DOES PLANT INVASION ALWAYS AFFECT THE ECOSYSTEM NEGATIVELY?

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Intentional and unintentional introduction of plants to areas outside their natural range can become invasive with time. With time, these invasive alien plant species (IAPS) can establish and become naturalize in their introduced range. Once integrated into native communities they can disrupt biodiversity and ecosystem functions [1, 2]. The impacts of invasive plants received much attention during the last decade due to their devastating effects such as suppress or eliminate native species, biodiversity losses, alterations of ecosystem structure and functions [3, 4]. Moreover, they cause huge economic impacts in sectors like agriculture, forestry, fisheries and health [5-7]. The IAPS seems to possess superior competitive ability over other plants such as higher growth rates [8–10], allelopathic effects [11, 12], higher litter quality and litter loading [13, 14] which eventually leading to their success in introduced range.

Impacts on Biodiversity conservation

Many research outcomes so far have highlighted the negative impacts of IAPS and are confined few plant species in restricted regions and environments [17]. However, a little is known about their positive impacts on their invaded habitats [12,15]. The positive impacts of AIPS are possibly underestimated and often perception biased [16]. Plant invasion may support the establishment of native communities in disturbed or degraded ecosystems such as landslide areas, abandoned plantations, lands integrated with anthropogenic activities (lands prone to Fire, chena cultivation) [17,18]. A meta-analysis revealed that invasive plants facilitate the establishment of native plants on highly degraded habitats thereby providing nursing effect to emerging seedlings through enhanced micro-habitat conditions [19]. A study conducted in a degraded grassland in the Knuckles Conservation Area of Sri Lanka revealed a higher abundance of forest tree seedlings under the canopy of the invasive shrub, *Austroeupatorium inulifolium* compared to that of a less-invaded grassland indicating a facilitative effect of *Austroeupatorium* invasion on the forest re-establishment of these grasslands [20]. They suggest that *Austroeupatorium* has improved micro-climatic and edaphic conditions on these highly degraded grasslands thereby enhancing the chances of forest tree establishment. Furthermore, plant invasion could significantly enhance C and N pools through higher quality litter production, thereby increasing the soil nutrient availability in invaded landscape [21]. Alteration of soil nutrient status may facilitate the sapling growth of native communities [22,23]. A study conducted in north eastern Australia shows that initially grasses out-compete rainforest seedlings, but once they established, tree seedlings can out-compete the grasses [24]. They suggested that understanding nature of interactions between plant groups is critical in practical applications in restoration trials to achieve rapid reforestation on degraded agricultural lands [24]. The information suggests that the plant invasions have positive outcomes especially on degraded ecosystems. However, these positive outcomes depend on the species involved and the habitat concerned. Such positive outcomes can be used in restoration interventions in degraded landscape with caution to avoid any repercussion in the future.

References

1. Richardson DM, Pyšek P, Rejmánek M, Barbour MG, Dane Panetta F, West CJ. Naturalization and invasion of alien plants: Concepts and definitions. *Divers Distrib*. 2000;6:93-107. doi:10.1046/j.1472-4642.2000.00083.x.
2. Patrick H Martin, Canham CD, Marksnviron PL. Why forests appear resistant to exotic plant invasions: intentional introductions, stand dynamics and the role of shade tolerance. *Front Ecol Env*. 2008. doi:10.1890/070096.
3. Gaertner M, Richardson DM, Privett SDJ. Effects of alien plants on ecosystem structure and functioning and implications for restoration: Insights from three degraded sites in South African fynbos. *Environ Manage*. 2011;48:57-69. doi:10.1007/s00267-011-9675-7.
4. Vorsino AE, Fortini LB, Amidon F a., et al. Modeling Hawaiian ecosystem degradation due to invasive plants under current and future climates. *PLoS One*. 2014;9(5). doi:10.1371/journal.pone.0095427.
5. Park MN, Pritekel C, Whittemore-olson A, Snow N, Moore JC. Impacts from invasive plant species and their control on the plant community and belowground ecosystem at Rocky. *Appl Soil Ecol*. 2006;32:132-141. doi:10.1016/j.apsoil.2005.01.010.
6. Barrett SCH, Colautti RI, Eckert CG. Plant reproductive systems and evolution during biological invasion. *Mol Ecol*. 2008;17:373-383. doi:10.1111/j.1365-294X.2007.03503.x.
7. Vilà M, Basnou C, Pyšek P, et al. How well do we understand the impacts of alien species on ecosystem services? A pan-European, cross-taxa assessment. *Front Ecol Environ*. 2010;8:135-144. doi:10.1890/080083.
8. Bradford MA, Schumacher HB, Catovsky S, Eggers T, Newingtion JE, Tordoff GM. Impacts of invasive plant species on riparian plant assemblages: Interactions with elevated atmospheric carbon dioxide and nitrogen deposition. *Oecologia*. 2007;152:791-803. doi:10.1007/s00442-007-0697-z.
9. James JJ, Drenovsky RE. A Basis for Relative Growth Rate Differences Between Native and Invasive Forb Seedlings. *Rangel Ecol Manag*. 2007;60(July):395-400. doi:10.2111/1551-5028(2007)60[395:ABFRGR]2.0.CO;2.
10. Daehler CC. Performance Comparisons of Co-Occurring Native and Alien Invasive Plants: Implications for Conservation and Restoration. *Annu Rev Ecol Evol Syst*. 2003;34:183-211. doi:10.1146/132403.
11. Inderjit, Seastedt TR, Callaway RM, Pollock JL, Kaur J. Allelopathy and plant invasions: Traditional, congeneric, and bio-geographical approaches. *Biol Invasions*. 2008;10:875-890. doi:10.1007/s10530-008-9239-9.
12. Orr SP, Rudgers JA, Clay K. Invasive plants can inhibit native tree seedlings: Testing potential allelopathic mechanisms. *Plant Ecol*. 2005;181:153-165. doi:10.1007/s11258-005-5698-6.
13. Allison SDD, Vitousek PMM. Extracellular enzyme activities and carbon chemistry as drivers of tropical plant litter decomposition. *Biotropica*. 2004;36:285-296. doi:10.1111/j.1744-7429.2004.tb00321.x.
14. Piyasinghe I, Gunatilake J, Madawala H.M.S.P. Comparative Study of Litter Quality, Decay Rates and Nutrient Fluxes of Invasive Species, Austroeupatorium inulifolium and Cymbopogon nardus. In: *Proceedings of the International Forestry and Environment Symposium 2013*.Vol 6.; 2013:35-42.
15. Rudgers JA, Mattingly WB, Koslow JM. Mutualistic fungus promotes plant invasion into diverse communities. *Oecologia*. 2005;144:463-471. doi:10.1007/s00442-005-0039-y.
16. Katsanevakis S, Wallentinus I, Zenetos A, Leppäkoski E, Çinar ME. Impacts of invasive alien marine species on ecosystem services and biodiversity : a pan-European review. *Aquat Invasions*. 2014;9(2014):1-58. doi:10.3391/ai.2014.9.4.01.
17. Throop HL, Archer SR. Interrelationships among shrub encroachment, land management, and litter decomposition in a semidesert grassland. *Ecol Appl*. 2007;17(6):1809-1823. doi:10.1890/06-0889.1.
18. Montané F, Romanyà J, Rovira P, Casals P. Mixtures with grass litter may hasten shrub litter decomposition after shrub encroachment into mountain grasslands. *Plant Soil*. 2013;368:459-469. doi:10.1007/s11104-012-1533-8.
19. Gómez-Aparicio L. The role of plant interactions in the restoration of degraded ecosystems: A meta-analysis across life-forms and ecosystems. *J Ecol*. 2009;97:1202-1214. doi:10.1111/j.1365-2745.2009.01573.x.
20. Haluwana N, Madawala HMSP. Changes in Plant Diversity and Composition across Forest Edges Bordered by Austroeupatorium inulifolium Invaded Grasslands in the Knuckles Conservation Area , Sri Lanka. *Ceylon J Sci (Biological Sci*. 2013;42(2):29-43.
21. Liao C, Peng R, Luo Y, et al. Altered ecosystem carbon and nitrogen cycles by plant invasion: A meta-analysis. *New Phytol*. 2008;177(2004):706-714. doi:10.1111/j.1469-8137.2007.02290.x.

22. Jordan NR, Larson DL, Huerd SC. Soil modification by invasive plants: effects on native and invasive species of mixed-grass prairies. *Biol Invasions*. 2008;10:177-190. doi:10.1007/s10530-007-9121-1.
23. Yelenik SG, D'Antonio CM. Self-reinforcing impacts of plant invasions change over time. *Nature*. 2013;503:517-520. doi:10.1038/nature12798.
24. Elgar AT, Freebody K, Pohlman CL, Luke P. Overcoming barriers to seedling regeneration during forest restoration on tropical pasture land and the potential value of woody weeds. *Front Plant Sci*. 2014;5(May):1-10. doi:10.3389/fpls.2014.00200.