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Review

Forest Health in the Southern Cone of America: State of the Art and Perspectives on Regional Efforts

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Abstract: The plantation and natural forests of South America have been highly impacted by native and exotic pests in recent decades. The interaction of emerging invasive pests, climate change, and timber markets will define the region's forests, with significant but uncertain ecological changes and economic losses expected. The Southern Cone Forest Health Group (SCFHG), a joint ad hoc initiative run by forest health professionals from Argentina, Brazil, Chile, and Uruguay, aims to strengthen relationships between the forestry industry, stakeholders, academia, and government agencies across the region. Here, we highlight regional strengths, weaknesses, threats, and opportunities to address forest health issues in the region. A regional approach with a strong communication network is relevant for future actions. In the current global scenario of invasive species and climate change, the implementation of practices that incorporate the resilience of forest ecosystems and sustainable management needs to be prioritized in forest policy across the region. Understanding that pests and pathogens do not recognize borders, we call on governments and organizations to support joint actions with agreements and adequate resources to enhance our regional capabilities.

Keywords: forest entomology; forest pathology; plantation forestry; invasive alien species; regional initiatives

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1. Introduction

Forests are diverse and complex systems that provide, among a suite of ecological benefits, wood and fiber to an increasing human population and, as such, need the deployment of urgent actions aimed toward their sustainable management and protection [1]. Because they cover a large part of the world's surface area, forest systems are exposed to a variety of threats, including abiotic and biotic factors [2]. Both native and invasive insects and pathogens are known to be a significant threat to plantations and native forests. It

has been reported that insects and pathogens may damage up to 10 and 9 million hectares, respectively, of the world's forested area every year [3], and their impacts are likely to increase with globalization and climate change in the coming decades.

Despite the increasing number of strategies proposed to manage emerging threats to forests worldwide (i.e., better tools for pest and disease surveillance, genetic improvement, enhanced diagnostics, and genetic engineering applied to breeding programs), the implementation of these strategies can be challenging in some regions, particularly in developing economies [4]. In the Southern Cone of South America, a region that includes Argentina, southern Brazil, Chile, and Uruguay, the production of goods and services from plantation forests (sensu FAO: forests intensively managed, composed mainly of one or a few even-aged exotic tree species) is a rapidly expanding economic activity [5]. The development of plantation forests in these countries shares some unique characteristics, such as a strong reliance on similar cultivated exotic tree species and pest problems, as well as social and economic challenges [5].

The Southern Cone Forest Health Group (SCFHG, linktr.ee/sanidadforestalconosur (accessed on 20 March 2023)) is an ad hoc and non-profit initiative developed and led by forest health professionals—both the private and public sector—from Argentina, Brazil, Chile, and Uruguay. Through an international and multidisciplinary approach, the SCFHG aims to: (1) support and disseminate research initiatives, (2) strengthen the links between countries, academia, forestry companies, stakeholders, and government agencies, (3) emphasize academic commitment to developing forest resources, and (4) facilitate information exchange across the region. The origin of SCFHG stems from the need to share knowledge on forest pests and diseases at the regional level, given the similarity of forest systems. Since 2007, efforts focused on established and emerging forest health issues, mostly in plantation forests, led to specific national technical and scientific meetings in the region. Uruguay has organized yearly, since 2008, the Annual Forest Health Meetings (*Jornadas de Protección Forestal*). Similarly, Argentina arranged bi-yearly Forest Health Meetings (*Jornadas Argentinas de Sanidad Forestal—JASaFo*), starting in 2013. However, the first Binational Forest Health Meeting, organized jointly by both countries, was held in 2017 motivated by the need of sharing knowledge and efforts on common forest health issues and, as such, can be considered a milestone in the region's integrated efforts. Finally, the SCFHG was consolidated with the incorporation of Brazil and Chile for the organization of the first Southern Cone Forest Health Conference, held in 2020. Notwithstanding this, given the global pandemic caused by COVID-19 and the uprising costs of travel, joint activities and meetings were transformed into a virtual format. During the period of 2020–2021, several topics, such as biosecurity, invasive species, and integrated pest management in the context of certification, have been presented in international webinars, consolidating the much-needed international collaboration on forest health in plantation forestry, in a region where the activity is economically significant and increasing [6]. The advent of global threats, including climate change and the unprecedented rate of arrival and establishment of invasive alien species, highlights the significance of shared goals at a cross-border scale.

The SCFHG vision is that success in sustainable pest management at a national and provincial scale can be achieved through joint efforts in diagnostics, early detection, and deployment of collaborative strategies at the regional, cross-border scale. However, the information available at the regional level on common forest health problems is scarce. Therefore, the main goal of this work is to carry out a regional synthesis of the current state of forest health, research efforts, and pest management policies in the Southern Cone of South America. In addition, we propose a set of the main focal themes that can contribute to collaboration agreements to improve both the generation and management of knowledge, as well as the development of regional strategies that allow for reducing the current and potential impacts of pests on forest resources.

2. Materials and Methods

Data were collected from primary and secondary sources of information following an exhaustive search of scientific and gray literature in countries of the Southern Cone. Literature included reports, government documents, peer-reviewed papers, and other creditable sources of information. The Strengths, Weaknesses, Opportunities, and Threats (SWOT) analysis framework was applied to categorize significant factors that affect forest health initiatives in the region [7].

3. Results

3.1. Forestry and Forest Health Status in the Southern Cone of South America

Exotic planted species have demonstrated higher productivity than native species [5], being highly adopted by governments and industries both for good production (wood fiber, resin) and the provision of ecosystem services to promote the mitigation of climate change impacts. In South America, plantation forests cover nearly 99% of the planted forest area, compared with only 4% in North and Central America. In the Southern Cone, natural and all planted forests categories (including both plantation forests and other planted forests) cover an approximate area of 528,4 million and 17 million hectares, respectively [6].

Plantation forests in Argentina cover more than 1.2 million hectares, composed mainly of exotic fast-growing species, such as pines (*Pinus* spp., 62% of the planted area), eucalypts (*Eucalyptus* spp., 27%), and willows and poplars (*Salix* spp. and *Populus* spp., 6%) [8] (Figure 1). Exports of forest products from Argentina in 2021 reached about USD 712 million [9]. In Brazil, in turn, the total plantation forest area covers approximately 9.55 million hectares, including 7.47 million hectares of eucalyptus, 1.7 million hectares of pine, and 382 thousand hectares of plantations with other commercial tree species (Figure 1). In 2020, the sector reached a total of exports of USD 8.9 billion [10]. In Chile, there is 2.3 million ha of plantation forests, with 1.3 million ha being planted with radiata pine (*Pinus radiata*) and 865,000 ha with different species of *Eucalyptus* [11] (Figure 1). Industrial consumption was about 43 million cubic meters in 2021 with exports of approximately USD 6000 million in the same period. The main product exported was chemical pulp with 45% of participation from the total [12]. In Uruguay, the plantation forest area reached 1.1 million hectares in 2021, with approximately 85% of the total area planted with several *Eucalyptus* species and their hybrids [13] (Figure 1). The area covered by plantation forests has increased at a rate close to 15 thousand hectares per year [14]. For Uruguay in 2020, exports from the forestry industry (including wood, wood products, pulp, and paper) reached USD 1473 million, representing 18% of the total value of exported goods by country and contributing to 4% of the national gross domestic product [15].

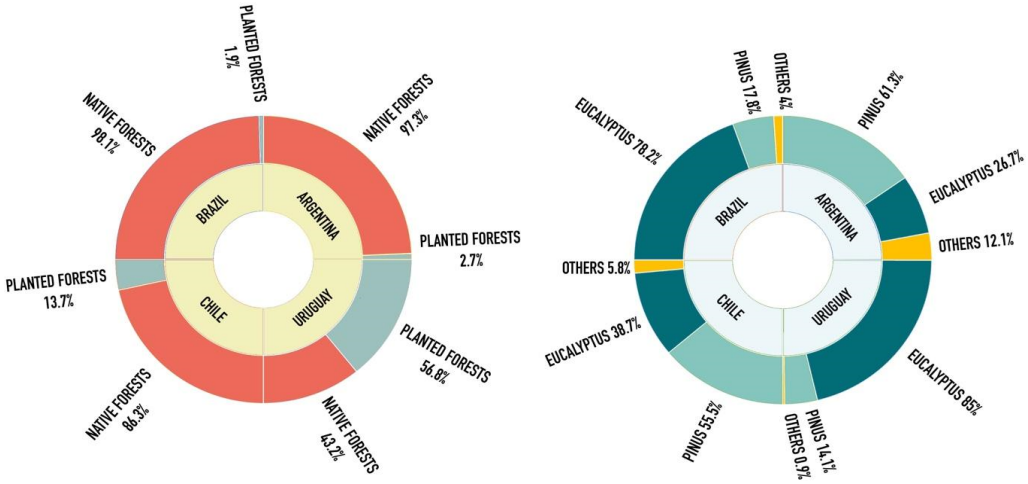

Figure 1. Percentage of native and planted forests (**left**) and percentage of commercial species (**right**) for Argentina, Brazil, Chile, and Uruguay.

Forest health protection in the Southern Cone of South America is promoted and coordinated together with other plant health threats through the "Comite Regional de Sanidad Vegetal del Cono Sur" (COSAVE, www.cosave.org, accessed on 20 March 2023), an inter-governmental organization conformed by a representative of National Plant Protection Organizations (NPPO) of Argentina, Bolivia, Brazil, Chile, Paraguay, Peru, and Uruguay. Government agencies, dealing with biosecurity, forest health, and forestry systems, have an active role in plant protection for countries in the Southern Cone. Field activities, such as monitoring or pest control, are developed in coordinated programs by both public and private statements following norms from the NPPOs. However, despite this regional effort, the national and cross-border collaboration programs to deal with forest health challenges, including, for instance, joint biosecurity efforts, are often insufficient, considering the importance of forest resources to the region. It has been noted that phytosanitary efforts in Latin America are still largely dominated by an informal process, and the availability of high-quality data is remarkably scarce [3,16].

Plantation forests can have their productivity drastically reduced by native and exotic pests. The traffic of goods (transported in wooden packaging material and dunnage) and plants for planting are recognized as the main pathways for the movement of forest pests around the world (see [17,18]). Recent estimates suggest that the area affected by insects and diseases in all of South America is almost 1.2 million ha, with 1.12 million ha affected by insect pests and 24,000 affected by diseases [19]. Even though geographical barriers exist within the region (e.g., the Andes is a natural barrier between Chile and Argentina), forest health problems are shared among countries (Figure 2).

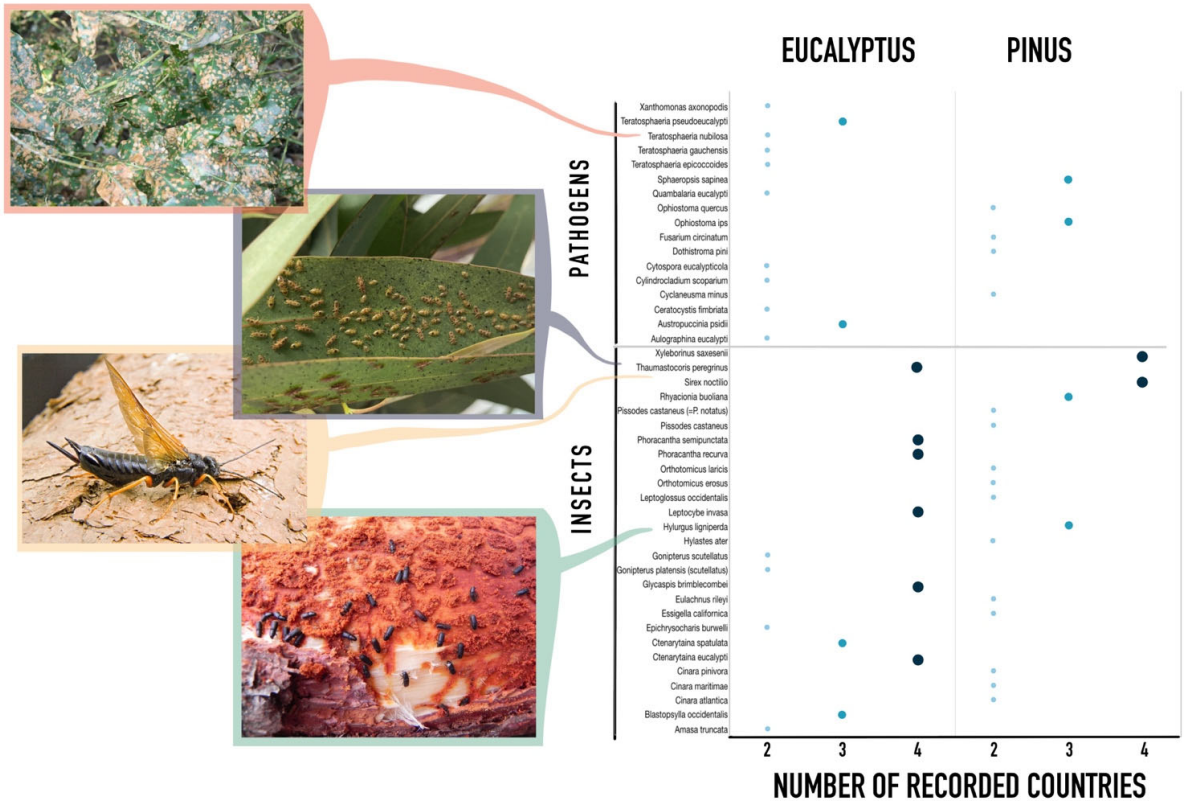

Figure 2. Shared forest pests recorded in the Southern Cone of South America (Argentina, Brazil, Chile, and Uruguay). Only species recorded from two or more countries are listed as circles. Images of *Teratosphaeria nubilosa*, *Thaumastocoris peregrinus*, *Sirex noctilio*, and *Hylurgus ligniperda* are shown (top to bottom).

Some of the most important examples of invasive insect pest present in three or more countries of the region include the woodwasp *Sirex noctilio* (Hymenoptera: Siricidae) [20,21],

Gonipterus pulverulentus and *G. platensis* (Coleoptera: Curculionidae), the *Phoracantha semipunctata* borer (Coleoptera: Cerambycidae), the bronze bug *Thaumastocoris peregrinus* (Hemiptera: Thaumastocoridae), the bark beetle *Orthotomicus erosus* and *Cyrtogenius luteus* (Coleoptera: Curculionidae) [22–24], and the gall wasp *Leptocybe invasa* (Hymenoptera: Eulophidae) [25]. Similarly, several pathogens have been accidentally introduced and are significantly impacting plantations across the region. Even though the importance of these health problems deeply depends on the host species, two remarkable introductions to the region resulted in devastating effects. *Fusarium circinatum* (sexual state = *Gibberella circinata*), the causal agent of pitch canker, is one of the most important pathogens in *Pinus radiata* plantations worldwide and was reported in Chile [26] and Uruguay [27] (although in the latter, it has not been recovered in further monitoring since initial detection leading to its removal from the list present in the country). The causal agent of Teratosphaeria Leaf Disease (TLD), *Teratosphaeria nubilosa*, was first detected in 2007 in Uruguay [28] and in Brazil [29–31]. The impact of TLD on *Eucalyptus globulus* plantations has been severe in both countries and, consequently, has led to the replacement of *E. globulus* by alternative species such as *E. dunnii* and *E. smithii.* In 2014, *Teratosphaeria pseudoeucalypti*, the causal agent of Teratosphaeria Leaf Blight (TLB), was reported simultaneously in Argentina, Brazil, and Uruguay [32–34], and has swapped out red gum eucalypts (*E. camaldulensis, E. tereticornis*, and hybrids), rapidly disseminating in the region after the first detection (Figure 2 and see in Supplementary Materials, a full revision of invasive forest pests (insects and pathogens) recorded in *Pinus* and *Eucalyptus* plantations in the Southern Cone of South America (Argentina, Brazil, Chile, and Uruguay)).

3.2. Key Factors in Forest Health in the Southern Cone

Strengths, weaknesses, threats, and opportunities have been identified across the region to deal with current and emerging forest threats (Figure 3).

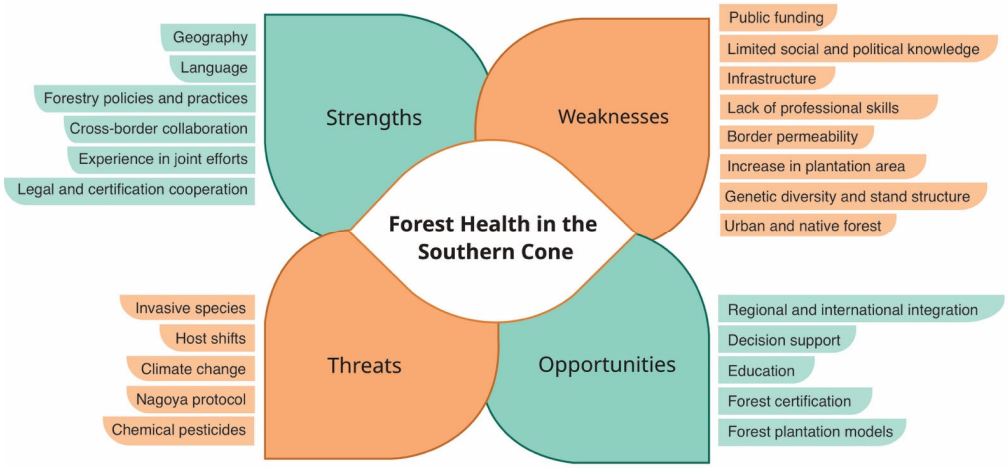

Figure 3. Summary of strengths, weaknesses, threats, and opportunities identified across the Southern Cone of South America (Argentina, Brazil, Chile, and Uruguay), as related to current and emerging forest threats.

3.2.1. Strengths

1. **Geography.** Only vulnerable from the north by land, surrounded by sea in all other directions, the region offers conditions for improved border control efforts and encourages collaboration in regulations for imports and accidental pest introductions. In some areas, forestry develops in areas sharing environmental characteristics (e.g., Northern Argentina, Southern Brazil, and Uruguay).
2. **Language.** Except for Brazil, the region shares Spanish as a common tongue, which improves communication among partners. Furthermore, several bilingual glossaries have been implemented under the Mercosur (regional agreement between Argentina,

Brazil, Paraguay, Uruguay, and Venezuela), which facilitates the exchange of information between Spanish and Portuguese speakers.

3. **Forestry policies and practices.** From the last century, national forest policies in Argentina, Brazil, Chile, and Uruguay have promoted the development of intensive plantation forests with rapid-growth tree species (many of them are even cultivated in more than one country). Additionally, in some cases, the same leading private companies have deployed operations in multiple countries across the region.
4. **Established cross-border collaboration in research.** It is known that all countries of the Southern Cone invest limited amounts of funds in forest health, and human resources dedicated to research on the subject matter are scarce. This otherwise limiting factor prompts scientists in the field to seek the development of research collaboration across borders to strengthen efforts and cover topics better developed in other countries.
5. **Experience in joint efforts to manage common pest/pathogen issues.** In the past, emerging threats that urged solutions approached by NPPOs led to joint efforts among countries. In Brazil, in 1989, the National Wood Wasp Control Program (PNCVM) was established to contain the impact of *Sirex noctilio* (Hymenoptera: Siricidae) in *Pinus* plantations. To finance this program, public and private institutions got together and created a non-profit civil entity named Fundo Nacional de Controle à Vespa-da-Madeira (Funcema). Pest control was achieved through the development of monitoring strategies and the production and inoculation of the parasitic nematode *Deladenus siricidicola*. The experience from this initiative in Brazil was shared with other Southern Cone countries, contributing to the region's woodwasp management plans. These successful examples reinforce the fact that common programs and activities are feasible. In the decade, the introduction of biological control agents has greatly benefited from the regional collaboration. For instance, the parasitoid *Cleruchoides noackae*, introduced to Brazil in 2012 for the control of the bronze bug *Thaumastocoris peregrinus*, was transferred to Uruguay and then to Argentina in less than 6 months under a regional cooperative project based on the PROCISUR, a regional program involving agriculture research institutes within the region [35,36]. Further regional cooperation was also assured through the implementation of regional surveillance and management programs within the framework of COSAVE, a key organization constituted of NPPO officers from its member countries that have discussed the implementation plans for potential threats to the region, such as the spongy moth *Lymantria dispar* and the pine nematode *Bursaphelenchus xylophilus*. At the regional level, COSAVE provides information on forest pests and pathogens surveillance through a shared database and sets phytosanitary standards that are harmonized with the legislation of each country.
6. **Legal and certification cooperation**. The Latin American Network of Environmental Forestry Law (RELADEFA) was created in 2003 as a multidisciplinary network of professionals and organizations dedicated to studying Environmental Forest Law and promoting its effective application. It integrates experts on forestry legislation from Latin America and is part of the International Union of Forest Research Organizations (IUFRO) as Unit 6.01 (Iberoamerican Forest and Environmental Law). Since its creation, RELADEFA has managed to influence the public, private, and academic sectors and national and international by holding academic events for analysis and debate on legislation and policies on forests and the environment in Latin America and writing policy documents, thus contributing to the development of sustainable forest policies in Latin American countries [37]. In addition, certification programs (FSC/PEFC certification) and similar instruments are increasingly being adopted, allowing for inter-institutional collaboration within countries on issues such as long-term insect pest monitoring for some relevant species and in the future among countries in the region.

3.2.2. Weaknesses

1. **Public funding.** Public investment in forest health research is limited throughout the region. In Argentina, only 0.46% of the country's GDP is spent on science in general [38] and funds devoted to forest health are acquired via competitive calls or as compartments of larger forestry projects, making specific funds almost non-existent. This is partly related to a limited number of full-time researchers on the subject matter. For instance, within INTA (the Argentine National Institute for Agricultural and Livestock Technology, which embraces most forest-related research), about 3% of researchers in plant protection work exclusively on forest health issues. According to the most recent report by the Ministry of Science of Brazil, Technology and Innovation (MCTI), in 2019, Brazil invested around BRL 89.5 billion in the science and technology sector. The value corresponded to only 1.21% of the GDP, lower when compared with investment in education, which corresponds to 6% of the GDP [39]. In Chile, investment in Research and Development stands only at 0.34% of the GDP [40]. In Uruguay, only 0.48% of the GDP is allocated to science [38], with specific funds allocated to forest health almost non-existent. Moreover, economic policies, in some countries, limited opportunities to generate/reinforce research networks and join actions between countries within and/or outside the region.
2. **Limited social and political awareness and knowledge of forest health impacts and threats to the region**. Limited funds for research and outreach have produced not only ecological but also social impacts that will need to be addressed. Massive communication strategies targeting the general public, including raising awareness on the risk of invasive species, the impact of climate change on forest health, or the effects of pests on forest productivity and ecosystem services, are scarce within the region. In addition, the lack of financial support impacts educational activities, and therefore, critical audiences are not always reached. Finally, although there exist phytosanitary standards and recommendations prepared by COSAVE regarding pest monitoring or pest eradication, often these are not accompanied by the creation of capacities for their implementation within the countries.
3. **Infrastructure**. Modern facilities and technology for forest health research are scarce and out of proportion to the magnitude of the problems. On the one hand, greater investment in equipment is needed to produce rapid diagnoses of newly introduced species as well as established pest population increases. For this, it is necessary to strengthen the research teams with basic equipment such as vehicles, measuring instruments, and supplies for sampling and with technologies and processes that allow rapid and reliable species identification (e.g., DNA barcoding). On the other hand, it is necessary to install or increase the capacities for experimental breeding and quarantine of natural enemies necessary for biological control strategies. Moreover, both national and regional public data infrastructure for pest monitoring and surveillance data need to be updated. Shared databases available at the regional level on surveillance of pathogens and insect pests are not exhaustive nor updated periodically and only show species detected in forest plantations of pines, eucalypts, poplars, or willows. Although the region contains one of the largest areas of natural forests in the world, basic data on harmful species in native forests are lacking.
4. **Lack of professional skills.** There is a significant deficit throughout public institutions related to research and management on forest health. Human resources trained on strategic issues, such as the identification and ecology of pests and natural enemies, are lacking. This occurs, in part, because job opportunities, salaries, and research incentives offered by the public sector are scarce.
5. **Border permeability.** While some borders have natural barriers, such as the Andes between Argentina and Chile, others, such as the borders between Argentina, Brazil, and Uruguay, are highly permeable to natural and anthropogenic-mediated pest and pathogen movements between the countries of the region. Note that formal and

informal trade activities among the countries of the region are, if unquantified, an important and growing pathway.

6. **Increased planted area.** The area of planted forests is expected to increase across the Southern Cone in the coming years. In Argentina, the current planted area is projected to increase to 2 million ha by 2030, both to strengthen economic activity and contribute to the adaptation and mitigation of climate change [41]. In Uruguay, only 1 million of the 3.55 million hectares approved for forestry purposes are currently covered [13]. In Brazil, *Eucalyptus* planted area has been rapidly increasing, especially in Mato Grosso do Sul, where funding has already been allocated for new plantations.
7. **Genetic diversity and stand structure.** Plantation forests in South America are mostly developed as intensive crops of even-aged trees, with relatively low genetic diversity (because of the widespread use in the industry of improved genetic trees and clones) and typically are established with non-native tree species. These are likely chosen because they show exceptional growth and yield rates in the new range when compared to those observed for the same species in their native distribution [42,43], as well as higher productivity than native tree species in the region. A commonly accepted mechanism to partially explain this phenomenon is the Enemy Release Hypothesis (ERH), which posits that exotic plants leave behind many diseases and herbivore pressure when transferred outside their native range [21,43,44].
8. **Urban and native forests.** Research programs focusing on urban and native forests are lacking in the region. In recent decades, pests and pathogens have caused economic and ecological impacts on rural and urban communities across the landscape. For example, there are no urban forestry programs that execute monitoring, inventory, and evaluation of urban forests over time. Despite the documented importance of urban trees with respect to energy use, flooding, and human health [45,46], funding for research projects to improve urban forests is non-existent. In the last decade, *Teratosphaeria pseudoeucalypti* has been diminishing *E. camaldulensis* populations, a common urban tree species in Uruguay and Argentina, impacting livestock and ornamental and shade plantations in city parks. Moreover, host jumps have been recorded in the region, with eucalyptus pathogens recorded in native Myrtaceous trees in Uruguay [47]. In addition, established exotic pests are recorded with direct or potential damage to native tree species, such as the woodwasp *Tremex fuscicornis* [48]. Moreover, surveillance and monitoring actions promoted by the NPPOs or local organizations/governments are limited or null for urban and native forests.

3.2.3. Threats

1. **Invasive species.** Because of the increasing regional and global trade, more forest pests are expected to get established outside of their native range. For example, all the pine-growing regions in the Southern Cone, particularly in Argentina and Chile, are suitable for the establishment of several economically important species of bark beetles [49]. Limitations in biosecurity systems, such as non-compliance and non-perfect phytosanitary measures, exist at both global and country scales, and biosecurity failures are more evident compared to successes, which are usually under-recognized and difficult to quantify [50].
2. **Host shifts.** The negative impact of host-jump events from commercial settings to native forest ecosystems, and vice versa, has been recorded in the region [28,51–53]. Funding to research native forest ecosystems is scarce in the region. Therefore, these jumps between different hosts are expected to increase and even remain temporarily undetected, impacting ecosystem services across the landscape.
3. **Climate change.** Climate change, a major driver of many insect outbreaks around the world, is causing extremely extended droughts, unprecedented heat waves, and more frequent and severe weather events, increasing tree stress at the landscape level [54]. Climate impacts, especially from extreme climatic events will affect planted forests in the future, and therefore, forest health impacts can be expected to increase [5]. For

example, bark beetle outbreaks are especially severe in regions where climate change pressures and available host material meet [55]. Many extreme events are already impacting the region and are projected to intensify, including warming temperatures and drought [56].

4. **The Nagoya Protocol.** The Nagoya Protocol came into force in 2014 as a supplementary agreement to the Convention of Biological Diversity, aimed at providing a framework for the effective implementation of the fair and equitable sharing of benefits resulting from the utilization of genetic resources [57]. As signatories, countries in the Southern Cone must develop a legal framework that ensures access to genetic resources, benefit sharing, and compliance. Many researchers have manifested concerns about the new challenges this new framework may represent, particularly in the field of biological control and identification of emergent pests [57–59]. For instance, the additional administrative burden imposed by the protocol, including the obtention of an a priori informed consent (PIC), the signing of Mutually Agreed Terms (MAT) including the specific intended use, as well as the requirement of a Material Transfer Agreement (MTA) and an Internationally Recognized Certificate of Compliance (IRCC) may hamper or even prevent the introduction of beneficial fauna to the region or even worse, the exchange within partner countries in the way it has been possible in the past experiences mentioned above (Strength n.5). It is important to note that all of the countries of the Southern Cone are signatories of the Nagoya protocol. Furthermore, the NPPO and the focal point of the Nagoya Protocol are generally provided by different secretaries, the former usually inside the ministry of agriculture and the latter within the ministry of environment, a situation that is more usual in the signatory parts [57].
5. **Chemical pesticides.** The restrictions on the use of chemical pesticides are intrinsic to certification schemes, which promote the use of non-chemical pest management methods and prohibit the use of several active ingredients commonly used in plantation forests (i.e., deltamethrin, fenitrothion, fipronil, and sulfluramid [60].

3.2.4. Opportunities

1. **Enhancing regional and international integration.** International collaboration and coordination, including international initiatives to reduce climate change and plant protection (through the International Plant Protection Convention), are critical to the management and prevention of invasive and native pests, with a focus on early warning and response systems, access to critical information and specialized trained personnel [61]. The generation of institutional agreements that integrate the scientific capacities of the Southern Cone into an international forest health laboratory would facilitate exchange amongst professionals, as well as promote stronger joint research actions.
2. **Developing and implementing a common decision support system.** Unequal levels of investment within and across the Southern Cone result in different capacities to identify and conduct research on relevant forest pests. In order to develop a framework to deal with native and invasive forest pests in the Southern Cone, regulatory agencies need a decision support system to accurately identify emerging threats, study their ecology, manage pathways of introduction, and establish early detection and eradication programs if needed. Likewise, legislation within countries should be reviewed in order to positively impact funding for forest health.
3. **Education in forest health issues.** A network of international cooperation with research institutions can be virtuous to increase university capacities through, for example, open international chairs or regional summer courses. Promoting undergraduate teaching with topics on biology, ecology, and tree health management in university forestry careers, as well as agronomics and biology, emerges as a proposal to reinforce HR training. In addition, extension and outreach programs in forest health

must provide opportunities for education that specifically target landowners and forestry professionals.

4. **Promoting increased adoption of forest certification programs.** Forest certification was created as a voluntary market tool to guarantee the sustainable management of forests in order to provide economic, environmental, and social balance (i.e., the use of chemicals safe for biodiversity in forest ecosystems). Certified companies must follow principles and criteria that deal with the relationship between neighboring communities, labor and environmental laws, preservation of biodiversity, forest planning, and management of plantation forests. The Forest Stewardship Council (FSC), has operated in the region for decades with 0.58, 8.5, 2.17, and 1.2 million hectares certified in Argentina, Brazil, Chile, and Uruguay, respectively (FSC website: latinoamerica.fsc.org), including both conservation areas and commercial plantations. In addition, national programs, internationally approved by the Programme for the Endorsement of Forest Certification—PEFC, account for 0.35, 4.7, 1.91, and 0.34 million hectares certified in Argentina, Brazil, Chile, and Uruguay, respectively [62].
5. **Discussing, designing, and proposing alternative forest plantation models.** A strong reconsideration of current plantation models is necessary. The development of new paradigms in the management of plantations that seek productivity but also improve the environmental quality of commercial plantations (i.e., increasing the diversity of planted species and developing practices that conserve local biodiversity and promote new configurations of the productive landscapes) can increase the resilience of forests to disturbances, including those caused by exotic insects and pathogens [63–68].

4. Discussion

The productive, social, and environmental demands on trees will continue to grow, pests and exotic pathogens will continue to arrive, and those present will continue to challenge our management capabilities. In a highly connected world, where natural barriers are blurred for the movement of species harmful to trees, forest health solutions should mainly focus on integrating management approaches regionally, rather than within single countries [43]. The current global and regional framework to address forest health issues highlights a need for collaborative efforts of multiple disciplines, with the relationship between forest ecosystem health and humans at its core. Recently, the One Health approach has facilitated the study of these connections holistically, with the goal of achieving optimal health outcomes for both forests and communities across the region [69].

The forests of the Southern Cone are vulnerable to high-impact invasive insects and pathogens species (Figure 2), as well as to native species becoming pests. Significant but uncertain ecological changes and economic losses are expected. The interaction of emerging invasive pests, climate change, and timber markets will define the region's forests. Our SWOT analysis highlights both strengths and shortcomings of forest health protection in the Southern Cone (Figure 3). To improve forest health successfully, we propose that activities deployed should be coordinated by the public (i.e., NPPO and forestry agencies) and private stakeholders, fully integrated at the regional level and involve a variety of actions, ranging from joint research efforts to teaching and outreach activities. A regional approach with a strong communication network is relevant for future actions. Proximity and lack of language barriers have promoted cross-border collaboration and joint efforts to manage common pests across the region. However, regional and international integration is still needed to better address the early detection and management of invasive species. For instance, the common language could be better capitalized through effective information exchange mechanisms among countries. Moreover, incorporating new paradigms in the management of commercial plantations that include the concepts of forest resilience is critical, particularly in the current scenario of climate change and invasive species, both identified as threats to the region.

The lack of trained researchers and professionals, the absence of research programs that focus on urban and native forests, and the limited funding, highly impact the region's

capacity to address forest health emerging threats. Education opportunities are needed in the region, and they rely on research-based knowledge and an understanding of the target audience. To be effective, explicit goals need to be designed to meet the needs of different audiences. Extension and outreach projects that support forestry professionals and landowners throughout the region are sometimes lacking and do not always focus on innovation transfer, a critical step in continuing the region's robust and profitable forestry industry.

Research is needed to address critical gaps in our abilities to forecast and manage the impacts of forest pests in natural, commercial, and urban forest ecosystems [70]. For example, the development of new and effective management techniques for important pests, such as native leaf-cutting ants, is an urgent challenge due to increasing restrictions on the use of chemical-based insecticides [71–73]. In addition, research on molecular genetics and the identification and taxonomy of forest pests should be promoted if we hope to deal with pest problems in the future [43]. Despite the advantages of molecular tools in recent decades, DNA-based identification is not reliable without the contributions of taxonomic experts [74].

Collaborations between scientists and governments cannot be underestimated and are crucial to generate and promote evidence-based policies for forest health management. Strengthening the capacities in each country for quarantine protocols to introduce natural enemies or facilities to rapid species identification can reduce the risks and optimize processes faced with new threats, but this depends on greater political commitment from national governments to build and maintain such capacity in the NPPOs. Likewise, it is necessary to update both national and regional public data infrastructure for pest monitoring and surveillance data to facilitate, for example, the generation of robust invasion risk analyses or the development of predictive models of pest distribution and impact.

5. Conclusions

The challenges faced by natural and plantation forests in the Southern Cone of South America call for urgent action. In the current global scenario of invasive species and climate change, the implementation of practices that improve the resilience of forest ecosystems and sustainable management, need to be prioritized in forest policy across the region and will require coordinated actions among the countries, but also the development of locally adapted strategies. Strongly motivated to promote improvements in forest health management, the results of the ad hoc SCFHG are intended to be collaborative, international, and interdisciplinary. Understanding that pests and pathogens do not recognize borders, we call on governments and organizations to support joint actions with agreements and adequate resources to enhance our regional capabilities.

Supplementary Materials: The following supporting information can be downloaded at: https://www.mdpi.com/article/10.3390/f14040756/s1, Table S1: Invasive forest pests (insects and pathogens) recorded in Pine and Eucalyptus plantations in the Southern Cone of South America (Argentina, Brazil, Chile, and Uruguay).

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