Chilean Antarctic Science Program (PROCIEN) and challenges of the 2020-2025 Five-Year Plan

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Background

The Chilean Antarctic Science Program (PROCIEN) of the Chilean Antarctic Institute (INACH), is composed of the projects that it finances, organizes, coordinates and executes directly or in support of other agencies in the country. Scientific activity comes from a variety of public, transparent and international peer-reviewed competitive funds.

On the 25th anniversary of the National Funding for Antarctic Scientific and Technological Research Projects of the INACH, one of the fundings with the longest tradition in polar science, the country shows a stable scientific development over time, mature in terms of its scientific productivity and in constant renewal in terms of the number of researchers that make up the national Antarctic community.

As of September 2020, PROCIEN includes 87 research projects, which mainly include initiatives financed by INACH and the National Research and Development Agency (ANID), as well as other international cooperation projects.

Chilean Antarctic science presents clear strengths in the study and understanding of the polar environment and its surroundings under the climate change scenario, its physical and biological dimensions, past, present, and (modeling) future scenarios, and social and humanities studies to understand the national Antarctic identity. Thus, INACH maintains seven research lines, aligned with the priorities of the Scientific Committee for Antarctic Research (SCAR): (i) The state of the Antarctic ecosystem, (ii) Antarctic thresholds: ecosystem resilience and adaptation, (iii) Climate change in Antarctica, (iv) Astronomy and Earth Sciences, (v) Biotechnology, (vi) Human Footprints in Antarctica and (vii) Social Sciences and Humanities.

PROCIEN numbers:

1. 78 researchers lead 2020 PROCIEN’s research projects;
2. 22 Chilean national institutions are involved (INACH included);
3. 327 personnel make up the PROCIEN network and community, including principal researchers (PI) and their collaborators;
4. 43 years old is the mean age of PIs ;
5. 72.4 % of the projects involve fieldwork and 27.6 % are office/laboratory-based;
6. INACH 61 % of the projects (53) were funded through INACH´s two funding programs and 31% of the projects (27) were funded through ANID’s 5 funding programs;
7. 8 % of the projects received funding from other sources, national (1 project) or international (6 projects);
8. INACH transferred to national institutions a sum of $M 648.237;
9. ANID is expected to transfer a sum of $M 2.117.-
10. The cost of logistical support is added to these amounts, not included in these ciphers;

Ten years of PROCIEN´s science

Changes in the development of Chilean Antarctic science since 2005 have had a positive impact on PROCIEN's scientific productivity. The number of Antarctic scientific publications have gradually increased from 21 articles in 2009 to 95 articles in 2019.

The analysis of scientometric indicators of articles produced by Chile between 2009-2019, a total of 541 Antarctic publications with authorship belonging to Chilean institutions were published in WoS journals. Chilean scientists published in 221 journals during this period. The journals with most publications were: Polar Biology (13.88%), Antarctic Science (4.13%), PLoS ONE (3.38%) and Revista Chilena de Historia Natural (3.11%). Other journals hosts less than 2% of publications. The number of publications increased significantly throughout the period with an increase rate of 8 articles per year. The research lines associated with the state of the Antarctic ecosystem, biotechnology and geosciences produced the largest number of studies, and the research line on climate change in Antarctica published more studies in journals with the highest impact factor.

The increase in the number of articles was greater in the first quartile Q1 impact factor journals. Research lines with an increase in articles in Q1 correspond to Antarctic ecosystems, biotechnology and geosciences, and a similar trend was observed in the total of citations. During the period analyzed, the Antarctic ecosystems and biotechnology lines contributed the highest number of articles in all quartiles. The Social Sciences and Humanities research line had the least number of articles since it is a recently incorporated line. The increase in the number of publications was greater in the journals belonging to the first quartile (Q1). Most of the studies received support from more than one source, demonstrating the high diversification of Chile's financing.

Most PROCIEN fieldwork studies have been developed in the South Shetland Islands and the Antarctic Peninsula. Fieldwork data was the main source of scientific article production, while Escudero, O'Higgins and Arctowski (Poland) research stations concentrated most of the work. The diversification of funding sources, the implementation of improvements in the peer review mechanisms of the selection process and the alignment of Chile with the SCAR programs have contributed to improve Chilean Antarctic science. However, it is necessary to improve the efficiency in the use of big data (for example, databases and information produced by satellites or remote sensors). In addition, an increase in the production of oceanographic data is expected with the incorporation of a new icebreaker. The addition of renovations at Chilean research stations will also significantly improve the scope of Chilean Antarctic science over the next three decades to contribute to the study of climate change in the Antarctic Peninsula.

International cooperation

A network analysis revealed that 72 countries collaborated with Chilean PROCIEN projects. A total of 24 countries participated in 10 or more publications, grouped in 5 clusters. The most important countries in each cluster (besides Chile) were the United States, the United Kingdom, Germany, France, Spain, and Australia. In addition, changes in the network map over time show more intense collaboration between 2012-2017. Papers with co-authors from the USA constituted the main contribution, followed by four European countries (Germany, France, United Kingdom, Spain) and two South American countries (Brazil and Argentina). This phenomenon is the product of the use of competitive funds that encourage the linking and strengthening of global research networks. From the total, 44% of the projects had international scientists in their teams. Therefore, 148 foreign researchers are participating in PROCIEN, from Germany, Argentina, Australia, Belgium, Brazil, Bulgaria, Canada, Korea, Denmark, United States, Spain, France, Italy, Japan, Mexico, Norway, New Zealand, French Polynesia, Poland, Czech Republic, Russia, South Africa, Switzerland and the United Kingdom.

Challenge to the INACH’s Strategic for 2020-2025

To continue strengthening PROCIEN's quality science indicators, it is necessary to face different challenges. One of these is the modernization of the scientific infrastructure administered by INACH in Antarctica. The scientific station remodeling program consists of two stages: design and execution. Currently, the design stage that is being carried out has allowed dimensioning the spaces and basic requirements for habitability, scientific infrastructure, and operation for these new bases. This program has a duration of 10 years and will allow the modernization of the main scientific stations of the country: Prof. Julio Escudero, Yelcho and Carvajal.

On the other hand, the pandemic has caused a delay in the progress of the construction of the new Oscar Viel icebreaker ship, with an estimated delivery date of 2024. This new icebreaker will increase the logistical and scientific capacities to carry out oceanographic studies. Currently, work is being done on the design of the laboratory spaces and infrastructure, for their subsequent acquisition.

Another major challenge is the digital connectivity of Antarctica. In this sense, we can report that the Austral Fiber Optic (FOA) project has been concluded and allowed the connection of the southern part of Chile, culminating in the arrival of the FOA to the city of Puerto Williams in Navarino Island. The extension of this infrastructure towards Antarctica would allow to increase the coverage of data transmission and help to make up for the low satellite coverage and the absence of high-speed data flow that today affects the area of the Antarctic Peninsula, technological gaps and challenges that have been detected by COMNAP and SCAR.

Currently, the project of the International Antarctic Center of the city of Punta Arenas is being evaluated by the central government for the financing of its construction. Meanwhile, INACH continues working and developing scientific-educational content that allows the further development of this project.

Finally, Chile is currently working on the development and installation of a decentralized sensor network - from Visviri in the north, to Antarctica in the south, covering 8,000 km - that is part of the Climate Change Observatory promoted by the Chilean Government and that will make it possible to understand, predict and project the effects, risks and threats of changes of the ecosystems. This collaborative work is carried out between the ministries of Foreign Affairs; Science, Technology, Knowledge and Innovation; Environment; Defense and Transport and Telecommunications.