

# THE INVASION OF *ERIGERON CANADENSIS* L. (ASTERACEAE: ASTEREA): A SUBSTANTIAL THREAT TO PLANT DIVERSITY AND COMMUNITY STABILITY IN NATURALLY RESTORED SECONDARY BARE LANDS

Wu B.D.<sup>a,\*</sup>, Qi Y.<sup>a</sup>, Chen Z.Y.<sup>a</sup>, He Z.Q.<sup>a</sup>, Wang C.Y.<sup>b,\*\*</sup>, Liu L.Y.<sup>c,\*\*\*</sup>

<sup>a</sup>School of Chemistry and Chemical Engineering, Zhaotong University

<sup>b</sup>School of the Environment and Safety Engineering, Jiangsu University

<sup>c</sup>Kunming Ecological Environment Monitoring Station, Yunnan Provincial Department of Ecology and Environment  
e-mail: \*bingde301@163.com; \*\*liuyexue623@ujs.edu.cn; \*\*\*1796651575@qq.com

Received October 09, 2025; revised February 05, 2026; accepted February 20, 2026

The ecosystem of naturally recovered secondary bare land (NRSBL) is highly vulnerable to external interference. Alien invasive plants can exert notable impacts on the restoration of indigenous plant communities. This study aimed to investigate the effects of a global alien invasive plant of *Erigeron canadensis* L. with different invasion degrees (including uninvaded condition, the low invaded with the relative abundance of *E. canadensis* < 35%, and high invaded with the relative abundance of *E. canadensis* > 75%) on the indigenous plant communities in NRSBL in the subtropical monsoon climate zone of Zhenxiong, Zhaotong, Yunnan, China. The results showed that *E. canadensis* invasion significantly decreased plant species diversity and community stability, with a highly significant negative correlation between *E. canadensis* relative abundance and these two types of indices. Low invasion of *E. canadensis* caused mild disturbance on the species diversity and no significant disruption (even potential promotion) on the community stability, while high invasion of *E. canadensis* induced moderate to severe disturbances on the two indices. This study provides a strong theoretical support for the early warning and control of invasive plants in NRSBL.

**Keywords:** Alien invasive plants; Naturally recovered secondary bare land; *Erigeron canadensis*; Invasion disturbance index

DOI: 10.35885/1996-1499-19-1-159-161

Full text of the paper is published in Russian Journal of Biological Invasions. DOI: 10.31857/S207511172104XXXYYY

## REFERENCES

- Ahmed, A., Atallah, M., Rashid, P., Paul, A.R., Dutta, S., and Ali, M.S., Species diversity, change in forest cover and area of the Sundarbans, Bangladesh, *Bangladesh J. Bot.*, 2018, vol. 47, no. 3, pp. 351–360.
- Aragão, L.W., Fernandes, S.S., Mallmann, V., Facco, J.T., Matos, M.D.F.C., Cabral, M.R.P., and Simionatto, E., Chemical composition and evaluation of antitumoral activity of leaf and root essential oils of *Conyza canadensis* (Asteraceae), *ORBITAL*, 2019, vol. 11, no. 5, pp. 284–291.
- Arbaeva, A., Arbaev, K., Baytikova, T., Omurzakova, K., and Namatova, E., Ecological role of tree and shrub plantations in urban landscapes, *UJOFAWS*, 2025, vol. 16, no. 1, pp. 108–127.
- Bonet, A., Secondary succession of semi-arid mediterranean old-fields in south-eastern Spain: insights for conservation and restoration of degraded lands, *J. Arid. Environ.*, 2004, vol. 56, no. 2, pp. 213–233.
- Cheng, Z.X., Zhenxiong Yearbook, Yunnan Publishing Group Yunnan People's Publishing House, 2020, pp. 348–350.
- Closset-Kopp, D., Chabrerie, O., Valentin, B., Delachapelle, H., and Decocq, G., When Oskar meets Alice: Does a lack of trade-off in *r/K*-strategies make *Prunus serotina* a successful invader of European forests?, *For. Ecol. Manage.*, 2007, vol. 247, no. 1–3, pp. 120–130.
- Crouzeilles, R., Curran, M., Ferreira, M.S., Lindenmayer, D.B., Grelle, C.E.V., and Rey Benayas, J.M., A global meta-analysis on the ecological drivers of forest restoration success, *Nat. Commun.*, 2016, vol. 7, no. 1, pp. 11666.
- Działek, J., Jarecka-Bidzińska, E., Staniewska, A., and Téoule, F., (Re)greening transition of academic green spaces as a response to social and environmental challenges: The role of bottom-up initiatives, *Urban For. Urban Greening*, 2025, vol. 105, pp. 128692.
- Hejda, M., Čuda, J., Pyšková, K., Foxcroft, L.C., Nkuna, K.V., Novoa, A., and Pyšek, P., Impacts of invasive alien species on riparian plant communities in South African savanna, *J. Trop. Ecol.*, 2023, vol. 39, pp. e39.
- Huang, Y.M., Zhang, G.L., Fu, W.D., Zhang, Y., Zhao, Z., Li, Z.H., and Qin, Y.j., Impacts of climate change on climatically suitable regions of two invasive *Erigeron* weeds in China, *Front. Plant Sci.*, 2023, vol. 14, pp. 1238656.

- Kaur, A., Sharma, A., Kaur, S., Siddiqui, M.H., Alamri, S., Ahmad, M., Kohli, R.K., Singh, H.P., and Batish, D.R., Role of plant functional traits in the invasion success: analysis of nine species of Asteraceae, *BMC Plant Biol.*, 2024, no. 1, vol. 24, pp. 784.
- Kim, I., Sou, H.D., Cho, H., Kim, J., Oh, J.H., and Park, C.R., Impact of urban forest structure, native species diversity, and vegetation community on invasive plant species richness, *Urban Ecosyst.*, 2025, vol. 28, no. 2, pp. 6.
- Lapenis, A., Henry, H., Vuille, M., and Mower, J., Climatic factors controlling plant sensitivity to warming, *Clim. Change*, 2014, vol. 122, no. 4, pp. 723–734.
- Li, H. D., Wu, X. W., and Xiao, Z. S., Assembly, ecosystem functions, and stability in species interaction networks, *CJPE*, 2021, vol. 45, no. 10, pp. 1049.
- Loreau, M. Biodiversity and ecosystem functioning: recent theoretical advances, *Oikos*, 2000, vol. 91, no. 1, pp. 3–17.
- Lukatkin, A.S., and Sharkaeva, E.S, Physiological and biochemical peculiarities of woody and herbal invasive plant species under stress conditions, *Russ J. Biol. Invasions*, 2025, vol. 16, no. 2, pp. 243–252.
- Margalef, F., Diversidad de especies en las comunidades naturales, Barcelona: Publicaciones del Instituto de Biología Aplicada, 1951. Vol. 6, pp. 59–72.
- Martin, R., and Martin, S., Survey of rare and sensitive plants in recent acquisitions: San Juan Island National Historical Park (sensitive version), *National Park Service*, 2023.
- Okada, M., Hanson, B.D., Hembree, K.J., Peng, Y., Shrestha, A., Stewart, C.N., Wright, S.D., and Jasieniuk, M., Evolution and spread of glyphosate resistance in *Conyza bonariensis* in California and a comparison with closely related *Conyza canadensis*, *Weed Res.*, 2015, vol. 55, no. 2, pp. 173–184.
- Pearman, P.B., Guisan, A., Broennimann, O., and Randin, C.F., Niche dynamics in space and time, *Trends Ecol. Evol.*, 2008, vol. 23, no. 3, pp. 149–158.
- Pielou, E.C., The measurement of diversity in different types of biological collections, *J. Theor. Biol.*, 1966, vol. 13, pp. 131–144.
- Poudel, A.S., Jha, P.K., Shrestha, B.B., and Muniappan, R., Biology and management of the invasive weed *Ageratina adenophora* (Asteraceae): current state of knowledge and future research needs, *Weed Res.*, 2019, vol. 59, no. 2, pp. 79–92.
- Rey-Benayas, J.M., Galván, I., and Carrascal, L.M., Differential effects of vegetation restoration in Mediterranean abandoned cropland by secondary succession and pine plantations on bird assemblages, *For. Ecol. Manage.*, 2010, vol. 260, no. 1, pp. 87–95.
- Sakachep, Z.K., and Rai, P.K., Effects of invasive alien plants on floristic diversity and soil physico-chemical characteristics in Hailakandi district, Assam, an Indo Burma hotspot region, *Trop Ecol.*, 2025, vol. 66, pp. 303–320.
- Shannon, C.E., Weaver, W., The mathematical theory of communication, *University of Illinois Press, Urbana, Illinois*, 1949, pp. 1–117.
- Simpson, E.H., Measurement of diversity. *Nature*, 1949, vol. 163, pp. 688.
- Smith-Ramesh, L.M., Invasive plant alters community and ecosystem dynamics by promoting native predators, *Ecology*, 2017, vol. 98, no. 3, pp. 751–761.
- Song, X.J., Liu, G., Qian, Z.Q., and Zhu, Z.H., Niche filling dynamics of ragweed (*Ambrosia artemisiifolia* L.) during global invasion, *Plants*, 2023, vol. 12, no. 6, pp. 1313.
- Suryanta, G., Arifanti, V.B., Yuwati, T.W., Darwo, D., Rusdiyatmoko, M.A., Anggara, G.W.S., Sivaiparm, I., and Basyuni, M., Spatial analysis of land cover changes in mangrove and peatland forests in North Sumatra, Indonesia, *IOP Conf. Ser.: Earth Environ. Sci.*, 2024, vol. 1352, no. 1, pp. 012071.
- Wang, C.Y., Cheng, H.Y., Wei, M., Wang, S., Wu, B.D., and Du, D.L., Plant height and leaf size: Which one is more important in affecting the successful invasion of *Solidago canadensis* and *Conyza canadensis* in urban ecosystems?, *Urban For. Urban Greening*, 2021a, vol. 59, pp. 127033.
- Wang, C.Y., Cheng, H.Y., Wu, B.D., Jiang, K., Wang, S., Wei, M., and Du, D.L., The functional diversity of native ecosystems increases during the major invasion by the invasive alien species, *Conyza canadensis*, *Ecol. Eng.*, 2021b, vol. 159, pp. 106093.
- Wang, C.Y., Jiang, K., Liu, J., Zhou, J.W., and Wu, B.D., Moderate and heavy *Solidago canadensis* L. invasion are associated with decreased taxonomic diversity but increased functional diversity of plant communities in East China, *Ecol. Eng.*, 2018, vol. 112, pp. 55–64.
- Wang, C.Y., Jiang, K., Zhou, J.W., and Liu, J., Allelopathic suppression by *Conyza canadensis* depends on the interaction between latitude and the degree of the plant's invasion, *Acta Bot. Bras.*, 2017b, vol. 31, no. 2, pp. 212–219.
- Wang, C.Y., Wei, M., Wang, S., Wu, B.D., and Cheng, H.Y., *Erigeron annuus* (L.) Pers. and *Solidago canadensis* L antagonistically affect community stability and community invasibility under the co-invasion condition, *Sci. Total Environ.*, 2020, vol. 716, pp. 137128.
- Wang, C.Y., Wu, B.D., and Jiang, K., Allelopathic effects of Canada goldenrod leaf extracts on the seed germination and seedling growth of lettuce reinforced under salt stress, *Ecotoxicology*, 2019a, vol. 28, no. 1, pp. 103–116.
- Wang, C.Y., Wu, B.D., Jiang, K., Zhou, J.W., and Du, D.L., Canada goldenrod invasion affect taxonomic and functional diversity of plant communities in heterogeneous landscapes in urban ecosystems in East China, *Urban For. Urban Greening*, 2019b, vol. 38, pp. 145–156.
- Wang, F.M., Ding, Y.Z., Sayer, E.J., Li, Q.L., Zou, B., Mo, Q.F., Li, Y.W., Lu, X.L., Tang, J.W., Zhu, W.X., and Li, Z.A., Tropical forest restoration: Fast resilience of plant biomass contrasts with slow recovery of stable soil C stocks, *Funct. Ecol.*, 2017a, vol. 31, no. 12, pp. 2344–2355.
- Wang, J., Chen, Y., Zhang, C.L., Song, X.J., Sun, Y.Y., Zou, J.B., and Liu, G., Invasive alien plants with broader niches possess higher invasive potential in China as a result of niche conservatism and effective niche filling, *Divers. Distrib.*, 2025, vol. 31, no. 12, pp. e70119.

- Wang, X., Peron, T., Dubbeldam, J.L.A., Kéfi, S., and Moreno, Y., Interspecific competition shapes the structural stability of mutualistic networks, *Chaos, Solitons Fractals*, 2023, vol. 172, pp. 113507.
- Wei, M., Wang, S., Xiao, H.G., Wu, B.D., Jiang, K., and Wang, C.Y., Co-invasion of daisy fleabane and Canada goldenrod pose synergistic impacts on soil bacterial richness, *J. Cent. South Univ.*, 2020, vol. 27, no. 6, pp. 1790–1801.
- Weidlich, E.W.A., Flórido, F.G., Sorrini, T.B., and Brancalion, P.H.S., Controlling invasive plant species in ecological restoration: A global review, *J. Appl. Ecol.*, 2020, vol. 57, no. 9, pp. 1806–1817.
- Wola, A.W., Land use or land cover change and its driving forces in Mago National Park, Southern Ethiopia, *J. Biomed. Res. Environ. Sci.*, 2023, vol. 4, pp. 693–705.
- Wu, B.D., Zhang, H., Jiang, K., Zhou, J.W., and Wang, C.Y., *Erigeron canadensis* affects the taxonomic and functional diversity of plant communities in two climate zones in the North of China, *Ecol. Res.*, 2019, vol. 34, no. 4, pp. 535–547.
- Xu, Z.L., Zhong, S.S., Li, Y., Li, C., Liu, J., Xu, Z.Y., Zhu, M., Wang, C.Y., and Du, D.L., The co-phytotoxicity of two Asteraceae invasive plants *Solidago canadensis* L. and *Bidens pilosa* L. with different invasion degrees, *Ecotoxicology*, 2023, vol. 32, no. 10, pp. 1221–1232.
- Xue, G.Y., Zeng, J., Huang, J.Y., Huang, X.G., Liang, F.J., Wu, J.D., and Zhu, X.P., Effects of soil properties and altitude on phylogenetic and species diversity of forest plant communities in southern subtropical China, *Sustainability*, 2024, vol. 16, no. 24, pp. 11020.
- Yan, H.Y., Feng, L., Zhao, Y.F., Feng, L., Zhu, C.P., Qu, Y.F., and Wang, H.Q., Predicting the potential distribution of an invasive species, *Erigeron canadensis* L., in China with a maximum entropy model, *Global Ecol. Conserv.*, 2020, no. 21, pp. e00822.
- Yan, H., Schmid, B., Xu, W., Bongers, F.J., Chen, G., Tang, T., Wang, Z., Svenning, J., Ma, K., and Liu, X., The functional diversity–productivity relationship of woody plants is climatically sensitive, *Ecol. Evol.*, 2024, vol. 14, no. 5, pp. e11364.
- Yu, Y., Cheng, H.Y., Wu, B.D., and Wang, C.Y., Combined effects of drought stress and different forms of nitrogen deposition as response mechanism to environmental change, *Int. J. Environ. Sci. Technol.*, 2023, vol. 20, no. 6, pp. 6697–6712.
- Yu, Y., Cheng, H.Y., Xu, Z.L., Zhong, S.S., Wang, C.Y., and Guo, E., Invasion intensity modulates the allelopathic impact of *Solidago canadensis* L. leaves and roots against *Lactuca sativa* L. during germination and early seedling stage, *Int. J. Environ. Res.*, 2022, vol. 16, no. 4, pp. 48.
- Zhang, B.G., Perceptions of trade-offs between urban forest ecosystem services and disservices: A case study of Canberra, Australia, *Urban For. Urban Greening*, 2025, vol. 105, pp. 128711.
- Zhang, H., Li, C., Li, Y., Xu, Z.L., Zhong, S.S., Liu, J., Du, D.L., and Wang, C.Y., Relationship between plant diversity and community stability and invasibility in the heterogeneous landscape of urban habitats undergoing *Solidago canadensis* invasion, *Plant Ecol. Divers.*, 2024, vol. 17, no. 1-2, pp. 75–84.