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PRACTICE INSIGHTS

Co-designed Projects in Ecological Research and Practice

Insights from experiences comanaging woody invasive alien plants in Argentina

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Abstract

1. The complexities of invasive alien species (IAS) management call for a close collaboration among stakeholders to codevelop and comanage actions to deliver effective solutions. To achieve this vision, iterative codesign and co-implementation of solutions is imperative.
2. Based on a rapid Strengths, Weaknesses, Opportunities and Threats analysis (SWOT), we synthesised the positive and negative aspects of comanagement experiences for woody IAS management in Argentina. We included four case studies in protected areas: (i) *Ligustrum lucidum* in a periurban mountain forest; (ii) *Rubus asp ulmifolius* in a subtropical forest; (iii) *Acacia melanoxylon* in a temperate grassland; and (iv) *Hedera helix* in a temperate forest.
3. Universities, research institutes and protected areas led these management projects under varying economic, social and ecological objectives, and constrained by the availability of resources. However, these heterogeneous realities did not translate into significant differences in our comanagement experiences.
4. We identified personal motivations and pre-existing funding for IAS management as key strengths for management actions. A relevant weakness was the ongoing undervaluation of applied research and stakeholder engagement in the Argentinian scientific system, resulting in a scarcity of research to inform management actions and a low interest in codesigning activities. Threats were related

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to the paucity of awareness and information on IAS management, and the lack of long-term funding. Nevertheless, recent national-level policies, such as the National Strategy for Exotic Invasive Species, together with the Forest Law for managing native forests and the mandate for the National Parks Administration to manage IAS, provide a unique opportunity to foster comanagement activities.

5. We recommend the development and promotion of spaces to share experiences and establish conversations among stakeholders. This should be complemented by a better alignment of disparate public policies driving IAS management in Argentina, and increased financial assistance to support local initiatives and reduce uncertainty in long-term funding.

KEYWORDS
codesign, information access, invasive alien species, protected areas, research-practice gap, stakeholder participation, SWOT

1 | INTRODUCTION

The management of invasive alien species (IAS, hereafter) requires the engagement of diverse stakeholders, integrating varied perspectives, needs, and expertise to effectively manage IAS impacts to deliver benefits for all, or the majority of stakeholders (Novoa et al., 2018; Shackleton et al., 2019).

Comanagement and adaptive management models incorporate these diverse dimensions into IAS management while addressing the complexities of IAS management by using the information acquired during the formulation and implementation of management actions to improve iteratively (García-Díaz et al., 2022; Novoa et al., 2018; Rist et al., 2013; Zalba & Ziller, 2007). In particular, it is essential to build networks of stakeholders and understand the interacting socio-economic and ecological factors that modulate the positive and negative impacts of invasions and the potential range of management actions (García-Díaz et al., 2021). Nonetheless, comanagement can be challenging because of the polarised perceptions of IAS and their management (Shackleton et al., 2022). Adding further complexity, limited economic resources for long-term IAS management and regulations imposing strict constraints can hinder IAS management (García-Díaz et al., 2022; Oficialdegui et al., 2020).

Comanagement of IAS and natural resources has been increasingly implemented in places such as Australia and New Zealand (Alter et al., 2019; Borrini et al., 2000) and while it is an element of participatory environmental governance in Latin America (de Castro et al., 2016), there are relatively few published comanagement experiences in South America (Neira Brito et al., 2022; Shackleton et al., 2019). Recent examples include the comanagement of woody invasive plants such as *Acacia melanoxylon* (Zaninovich et al., 2023), *Hedera helix* (Quiroga et al., 2023) and *Ligustrum lucidum* in Argentina (Lambin et al., 2020; Valfré-Giorello et al., 2019).

Here, we characterise comanagement initiatives (design and implementation) for controlling woody IAS in Argentina based on four experiences (Table 1 and Figure 1). These involved a variety of species, environments and local communities (Table 1 and Figure 1). These diverse environmental and social contexts exemplify the socio-ecological scenarios that managers of woody IAS routinely face across Argentina. Consequently, our insights provide lessons for comanagement projects in Argentina.

2 | STRENGTHS, WEAKNESSES, OPPORTUNITIES AND THREATS TO WOODY IAS COMANAGEMENT IN ARGENTINA

The managers and researchers involved in our four IAS management experiences were invited to contribute to a 'rapid' SWOT (Strengths, Weaknesses, Opportunities and Threats) analysis by completing an individual questionnaire (online Google Form) identifying the strengths, weaknesses, opportunities and threats faced by their respective projects. Afterwards, we discussed and synthesised (virtually) the similarities and differences across experiences (Table 2). SWOT is a planning technique used to evaluate the situation of a project and identify challenges and opportunities (e.g. Braun & Amorim, 2014; Comino & Ferretti, 2016). Two self-identified managers, nine researchers and three researcher–practitioners—all of them co-authors—contributed to our SWOT analysis.

2.1 | Strengths: Pre-existing networks and resources

Across our four case studies, we found that pre-existing informal networks of protected area managers and researchers facilitated the convergence of interests in tackling IAS. This was further facilitated by the pre-existing knowledge about the systems (including IAS impacts on native ecosystems) accumulated by managers and

TABLE 1 Features and current status of the four woody invasive alien plant comanagement case studies described and analysed here. The four invasive alien species (IAS) populations originated from ornamental escapees.

Target woody IAS	Location	Main comanagement aim and spatial scale (hectares)	Stakeholders involved in the comanagement experience	Start of comanagement	Current adaptive management stage(s)	Environmental and socio-economic context
Ligustrum lucidum	Peri-urban Yungas forest (Tucumán)	Restore woody native biodiversity through IAS control 89 ha	Researchers (CONICET) and managers of three public protected areas (Jardín Botánico Horco Molle, Reserva Horco Molle, and Parque Sierra San Javier)	2019	Monitoring native and IAS tree responses to management actions. Expanding IAS management into new areas	Severely invaded forest included in a protected area since 2016. Located between native forests and the city of Tucumán (1.25 million people). Used for recreation and outdoor activites by the residents of Tucumán
Rubus asp ulmifolius	Subtropical Yungas forest (Tucumán)	Keep forest trails walkable and accesible trough IAS control 4 ha	Researchers (CONICET and University); Managers of 1 protected public area (Parque Nacional Aconquija); and an NGO (Asociación Argentina de Montaña)	2021	Definition of the problem (engagement between managers and researchers; hypothesis and research programme development)	National Park protecting and surrounded by native forests. *R.asp ulmifoulius* invaded forest gaps after cattle were excluded due to conservation practices within National Parks Managers of the protected area and trekkers are affected by the invasion because it renders trails and camping areas unusable
Acacia melanoxylon	Temperate grassland (Pampas Ecoregion, Buenos Aires)	Management of native grassland biodiversity through IAS control 44.8 ha	Researchers (CONICET and University); owner of the protected private area	2020	Monitoring native grasslands after IAS control and fostering environmental education	Private nature conservation reserve surrounded by agricultural land near an important touristic town. The reserve coexists with agroecological activities and mountainous environments that act as refuges for biodiversity and spaces for the preservation of cultural assets of the region (e.g. cave paintings). In addition, the reserve carries out activities to raise awareness about the environment through educational, recreational, and research initiatives
Hedera helix	Temperate forest (Nahuel Huapi National Park, Río Negro)	Controlling IAS to promote passive restoration 3 ha	Researchers and professors (CONICET and University); managers from the National Parks Administration Volunteers (university students and National Parks Administration workers)	2019	Control of IAS and monitoring regeneration in the managed sites	Core of a National Park: high biodiversity area with high conservation priority protecting Valdivian wet temperate forests. The invasion occurred within a human settlement before the creation of the National Park. The area is an important tourist destination visited by large numbers of people annually

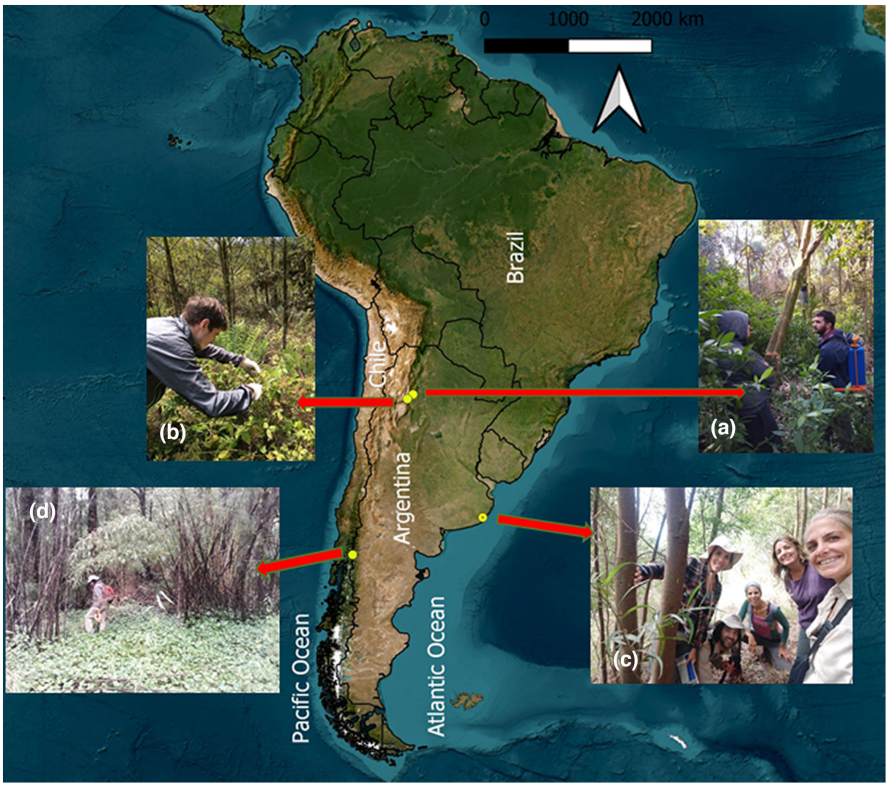


FIGURE 1 Geographical location of our four woody invasive alien plant comanagement experiences. (a) *Ligustrum lucidum* in a periurban mountain forest; (b) *Rubus asp ulmifolius* in a subtropical forest; (c) *Acacia melanoxylon* in temperate grassland; and (d) *Hedera helix* in temperate forest.

TABLE 2 Summary of our SWOT analysis of the four comanagement initiatives in Argentina. Intrinsic aspects are specific to each project and can be modified or controlled by the project partners or their organisations. External aspects lay beyond the will or ability to be changed by project partners. Experiences that reported each aspect are indicated by superscripts (1: *L. lucidum*; 2: *R. asp ulmifolius*; 3: *A. melanoxilon*; and 4: *H. helix*).

***Strengths* (*positive*; *intrinsic to the comanagement experience*)**	***Weaknesses* (*negative*; *intrinsic to the comanagement experience*)**
• Pre-existing networks of managers and researchers[1,2,3,4] • Knowledge about target ecosystems and issues related to IAS[1,2,3,4] • Pre-assigned funding for IAS management[1,4] • Volunteers assisting fieldwork operations[4]	• Informal networks[1,2,3,4] • Challenges in establishing new connections[1,2] • Burdensome bureaucracy[1,2] • Undervaluation of engagement with stakeholders in scientific performance evaluations[1,2,3,4]
***Opportunities* (*positive*; *external to the comanagement experience*)**	***Threats* (*negative*; *external to the comanagement experience*)**
• International and national policies on IAS[1,2,3,4]	• Poorly implemented funding mechanisms[1,2,3,4] • Inadequate representation of native grasslands in restoration schemes[3] • Absence of formal markets for by-products of IAS management[1,3] • Low level of knowledge of IAS management methods[1,2,3,4] • Incipient societal awareness of the negative impacts of IAS[1,2,3,4] • Promotion of IAS use for productive purposes [1,2,3,4]

researchers through practical experience and academic research. A critical shared strength was the deep commitment of managers and researchers to resolve the challenges of IAS management.

In two of our case studies, the fact that some stakeholders already had funds available for IAS management and research proved paramount for linking up and initiating collaborations. These funds were intended for direct interventions, including funds for restoring native forests provided by the Argentinian Forest Law and private funding for research and extension activities to engage with the broader public.

Adopting a comanagement approach facilitated projects by combining resources from the involved organisations. For example, the management of *H. helix* drew on volunteers from the comanaging organisations (a University and a National Park) to make the most of the limited economic resources available (Quiroga et al., 2023). There, the management project capitalised on an enthusiastic and almost cost-free labour force for the time-consuming and delicate task of pulling *H. helix* threads out of a matrix of native plants.

2.2 | Weaknesses: Establishing new relationships, limited resources and recognition

In Argentina, shared workspaces, where managers and researchers can join forces to design and implement IAS management actions,

were informal and relied on personal interests and motivations. In most cases, IAS comanagement entailed creating new relationships among disparate partners (managers and researchers), a process sometimes hampered by different perceptions, knowledge, aims and working schedules. This resulted in delayed activities and lagged access to resources for joint work. Nevertheless, the availability, willingness and transparent communication among partners and stakeholders were instrumental in overcoming these barriers. We found that, as new relationships started, it was essential to establish trust among partners. This trust was built and maintained by openly and honestly discussing medium- and long-term expectations about project management, leadership, and anticipated outcomes. Likewise, data availability and use by partners and third parties were contentious issues that required negotiation and open communication.

Once again, it was clear that resource availability was a key weakness. In some cases, different priorities for IAS management across high-ranking authorities of partner organisations resulted in delayed access to sites, permissions (particularly critical due to COVID-19 pandemic lockdown), and resources needed by other partners. Additionally, we found that including volunteers in an IAS management project involved a burdensome and time-consuming bureaucratic process.

We identified a critical weakness undermining the involvement of researchers in comanagement, as collaborations with IAS managers were not adequately recognised in scientific performance evaluations. Therefore, being involved in comanagement activities may carry negative reviews and missed opportunities if the time invested yields reduced scientific outputs such as peer-reviewed publications.

2.3 | Opportunities: International and national policies

For most of our comanagement experiences, policies and strategies drove opportunities to achieve societal and organisational support and acceptance. First, international initiatives played a role in communicating our comanagement projects. In particular, the inclusion of IAS in global initiatives, such as the United Nations Sustainable Development Goals (The 17 Goals|Sustainable Development, n.d.) and the UN Convention on Biological Diversity Post-2020 Biodiversity Framework (Target 6 on IAS; https://www.cbd.int/conferences/post2020), was used to capture the attention of stakeholders not involved directly in our experiences and unaware of the issues caused by IAS. Many of those people not previously interested quickly became aware of the problems and potential solutions to the negative impacts of IAS, supporting IAS management initiatives.

At the national level, laws and policy initiatives presented opportunities for allocating management resources (including funding) across sectors with a vested interest in woody IAS management. For example, the 'Forest Law' (Congreso de la Nación Argentina, n.d., p. 26) recognises the threat of IAS to native forests and provides payments to restore native forests, including managing IAS such as *L. lucidum* in periurban forests. Complementarily, the National Parks Administration has developed documents to assist in the management of IAS (Administración de Parques Nacionales (APN), 2007; Izquierdo et al., 2018; Menvielle et al., n.d.)

2.4 | Threats: Funding mechanisms, markets, literature and social support

Poorly implemented funding mechanisms undermined the opportunities identified in the previous section. For example, although the Forest Law provided financial support, the process from application to approval of resources took several years (Ministerio de Ambiente y Desarrollo Sostenible, 2021). Due to decreases in the purchasing power of the Argentine peso, this meant that when funding was finally approved, it was worth much less than when the initial proposal was submitted, as happened in some of our experiences. In addition, invasions in native ecosystems other than forests, including our case of native grasslands invaded by *A. melanoxylon*, were underrepresented in national restoration schemes and not appropriately covered by funding schemes.

Relatedly, the absence or weakness of markets and interest in using the wood of nontraditional woody species made it difficult to sell and use woody IAS (Zaninovich et al., 2023). Selling wood obtained from IAS management actions could provide an income stream to offset management costs, although care is needed to avoid creating a market that could promote IAS planting (Shackleton et al., 2022).

Another significant threat was the relatively low level of knowledge of IAS management processes and techniques. This was associated with the poor coverage of IAS management activities in Argentina in the literature (scientific and technical reports). Besides, we found a weakness associated with the lack of monitoring to evaluate the success of IAS management projects. In turn, this scarcity of information increased the risk of repeating mistakes, leading to sub-par project outputs and increasing costs.

Societal awareness of the negative impacts of IAS remains incipient in many countries (Nuñez & Pauchard, 2010), such as Argentina. Indeed, we found that even NGOs and environmental managers did not always understand which management actions were necessary to mitigate the adverse effects of IAS. Furthermore, it was apparent that some government agencies and production sectors promoted the use of IAS through economic incentives. For example, the Argentinian National Law of Investments in Forestry in Planted Forests (No. 25,080, later expanded in 2019 by Law No. 27,487) promoted forest plantations subsidising the use of potential IAS for production and gardening endeavours.

Social misperceptions and misconceptions about trees in general and the difference between native and alien species in particular represent a serious barrier to effective IAS management in Argentina (Sanguinetti et al., 2014). Examples include notions such as that planting any tree species anywhere is 'good'; that cutting trees is 'bad' regardless of the species or situation; or that applying any kind of chemical is 'bad' despite herbicides being recommended to control certain IAS (Menvielle et al., n.d.).

3 | KEY LESSONS AND RECOMMENDATIONS

In Argentina, the comanagement of woody IAS is in its early stages. However, our four case studies show an appetite for it and an associated need for further development and testing. Based on our SWOT analysis, we provide a series of recommendations for improving and fostering woody IAS comanagement activities in Argentina.

First, it is crucial to facilitate communication among stakeholders through the development of joint workspaces to share experiences and knowledge, and articulate joint actions to address the impacts of IAS. Engagement between managers and researchers should start by codefining applied questions and actions of relevance to both groups, defining criteria for decision-making and developing adaptive IAS management strategies (García-Díaz et al., 2022). Additionally, these spaces should be facilitated to ensure that the views of all stakeholders are considered and incorporated (Crowley et al., 2016; Estévez et al., 2015; García-Díaz et al., 2022). Our four case studies involved managers from protected areas, research ecologists, and volunteers, the most common mix of groups associated with IAS management initiatives (Shackleton et al., 2019). The inclusion of other key stakeholders, including senior government officials and communities, would be necessary to develop adequate IAS management strategies that incorporate the social and economic dimensions of IAS (Novoa et al., 2018; Shackleton et al., 2019). Complementarily, information campaigns on IAS comanagement actions should be implemented at critical stages of all projects to secure social support and the viability of long-term actions (Crowley et al., 2017; Shackleton et al., 2019).

To address the lack of access to information, it is fundamental to report the techniques and procedures used, the outcomes of IAS comanagement actions, and any barriers and how these were resolved (Matzek et al., 2014). These publications should be in the local language and are fundamental in providing evidence to inform future projects (Amano et al., 2023; Matzek et al., 2014). All of these recommendations need to be supplemented with a strategic plan to recognise the value of working with environmental managers in researcher performance evaluations (Shanley & López, 2009), and explicitly listing joint work as a desirable criterion in job profiles for environmental managers.

The guidelines and products that arose from the Estrategia Nacional de Especies Invasoras (Res 109/2021, RESOL-2021-109-APN-MAD, 2021) should be disseminated more widely across educational and training levels. Likewise, outreach and extension activities are key, as we have identified national policies as both opportunities and threats, since some seek to address IAS impacts whereas others incentivise the use of IAS, as reported in other Latin American countries such as Brazil (Faria et al., 2022). On the other hand, federal funds would help provinces mitigate IAS impacts, particularly if organisations join forces through comanagement. Restoring degraded ecosystems is not a priority in Argentina, and funds from the Forest Law are mainly allocated to reducing deforestation (Ministerio de Ambiente y Desarrollo Sostenible, 2021).

Comanagement represents a promising pathway for addressing the challenges of woody IAS in Argentina. Our work provides a way forward: align and improve management objectives and implementation by actively creating spaces and communication channels for comanaging IAS while adopting an adaptive management approach to learn and improve iteratively.

AUTHOR CONTRIBUTIONS

All the authors led and implemented the four case studies. Priscila Ana Powell, Pablo García-Díaz and Lía Montti conceptualised the paper; Priscila Ana Powell and Pablo García-Díaz conceptualised and designed the SWOT analysis. Priscila Ana Powell led the synthesis of the SWOT analysis results with major contributions from all authors; Priscila Ana Powell led the writing with major contributions from all the authors.

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CONFLICT OF INTEREST STATEMENT

The authors declare no conflicts of interest.

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There are no data associated with this manuscript.

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