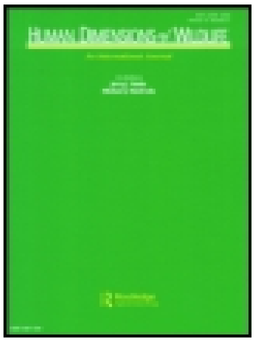

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Estimated economic impacts of seven invasive alien species in Chile

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ABSTRACT

This findings abstract presents preliminary estimates of the economic impact of seven invasive alien species (IAS) in Chile on productive sectors of the economy and biodiversity. The study was required by decision-makers as part of the research of the project "Strengthening National Frameworks for Invasive Alien Species Governance" funded by GEF (Global Environmental Facility). The impacts of beaver (*Castor canadensis*), rabbit (*Oryctolagus cuniculus*), wild boar (*Sus scrofa*), American mink (*Neovison vison*), yellow jacket (*Vespula germanica*), blackberry (*Rubus spp.*), and ulex (*Ulex europaeus*) were assessed. Few impacts could be estimated given the lack of information in Chile. Considering the impacts assessed, Chile may lose at least USD 90 million per year due to these seven IAS. Without implementing control measures, in 20 years, Chile will lose at least approximately USD 2 billion from the impacts of these species on biodiversity and productive sectors.

KEYWORDS

Alien species; economic valuation; impacts; Chile

We estimated economic impacts of seven invasive alien species (IAS) in Chile: beaver (*Castor canadensis*), rabbit (*Oryctolagus cuniculus*), wild boar (*Sus scrofa*), American mink (*Neovison vison*), yellow jacket (*Vespula germanica*), blackberry (*Rubus spp.*), and ulex (*Ulex europaeus*). These species impact productivity sectors (e.g., agricultural, forestry, livestock) and biodiversity.

For each IAS, impacts were identified, quantified and economically valued. Only secondary information was used. The findings provide an indication of the value that could be gained from such expenditures. Impacts were identified through a technical literature review for each species and interviews with experts. To quantify identified impacts (Table 1), cartography was performed on the Vegetation Cadastre of the Native Forest Resources of Chile (1997 and later updates). This illustrated the presence of each species in the territory and allowed impacts to be extrapolated from the available information. This information was strengthened with available scientific and technical information for each species. When insufficient data were available regarding species habitat, experts with the analyzed species and public/private administration professionals in IAS management were consulted. Cartography is available at PNUD (2016).

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Table 1. Minimum total loss projected in 20 years (MM USD) for alien species (modified from PNUD, 2016). Details of calculations are presented in PNUD (2016) in Spanish. References used to determine the minimum total loss projected for each alien species are provided in PNUD (2016). (-): Negative impact, (+): Positive impact.

	MINIMUM TOTAL LOSS PROJECTED TO 20 YEARS (MM USD)							
ECONOMIC VALUATION OF OVERALL IMPACTS	ULEX (*Ulex europaeus*)	BLACKBERRY (*Rubus spp.*)	YELLOW JACKET (*Vespula germanica*)	AMERICAN MINK (*Neovison vison*)	BEAVER (*Castor canadensis*)	WILD BOAR (*Sus scrofa*)	RABBIT (*Oryctolagus cuniculus*)	TOTAL IMPACT (MM USD)
Public resources allocated to research	−0.05	–	−0.02	−0.60	−2.99	−0.06	–	**−3.72**
Impact on livestock production	−44.01	−108.95	−57.58	–	−0.50	−176.78	–	**−387.82**
Impact on wood production	−4.06	−19.72	–	–	–	–	–	**−23.78**
Impact on forest plantations	–	–	–	–	–	−21.62	−0.32	**−21.94**
Impacts on components of biodiversity	–	–	−274.08	−406.71	–	−179.40	−88.72	**−948.91**
Resources used in species control	–	−145.09	−0.16	−10.02	–	–	−1.47	**−156.74**
Impact on agricultural production	–	+0.04	−59.52	–	–	−23.06	−2.92	**−85.46**
Loss of forest biomass	–	–	–	–	−65.53	−202.39	–	**−267.92**
Repair of road infrastructure	–	–	–	–	−0.53	–	–	**−0.53**
Potential cost in fire control	−1.03	–	–	–	–	–	–	**−1.03**
Impact on vitiviniculture production	–	–	−105.68	–	–	–	–	**−105.68**
Decrease in carbon sequestration	–	–	–	–	−0.05	–	–	**−0.05**
TOTAL SPECIES (MM USD)	**−49.16**	**−273.72**	**−497.04**	**−417.33**	**−69.61**	**−603.31**	**−93.43**	**2,003.72**[a]

[a]The value obtained does not consider the estimated cost of potential American mink control or the potential expense for fire control in the presence of Ulex, since it is not possible to affirm that these expenses will be incurred.

When market information was available, direct methods of economic valuation were used (PNUD, 2016). For estimations of economic impacts on biodiversity, the direct benefit transfer method was used (Brookshire & Neill, 1992); only Chilean studies were used when determining transfers of local economic values. Methodological details regarding the economic estimation of impacts were validated by experts and are available in PNUD (2016). The total impact value of each IAS was estimated by projecting the estimated economic impact values 20 years into the future; in accordance with the suggestion of the Ministry of Social Development in Chile, these flows were then adjusted downward to the present value at a rate of 6%. This rate allows understanding the opportunity costs of values in the time flow within a conservative, local, and balanced framework for social and environmental items. The invasion scenarios were assumed not to change, and no multiplier effects flowing into the economy were included, although these would be expected to significantly increase the total cost estimated. The total cost of impact per species was calculated by summing the costs due to impacts on biodiversity and ecosystem services, and to direct expenses incurred by the state, private sector, and society (e.g., resource allocation for control of the IAS) (Bertram, 1999). The results were validated by a group of experts and disseminated to the public through the national press.

Limited data availability allowed for only a rough preliminary economic analysis to obtain an initial quantification of certain impacts (Table 1; see PNUD, 2016 for details). The minimum annual losses caused by the seven analyzed IAS were valued at 87.9 USD million per year, corresponding to a minimum baseline estimated value of the losses incurred. If Chile does nothing, at least 2 billion USD will be lost during the next 20 years. Of this projected amount, approximately 948.9 USD million (47%) corresponds to losses due to the impacts of IAS on the components of biodiversity, primarily native species. Table 2 presents impacts that were identified but could not be economically valued due to lack of information for such purpose.

This is the first attempt to economically assess the impact of IAS in Chile. The obtained value in biodiversity could be compared to the average annual budget allocated to the Chilean System of Protected Areas from 2010 to 2014, which was approximately 6 USD million (Figueroa & Pasten, 2013). The economic value of the impacts (87.9 USD million per year) is significantly higher than this budget.

The assessment of impacts on biodiversity as well as indirect impacts such as those associated with ecological cycles, soil erosion, habitat destruction, pollination, ecological interactions, and changes in vegetation composition (Table 2), should be an important focus. The results obtained here have to be used with caution. Information about the biophysical quantification of impacts is still scarce but of the highest priority because this information can shed light on the magnitude of these impacts. Determining the population dynamics of IAS under different management scenarios (e.g., eradication or prioritized control) should also be a high priority and more information should be generated about the benefits gained by the implementation of different control strategies. Information and future studies that collect primary data about the impact of the different species are urgent.

Table 2. Impacts not valued economically. (-): Negative impact, (+): Positive impact. References used for the identification of impacts are provided in detail in PNUD (2016).

Species	Type of impact	Impact not quantified or valued economically	Species	Type of impact	Impact not quantified or valued economically
Beaver	Direct impacts	Landscape changes (-)	**American Mink**	Direct impacts	Effects on local agricultural and livestock activity (-)
		Animals (cattle) drinking at site (+)[a]			Potential effect on tourism (-)
		Touristic development (+,-)[b]		Indirect impacts	Impact on food webs by dissemination of Didymo (-)
	Indirect impacts	Destruction of riparian forests and soil destabilization (-)			Environmental pollution and resulting effects (-)
		Modification of habitat structure and aquatic biota (-)		Impacts on biodiversity (non-use value of ecosystem)	Intermediate host between dogs and carnivores in danger of extinction (-)
		Modification of hydrology and geomorphology (-)		Other impacts	Seroprevalence of toxoplasmosis in American minks (-)
		Modification of nutrient cycles (-)	**Yellow Jacket**	Direct impacts	Impact on pear and apple production (-)
	Impacts on biodiversity (non-use value of ecosystem)	Creation of aquatic habitats for specific species (+)[c]			Impact on flower production (-)
Rabbit	Direct impacts	On vitiviniculture (-)			Impact on tourism development in protected wild areas (-)
		Hunting (game species) (-)		Indirect impacts	Potential impact on food webs (-)
	Indirect impacts	Change in plant composition (-)		Impacts on biodiversity (non-use value of ecosystem)	Impact on native birds (-)
		Erosion (-)		Other impacts	Effects on people's health and in urban and rural quality of life (-)
		Poppy seed disperser (-)			
			Blackberry	Direct impacts	Impacts on recreation in protected wild areas (-)
	Impacts on biodiversity (non-use value of ecosystem)	Impact on *Cryptocarya alba* and *Convolvulus chilensis* (-)			Landscape deterioration (-)
Wild Boar	Direct impacts	Hunting (game species) (-)			Impact on the family economy due to temporary economic activity (+)[e]
	Indirect impacts	Potential trophic facilitation (*Puma concolor*)(+)[d]		Indirect impacts	Effects on pollination and frugivory (-)
	Impacts on biodiversity (non-use value of ecosystem)	Consumption of plant species (-)			Impacts on biological interactions between wild plants and animals (-)
		Parasite transmission in the wild (-)			Erosion control (+)[f]
	Other impacts	Parasite transmission to humans (-)		Impacts on biodiversity (non-use value of ecosystem)	Impact on vertebrates (-)
		Risk of attacks on people (-)			Impact on native plant species of the invaded lands (-)

			Impact on endemic flora species and conservation category (-) Impacts on native aerial arthropods (-) Impact due to the modification of the fire cycle on native plants (-) Impact due to the protection of native plants and animals (+)[g]
Ulex	Direct impacts	Negative impacts on recreational areas (snack, camping) in wilderness areas (-) Impacts on the landscape (-) Negative impact due to invasion of meadows and agricultural crops (-) Negative impact due to invasion of forest plantations (e.g., *Pinus radiata*) (-) Positive impacts due to energy use (+)	
	Indirect impacts	Negative impact on native plants by N_2 fixation in the soil (-)	
	Impacts on biodiversity (non-use value of ecosystem)	Impact from fires affecting native plants (-) Impact on native plants in protected wilderness areas (-) Impact on endemic flora species and/or conservation category (-)	
	Other impacts	Impact on the health of injured people (-) Impact on health due to promoting disease transmission (-) Impact on transport of people and merchandise due to decreased road visibility (-)	

[a]Reported by some private landowners (personal communication).
[b]Beavers could motivate the development of tourism (e.g., Bahamonde, 2007).
[c]Beavers on the island of Tierra del Fuego and Navarino may favor native birds associated with lentic environments (Sielfeld & Venegas, 1980).
[d]Reported by consulted experts. See also Skewes et al. (2012).
[e]Reported by consulted experts.
[f]Reported by consulted experts.
[g]Novoa 2013.

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References

Bahamonde, C. (2007). Alternativas de elaboración de charqui a partir de carne de *Castor canadensis* (KHUL 1820, Rodentia). . Tesis para optar al título de Ingeniero de Ejecución Agropecuario de la Universidad de Magallanes, Punta Arenas, Chile. 89 pp.

Bertram, G. (1999). The impact of introduced pests on the New Zealand economy. In K. Hackwell & G. Bertram (Eds.), *Pests and weeds: A blueprint for action* (pp. 45–71). New Zealand Conservation Authority.

Brookshire, D. S., & Neill, H. R. (1992). Benefit transfers: Conceptual and empirical issues. *Water Resources Research*, *28*(3), 651–655. https://doi.org/10.1029/91WR02590

Figueroa, E., & Pasten, R. (2013). Economically valuing nature resources to promote conservation: An empirical application to Chile's national system of protected areas. *Papers in Regional Science*, *93*(4), 865–888. https://doi.org/10.1111/pirs.12036

Novoa, P. (2013). Hallazgo de una población de *Beilschmiedia miersii* (Gay) Kosterm. (Lauraceae) en Reñaca. *Boletín del Jardín Botánico Nacional*, *6*, 12.

PNUD. (2016). *Valoración económica del impacto de siete especies exóticas invasoras sobre los sectores productivos y la biodiversidad en Chile*. PNUD. Report. Programa de las Naciones Unidas para el Desarrollo, Santiago de Chile., Chile. Available at: https://especies-exoticas.mma.gob.cl/wp-content/uploads/2018/12/1.-LIBRO-Valoracion-economica-EEI-FINAL.pdf

Sielfeld, W., & Venegas, C. (1980). Poblamiento e impacto ambiental de Castor canadensis Kuhl, en la Isla Navarino, Chile. *Annales del Instituto de la Patagonia*, *11*, 247–257.

Skewes, O., Moraga, C., Arriagada, P., & Rau, J. (2012). El jabalí europeo (*Sus scrofa*): Un invasor biológico como presa reciente del puma (*Puma concolor*) en el sur de Chile. *Revista Chilena De Historia Natural*, *85(2)*, 227–232. https://doi.org/10.4067/S0716-078X2012000200009