

Enabling Actions and Leverage Points for Governing Conifer Invasions in NW Patagonia

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INTRODUCTION

Invasive conifers pose a significant threat to biodiversity, ecosystem services, and fire safety in Patagonian urban-natural interfaces. The Red PINOS partnership, a transdisciplinary initiative established in 2021, aims to develop a robust governance framework for managing conifer invasions in Bariloche department, Argentina. The central objective of the Red PINOS Partnership is to identify and promote governance mechanisms for exotic conifer invasions, in order to mitigate their environmental impacts.

This study explores the perceptions of key stakeholders in the PINOS Network regarding effective actions to reduce and prevent biological invasions after more than 30 discussion meetings along the last 2,5 years. Through a participatory process, we assessed: a) the consensus on the most promising enabling or immediate actions as well as long term strategies (hereafter “actions” for both cases), b) the actions perceived as most promising based on the average individual ratings, and c) the alignment of these perceptions with actions already implemented by the Network.

To evaluate the potential impact of different actions, we applied a Leverage Point approach (Meadows 1997), assessing their capacity to shift system dynamics towards a less invaded and invisable state. This involved considering a comprehensive set of criteria to identify actions that could have a significant influence on the overall system.

METHOD

Thirty-nine action types were evaluated by ten social actors involved in Red PINOS. These actors assessed performance using seventeen criteria, assigning weights to each (Table 1). This resulted in a database of 6,630 values. A Leverage Capacity index was calculated for each action and for each actor, based on the weighted sum of action performance across all criteria.

ACTIONS ID & Name	ACRONYM	ACTIONS ID & Name	ACRONYM	ASSESSMENT CRITERIA
1 Seed control	SEEDC	21 Photography/video contests	PHOTO	1 Effectiveness
2 Removal of adult individuals	MREM	22 Use of social networks for awareness	SOCMED	2 Benefit/cost
3 Removal of saplings	SAREM	23 Talks in elementary and secondary schools	SCHOOT	3 Social acceptance
4 Invasion control	MICON	24 Workshops in elementary schools	SCOOW	4 Environmental sustainability
5 Control of early invasion patches	CEINFO	25 Fieldwork with students	FIELDST	5 Technical feasibility
6 Biological control (natural predators)	BIOLCO	26 Environmental education programs	ENVEDA	6 Local economic development
7 Chemical control (herbicides)	CHEMC	27 Environmental education for decision-makers	ENVEDD	7 Capacity building
8 Active restoration	ACTRES	28 Biological and ecological studies	BIOLST	8 Political feasibility
9 Focused participatory removals	PARINC	29 Analysis of social impacts	ENVIMP	9 Community / citizen involvement
10 Diffuse participatory removals	PARDIC	30 Evaluation of the effectiveness of different control methods	CESSAY	10 Environmental justice
11 Servicio Forestal	STATEC	31 Monitoring	MONIT	11 Knowledge transfer
12 forestales)	PRIVAC	32 Economic evaluation	ECONEV	12 Scalability
13 Compliance with existing regulations	ANACC	33 Bioeconomic studies	BIOECO	13 Innovation
14 New regulations for forest plantations	NNFPL	34 Design of effective public policies	PPDES	14 Risk management
15 Restrictions on trade in invasive plants	TRADC	35 Interinstitutional articulation	INTERAR	15 Empowerment
16 Creation of special taxes	TAXES	36 Fuel management	FUELMG	16 Financial sustainability
17 Request for international aid	INTAID	37 Development of an integrated management plan	MANPL	17 Organizational sustainability
18 Utilization of wood and waste	WOODU	38 Strengthening citizen participation	PUBPART	
19 Funds for scientific research	SCFUND	39 Creation of an early warning system	EARLYW	
20 Information campaigns in local media	MASSME			

Table 1. Actions and Assessment Criteria. Cells highlighted in pink and yellow indicate actions with low and high average Leverage Capacity scores, respectively, as visualized in Figure 2.

RESULTS & DISCUSSION

The results show that there is a high dispersion in the perception of the capacity of different actions to influence the central objective of the Red PINOS (Fig. 1). This high dispersion is evident for both actions with high and low average LC. On the other hand, 5 of the 8 actions identified with the highest average LC are currently being implemented at a significant level, while none of the 5 actions with the lowest average LC have been implemented or are part of the Network's action plan (Table 1, Fig. 2).

Perception of action performance

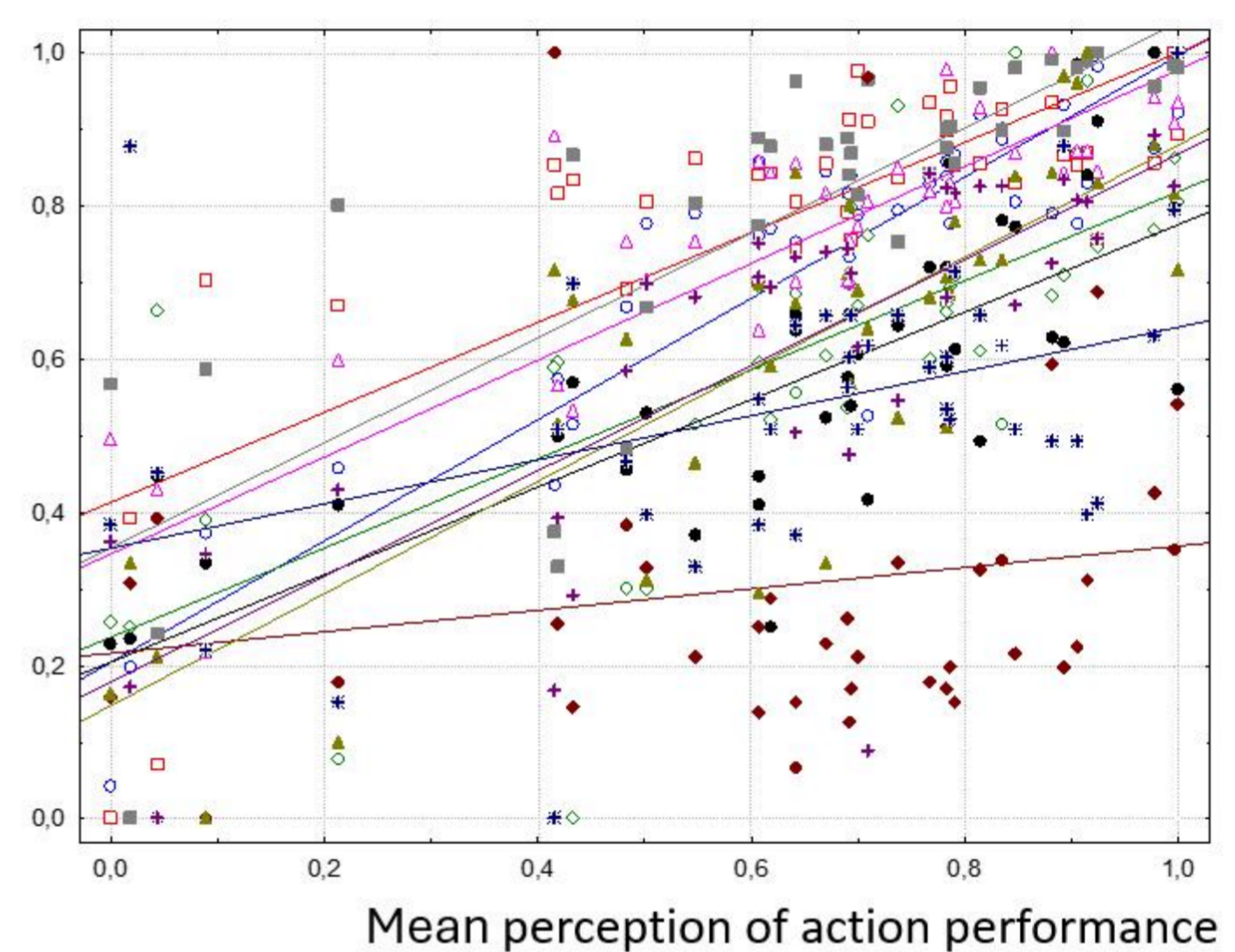


Figure 1. Individual variation in Perceived Action Performance. Scatter plot comparing individual and mean action performance values, with each individual actor represented by a unique color and linear trend. Individual and mean perception values were scaled to a 0-1 range.

Normalized Leverage Capacity

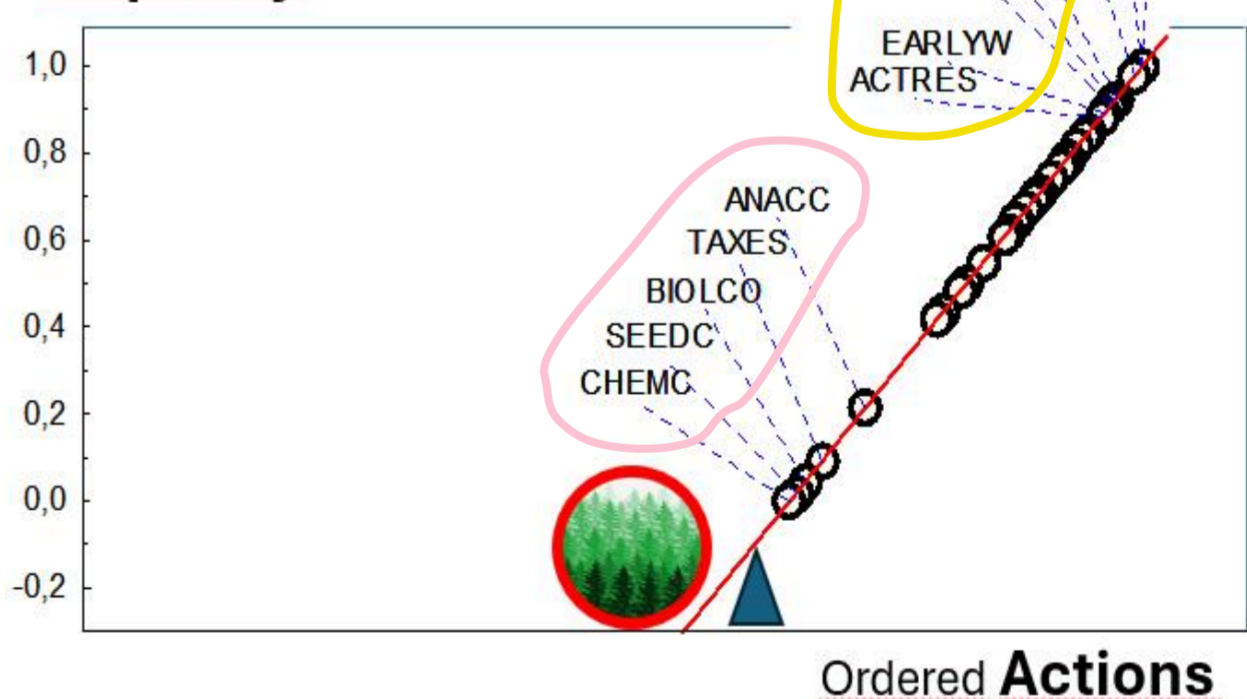


Figure 2. Average Leverage Capacity Index (LC) for 39 Actions. The figure presents the average LC scores for each action, calculated across ten interviewed actors. Actions are ordered from lowest to highest LC, following Meadow's leverage point model (1997). Actions below the pink line have lower leverage capacity than those above the yellow line.

CONCLUSION

Our findings underscore the critical need to incorporate diverse stakeholder perspectives when crafting governance strategies for invasive species management. The Leverage Capacity Index proves to be a valuable tool for guiding future discussions on prioritizing actions, as it assesses their potential impact on the system based on a comprehensive set of criteria. Moving forward, our analysis will delve deeper into the factors influencing stakeholder perceptions, specifically examining the interplay between the dispersion of action scores and the dispersion of criteria weights. This understanding will inform the development of strategies aimed at building consensus on effective actions, ultimately leading to more robust and impactful governance frameworks for invasive pines management.