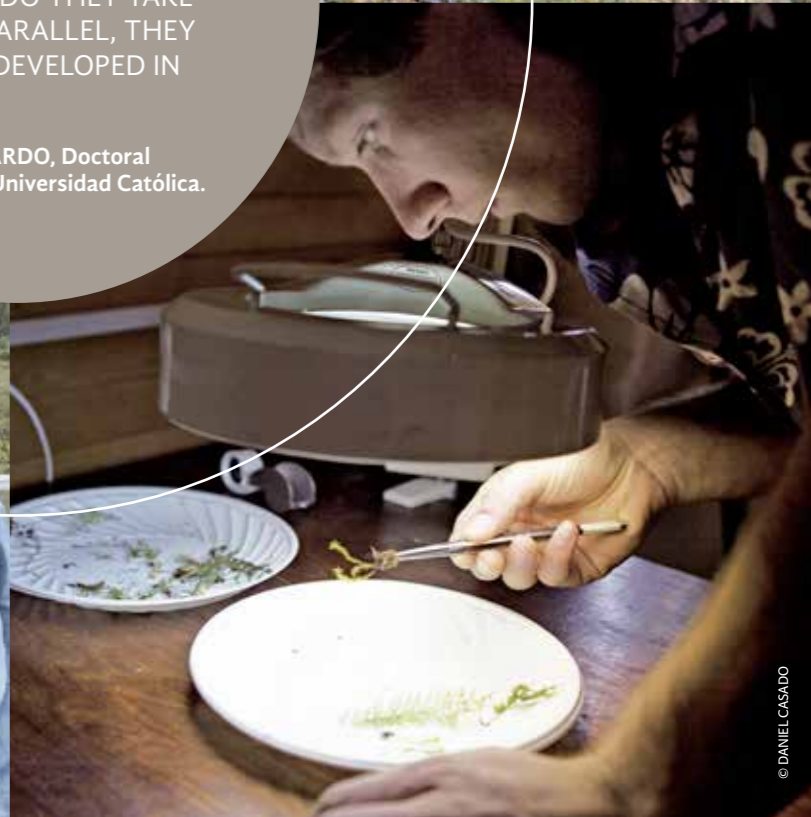
Another important aspect of the academic collaboration of the station with Universidad Católica and other Universities is teaching. In this context, a primary task has been the course “Ecology and biodiversity in temperate forests,” annually taught on site by a group of professors, coordinated by Juan Armesto, head of the Fundación Senda Darwin Board of Directors. Each year approximately 25 local and foreign students from undergraduate and graduate programs participate in this course. Renowned professors from Universities such as Stanford (USA), Comahue (Argentina), and Cambridge (UK) have participated as lecturers.

The station also promotes activities designed to enrich or complement the curriculum of school level biology teachers. For example, in the workshop “Ecology in the Schoolyard”, which is part of a Latin-American educational program that takes place in 14 countries, children and teachers from schools on Chiloé study ecological processes and organisms from their surroundings, and investigate the impact that humans have on the local environment, as well as the regional and global implications.



“SCIENTIFIC RESEARCH AND DISSEMINATION OF KNOWLEDGE ARE ESSENTIAL IN SCIENCE, AND AT SENDA DARWIN NOT ONLY DO THEY TAKE PLACE IN PARALLEL, THEY ARE ALSO DEVELOPED IN SYNERGY.”

BELÉN GALLARDO, Doctoral candidate at Universidad Católica.



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5.

PATAGONIA STATION

FOR INTERDISCIPLINARY
RESEARCH

STUDYING AT
THE SOUTHERNMOST
FRONTIER

ENTRANCE TO PATAGONIA STATION, Maldonado sector, Bahía Exploradores.

PATAGONIA STATION FOR INTERDISCIPLINARY RESEARCH

STUDYING AT THE SOUTHERNMOST FRONTIER



Between fjords, rivers and lagoons in southern Chile, Pontificia Universidad Católica de Chile is developing an exceptional scientific center in an area essential for the study of global change and local biodiversity.

In the southernmost fjords in the Pacific Ocean, 300 kilometers from the city of Coyhaique, we find Bahía Exploradores. In 2009, thanks to a land concession given by the Chilean state, these 5,014 hectares of remote land became the Patagonia Station for Interdisciplinary Research. Due to its isolation and difficult access the site presents privileged conditions for scientific research, such as the minimum human intervention on its land and in its marine ecosystems. Dr. Alejandro Salazar is the director of the field station, that is conformed by the Faculties of History, Geography and Political Science; Biological Sciences; Architecture, Design and Urban Studies; and Agricultural and Forestry Engineering. The Patagonia Station for Interdisciplinary Research signed an agreement with French researchers from the National Center for Scientific Research (in French, CNRS).

Bahía Exploradores is an extraordinary natural laboratory for observing global changes. North of the station is the South Patagonian Ice Field (Campos de Hielo Sur), and it borders with highly pristine forests. This is a fascinating frontier to analyze, due to changing environmental and

climate phenomena ready to be studied. Taking advantage of these conditions, ideal for studying climate change and biodiversity, scientists at Pontificia Universidad Católica de Chile are carrying out a wide variety of scientific research. These include a study of bryophytes, an ancient plant, in order to find compounds with potential antibiotic properties. Researchers are also studying the hydro-geomorphology of the area (the shape and composition of rivers), as well as undertaking palaeoclimatological studies to better understand the environmental history of Bahía Exploradores' valley. Finally, researchers are undertaking a local dendrochronological study, counting and measuring rings on trees, to estimate the temperature and precipitation of the year in which each ring was formed. The purpose of this research is to produce a systematic record of the changes in climatic conditions in the valley over the last 200 years.


Notwithstanding these studies, the director believes that the area remains relatively uncharted when it comes to scientific research. He therefore invites both Chilean and foreign scientists to diversify experimental observations and deepen the analysis

"THIS IS A MARVELOUS PLACE, IT'S A LIFE-SIZE LABORATORY WHERE YOU CAN MONITOR AND SEE THE CHANGES AND THE DYNAMICS OF ENVIRONMENTAL VARIABLES *IN SITU*."

JORGE QUENSE, Assistant Professor at the Institute of Geography.



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“FOR US, WORKING AT THE STATION HAS BEEN A FANTASTIC EXPERIENCE BECAUSE IT HAS MEANT DEALING WITH CONSTRUCTION IN AN EXTREMELY ISOLATED AREA. SO IN ADDITION TO BEING AN ENJOYABLE ARCHITECTURAL EXERCISE, WE HAVE LEARNED A LOT ABOUT THE LOGISTICS OF THIS TYPE OF WORK”.

FRANCISCO CHATEAU,
Professor and Director of the Models and
Prototype Laboratory from the Faculty of
Architecture.



“THE FIELD EXPERIENCE HAS BEEN AN IMPORTANT PART OF MY ACADEMIC TRAINING BECAUSE IT MAKES A DIFFERENCE WHEN YOU UNDERSTAND WHERE THE SAMPLES YOU WORK WITH COME FROM.”

KARINA ROBLES, Undergraduate Student of Marine Biology.



of the local ecosystem. To this end, the infrastructure has improved significantly; it now includes a platform, three domes to store research material, and a dock and a walkway crossing the river. A service facility has already been added to include work areas and photovoltaic panels.

It is important to highlight that along with the development of the station, researchers from Universidad Católica have established important ties with the local community, both with new settlers and with earlier inhabitants of the area. In fact, one of the projects planned in the medium term is to consolidate and strengthen the relationships established with rural schools in the area by performing periodic visits and implementing science workshops aimed at both teachers and students (the latter through “Biblioteca Escolar Futuro”). They have also established a strategic alliance with Universidad de Aysén in order to develop joint projects that will benefit the region. Thus, the station will become not only a research center for ecological conservation and scientific development, but also a center for environmental education.

“I’VE HAD AN EXCELLENT EXPERIENCE. THIS STATION IS A TRUE THINK-TANK; IT IS A HOTBED FOR ENRICHING CONVERSATIONS AND THE EXCHANGE OF OPINIONS THAT ENABLES US TO SEE PROBLEMS FROM DIFFERENT PERSPECTIVES.”

ALEJANDRO DUSAILLANT, Associate Professor and Director of Research from Universidad de Aysén.



TO DATE MORE THAN 40 SPECIES OF BRYOPHYTES (a type of terrestrial plant) have been recorded at the station, among which we highlight *Dendroligotrichum dendroides*, one of the largest species of moss.



IN 2017, THE INCORPORATION OF PATAGONIA STATION FOR INTERDISCIPLINARY RESEARCH was formalized as part of the network of Human Environment Observatories (OHM) at the National Center for Scientific Research (CNRS). in France,

being the only Latin-American Center to become a member of this international institution.



OVER THE PAST 8 YEARS, more than 25 research studies from several disciplines have been carried out with the collaboration of more than 100 students from undergraduate and graduate programs from Pontificia Universidad Católica de Chile and other national higher education institutions.

CENTER OF EXCELLENCE IN BIOMEDICINE OF MAGALLANES

PATAGONIA,
MEDICINAL LAND

6.

CENTER OF EXCELLENCE OF BIOMEDICINE IN MAGALLANES

PATAGONIA, MEDICINAL LAND



In Chile's extreme south, researchers explore new ways to fight neurodegenerative and chronic diseases based on botanical biotechnological products obtained from vegetable species found in the area.

In late 2012, the Center for Aging and Regeneration (CARE Chile UC) and the Vice Presidency for Research and Graduate Studies at Universidad de Magallanes

(UMAG), signed a collaboration agreement to create the Center of Excellence of Biomedicine in Magallanes (CEBIMA). Quickly becoming a reference point of excellence in scientific development in South America, the center unites UMAG's progress in chemical and biological studies of Patagonian plants and algae with the research capacities at CARE Chile UC, in order to identify potential treatments for neurodegenerative and chronic diseases. This is a unique opportunity for development in Patagonia, both for the scientific advances expected, and for the positive impact it will have on strengthening the region's human capital.

The center was inaugurated in September 2019. According to Dr. Nivaldo Inestrosa, director of CARE Chile UC and recipient of the National Award in Natural Sciences 2008, the center, which will have more than 120 researchers, will combine decentralization with a territorial approach. The initiative is of utmost importance given the characteristics of the local

people of Magallanes: the region has one of the highest national levels of population ageing and the highest rates of pathologies

like cancer and diabetes. In addition, along with undergraduate and doctoral programs that will be created for students in the area, scientific lectures and seminars aimed at undergraduate students and students from both private and public schools are already taking place. CEBIMA aims to become not only a force for improving advanced human capital, but also in developing a better quality of life for the region's inhabitants.

Additionally, it is important to point out that one of the objectives in biomedicine is the biotechnological creation of drugs based on botanical products and natural compounds to make them potentially less toxic and invasive than those created from artificially synthesized molecules. With this in mind, the Magallanes Region has an excellent advantage in its unique climate and vegetation. Its extreme temperatures and strong winds subject plants to high levels of environmental stress, producing a flora that possesses active components which could potentially be used in fighting human diseases. One of



"TO BE ABLE TO UNDERTAKE RESEARCH WITH NATURAL PRODUCTS, PREVIOUSLY UNUSED IN THE STUDY OF CELLULAR AND MOLECULAR BASES IN SEVERAL DISEASES, WITHOUT A DOUBT TRANSFORMS THE CENTER INTO A UNIQUE EXPERIENCE, WITH THE ADVANTAGE OF HAVING ACCESS TO LOCAL SPECIES THAT GROW IN EXTREME ENVIRONMENTS."

ENRIQUE BRANDAN, Professor from the Faculty of Biological Sciences.



“THIS PROJECT, WHICH AIMS TO IMPLEMENT A SCIENTIFIC CENTER FOR EXCELLENCE IN AN AREA THAT HAS HISTORICALLY BEEN SIDELINED IN ADVANCED BIOMEDICAL SCIENCE, IS UNIQUE IN CHILE. IF THIS PROJECT IS DEVELOPED AS IT WAS PLANNED, IT WILL BECOME A COUNTRY BENCHMARK.”

ELISEO CAMPOS, Executive Coordinator of CEBIMA.

PEAT BOGS, DARWIN CORDILLERA, Magallanes and the Chilean Antarctic Region.



AMONG THE PATAGONIAN PLANTS researched by the scientists at CEBIMA we find *Huperzia fueguina*, a type of fern that could help fight Alzheimer's; and "Luga roja" (*Gigartina skottsbergii*), algae that could have anti-diabetic effects.

THE REGIONAL GOVERNMENT OF MAGALLANES provided economic resources worth 4 billion pesos, which were used in acquiring the land where CEBIMA will be located. The development of the center implies an additional cost of approximately 16 billion pesos for the construction of a building completely equipped with the necessary high-tech laboratories.

"CEBIMA CONSTITUTES A NEW MODEL FOR RESEARCH CENTERS, DECENTRALIZED IN THE REGIONS AND THE RESULT OF A COLLABORATION BETWEEN UNIVERSITIES AND THE REGIONAL GOVERNMENT. IT REPRESENTS AN ENORMOUS CHALLENGE: PERFORMING SCIENCE IN ISOLATED REGIONS AND IN AN INTERDISCIPLINARY WAY."

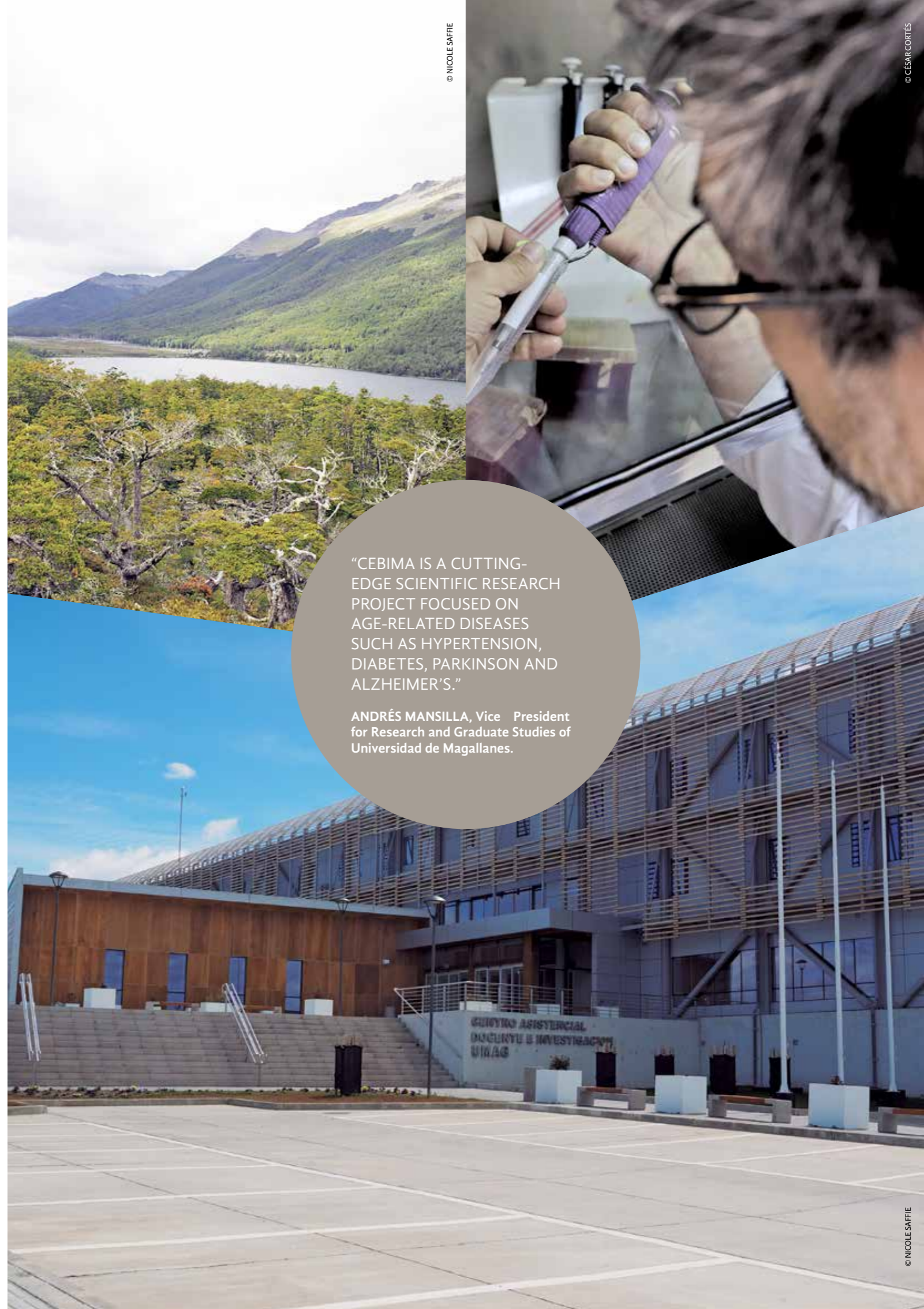
CARLOS VIO, Deputy Director of CARE and Professor at the Faculty of Biological Sciences.

"CEBIMA IS A CUTTING-EDGE SCIENTIFIC RESEARCH PROJECT FOCUSED ON AGE-RELATED DISEASES SUCH AS HYPERTENSION, DIABETES, PARKINSON AND ALZHEIMER'S."

ANDRÉS MANSILLA, Vice President for Research and Graduate Studies of Universidad de Magallanes.

CEBIMA's scientists' main objectives is precisely this: to analyze the natural resources of the area to identify and extract pure compounds that have potentially medicinal effects in ageing processes and cellular regeneration in relation to pathologies such as, among others, Alzheimer's, diabetes, metabolic syndrome, and cancer.

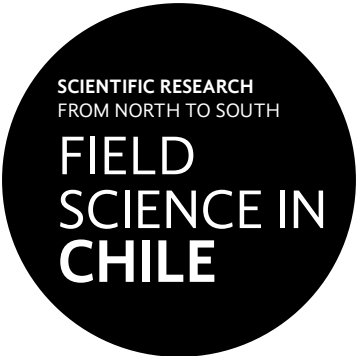
CEBIMA is located in a building adjacent to the Punta Arenas Hospital in the Magallanes Region. Its laboratories have cutting-edge research instruments and equipment. Dr. Nivaldo Inestrosa, who has already achieved great progress in Alzheimer's research, along with Dr. Juan Larraín, whose investigations have been focused on medullar spine regeneration, continue their research, contributing not only to scientific development, but also to the regional development of Magallanes and Patagonia.



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SCIENTIFIC RESEARCH
FROM NORTH TO SOUTH

FIELD SCIENCE IN CHILE

FINANCIA



**CHILE LO
HACEMOS
TODOS**

