Prof. Lucas Alejandro Garibaldi from Argentina receives the 2021 Golden Bee Award

Dr Lucas A. Garibaldi is Principal Investigator at the National Scientific and Technical Research Council of Argentina (CONICET), Professor at the National University of Río Negro (UNRN), and Director of the Institute for Research in Natural Resources, Agroecology and Rural Development (IRNAD, Sede Andina - UNRN and CONICET). Among other tasks, he dedicates a large part of his time working ad-honorem in inter-governmental scientific-political platforms (e.g., IPBES, FAO) and with farmers (e.g., Fundación Cultivo Ecológico, CREA, AAPRESID) and beekeepers (e.g., APIMONDIA) associations. His research seeks to promote biodiversity, healthy food production, and physical, mental, and social well-being. To achieve this, he addresses issues related to pollination, agroecology, and nature's contributions to people. The results of his studies are actively shared through appearances in multiple media outlets, public talks, documentaries, and audiovisual series, among other communication channels.
The research carried out on pollinators has allowed Dr Garibaldi to develop key - and often novel - knowledge about their ecology, ethology, and taxonomy, among other biological disciplines. His studies on interactions between pollinators, the environment, and human beings are particularly noteworthy and aimed at raising awareness about the role of pollinators in ensuring food security, sustainable agriculture, biodiversity conservation, and cultural heritage. Through these works, Dr Garibaldi has advanced in the design, implementation, and transfer of beekeeping technologies. Such innovations target global socio-environmental problems through biodiversity-based solutions. In this way, his studies take action on the territory and provide concrete strategies for pollinators preservation and the promotion of beekeeping activities all over the world.

In one of his most significant contributions to pollination studies, Dr Garibaldi showed that diverse assemblages of wild and domestic pollinators improve crop performance, thus benefiting nutritious food production and long-term farmer profits[18, 19, 25, 31, 35]. Identification of commercial crops whose production depends on pollinator activity has helped make visible and value the frequently overlooked pollination services in productive landscapes[1, 2, 22, 23, 29]. These works have also explored the importance of landscape structure in guaranteeing the stability of ecosystem services over time, in particular the presence of diverse natural and semi-natural habitats that offer resources for pollinator survival[30, 32, 37, 39]. To improve the use of their contributions, relationships between pollinator diversity and ecosystem functioning have been extensively explored[4, 17, 33, 36], as well as sound management practices integrating

activity tracking for better decision-making in the field[28]. Numerous studies have also deepened the knowledge about the current state of pollinator populations, their trends, possible causes behind their decline, and the potential impact that this event can have on crops[10, 14, 41, 42]. Such work has provided invaluable data for developing pollinator-friendly agricultural management techniques and protocols accessible to producers of any scale and location[11].

These studies focus on pollination but are often framed within broader research dealing with agroecology and the diversity of contributions that nature can offer to people[7, 8, 21, 34, 43]. In this sense, from the early stages of his career Dr Garibaldi works on building sustainable production systems, exploring alternative management practices that reconcile agricultural productivity with environmental conservation and human well-being[5, 9, 15, 16]. His involvement allowed progress in conceptualizing agroecology as a suitable approach and helped promote the design of multi-functional landscapes adapted to different regional, national, and international contexts[3, 24, 26, 27, 34, 38, 44, 45]. Thanks to these activities, he has been able to cooperate with family farmers around the globe to facilitate and encourage their transition to low-cost, high-yield, nature-friendly farming practices. These results are achieved by taking advantage of environmental functions that occur naturally, thus allowing reductions of external inputs and extractive techniques that impact agroecosystems' ability to self-regulate. On many occasions, this approach also represents a source of employment for rural workers and leads to creating integrated networks that multiply partnerships and perpetuate them over time[6, 12, 20].

In this way, Dr Garibaldi's work encourages debate and discussion around the changes that can improve nutrition and well-being through biodiversity, advocating for inclusive processes in which the environment progressively transforms with clear objectives and decisions based on adaptive management.

References

[1]Aizen, M. A., Garibaldi, L. A., Cunningham, S. A., & Klein, A. M. (2009). How much does agriculture depend on pollinators? Lessons from long-term trends in crop production. Annals of botany, 103(9), 1579-1588.

[2]Chacoff, N. P., Morales, C. L., Garibaldi, L. A., Ashworth, L., & Aizen, M. A. (2010). Pollinator dependence of Argentinean agriculture: current status and temporal analysis.

[3]Chaplin-Kramer, R., Brauman, K. A., Cavender-Bares, J., Díaz, S., Duarte, G. T., Enquist, B. J., ... & Zafra-Calvo, N. (2021). Conservation needs to integrate knowledge across scales. Nature ecology & evolution, 1-2.

[4]Coulin, C., Aizen, M. A., & Garibaldi, L. A. (2019). Contrasting responses of plants and pollinators to woodland disturbance. Austral Ecology, 44(6), 1040-1051.

[5]Dainese, M., Martin, E. A., Aizen, M. A., Albrecht, M., Bartomeus, I., Bommarco, R., ... & Steffan-Dewenter, I. (2019). A global synthesis reveals biodiversity-mediated benefits for crop production. Science advances, 5(10), eaax0121.

[6]D'Annolfo, R., Gemmill-Herren, B., Graeub, B., & Garibaldi, L. A. (2017). A review of social and economic performance of agroecology. International Journal of Agricultural Sustainability, 15(6), 632-644.

[7]Díaz, S., Settele, J., Brondízio, E. S., Ngo, H. T., Agard, J., Arneth, A., ... & Zayas, C. N. (2019). Pervasive human-driven decline of life on Earth points to the need for transformative change. Science, 366(6471).

[8]Díaz, S., Settele, J., Brondízio, E. S., Ngo, H. T., Guèze, M., Agard, J., ... & Zayas, C. (2019). Summary for policymakers of the global assessment report on biodiversity and ecosystem services of the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services. Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services.

[9]Díaz, S., Zafra-Calvo, N., Purvis, A., Verburg, P. H., Obura, D., Leadley, P., ... & Zanne, A. E. (2020). Set ambitious goals for biodiversity and sustainability. Science, 370(6515), 411-413.

[10]Freitas, B. M., Vaissière, B. E., Saraiva, A. M., Carvalheiro, L. G., Garibaldi, L. A., & Ngo, H. (2016). Identifying and assessing pollination deficits in crops. In Pollination Services to Agriculture (pp. 35-50). Routledge.

[11]Garibaldi, L. A. & Azzu, N. (2016). Multidimensional valuation of ecosystem services in agriculture. Anexo en Mainstreaming ecosystem services and biodiversity into agricultural production and Management in east Africa (ed. FAO y Convention on Biological Diversity). FAO, Roma, 170 págs. ISBN 978-92-5-109215-6.

[12]Garibaldi, L. A., & Pérez-Méndez, N. (2019). Positive outcomes between crop diversity and agricultural employment worldwide. Ecological Economics, 164, 106358.

[13]Garibaldi, L. A., Aguiar, D. S., Aizen, M. A., Morales, C. L., & Sáez, A. (2017). ¿ Diversidad o dominancia en la producción de alimentos? El caso de los polinizadores.

[14]Garibaldi, L. A., Aizen, M. A., Cunningham, S., & Klein, A. M. (2009). Pollinator shortage and global crop yield: looking at the whole spectrum of pollinator dependency. Communicative & Integrative Biology, 2(1), 37-39.

[15]Garibaldi, L. A., Andersson, G. K., Requier, F., Fijen, T. P., Hipólito, J., Kleijn, D., ... & Rollin, O. (2018). Complementarity and synergisms among ecosystem services supporting crop yield. Global food security, 17, 38-47.

[16]Garibaldi, L. A., Andersson, G., Fernández Ferrari, C., & Pérez-Méndez, N. (2018). Seguridad alimentaria, medio ambiente y nuestros hábitos de consumo. Ecología austral, 28(3), 572-580.

[17]Garibaldi, L. A., Bartomeus, I., Bommarco, R., Klein, A. M., Cunningham, S. A., Aizen, M. A., ... & Woyciechowski, M. (2015). Trait matching of flower visitors and crops predicts fruit set better than trait diversity. Journal of Applied Ecology, 52(6), 1436-1444.

[18]Garibaldi, L. A., Carvalheiro, L. G., Leonhardt, S. D., Aizen, M. A., Blaauw, B. R., Isaacs, R., ... & Winfree, R. (2014). From research to action: enhancing crop yield through wild pollinators. Frontiers in Ecology and the Environment, 12(8), 439-447.

[19]Garibaldi, L. A., Carvalheiro, L. G., Vaissière, B. E., Gemmill-Herren, B., Hipólito, J., Freitas, B. M., ... & Zhang, H. (2016). Mutually beneficial pollinator diversity and crop yield outcomes in small and large farms. Science, 351(6271), 388-391.

[20]Garibaldi, L. A., Gemmill Herren, B., D'Annolfo, R., Graeub, B. E., Cunningham, S. A., & Breeze, T. D. (2017). Multidimensional Performance of Farming Approaches. Trends in Ecology & Evolution, 32, 721-722.

[21]Garibaldi, L. A., Kitzberger, T., Noemí Mazía, C., & Chaneton, E. J. (2010). Nutrient supply and bird predation additively control insect herbivory and tree growth in two contrasting forest habitats. Oikos, 119(2), 337-349.

[22]Garibaldi, L. A., Morales, C., Ashworth, L., Chacoff, N. P., & Aizen, M. A. (2012). Los polinizadores en la agricultura. Ciencia hoy, 21(126), 34-43.

[23]Garibaldi, L. A., Muchhala, N., Motzke, I., Bravo-Monroy, L., Olschewski, R., & Klein, A. M. (2012). Services from plant–pollinator interactions in the neotropics. In Ecosystem Services from Agriculture and Agroforestry (pp. 153-174). Routledge.

[24]Garibaldi, L. A., Oddi, F. J., Miguez, F. E., Bartomeus, I., Orr, M. C., Jobbágy, E. G., ... & Zhu, C. D. (2021). Working landscapes need at least 20% native habitat. Conservation Letters, 14(2), e12773.

[25]Garibaldi, L. A., Pérez-Méndez, N., Cordeiro, G. D., Hughes, A., Orr, M., Alves-dos-Santos, I., ... & Viana, B. F. (2021). Negative impacts of dominance on bee communities: Does the influence of invasive honey bees differ from native bees?.

[26]Garibaldi, L. A., Pérez-Méndez, N., Garratt, M. P., Gemmill-Herren, B., Miguez, F. E., & Dicks, L. V. (2019). Policies for ecological intensification of crop production. Trends in Ecology & Evolution, 34(4), 282-286.

[27]Garibaldi, L. A., Requier, F., Rollin, O., & Andersson, G. K. (2017). Towards an integrated species and habitat management of crop pollination. Current opinion in insect science, 21, 105-114.

[28]Garibaldi, L. A., Sáez, A., Aizen, M. A., Fijen, T., & Bartomeus, I. (2020). Crop pollination management needs flower-visitor monitoring and target values. Journal of Applied Ecology, 57(4), 664-670.

[29]Garibaldi, L. A., Schulte, L. A., Jordar, D. N. N., Carella, D. S. G., & Kremen, C. (2021). Time to Integrate Pollinator Science into Soybean Production. Trends in Ecology & Evolution.

[30]Garibaldi, L. A., Steffan-Dewenter, I., Kremen, C., Morales, J. M., Bommarco, R., Cunningham, S. A., ... & Klein, A. M. (2011). Stability of pollination services decreases with isolation from natural areas despite honey bee visits. Ecology letters, 14(10), 1062-1072.

[31]Garibaldi, L. A., Steffan-Dewenter, I., Winfree, R., Aizen, M. A., Bommarco, R., Cunningham, S. A., ... & Klein, A. M. (2013). Wild pollinators enhance fruit set of crops regardless of honey bee abundance. science, 339(6127), 1608-1611.

[32]Gemmill-Herren, B., Garibaldi, L. A., Kremen, C., & Ngo, H. T. (2021). Building effective policies to conserve pollinators: translating knowledge into policy. Current Opinion in Insect Science.

[33]Giannini, T. C., Garibaldi, L. A., Acosta, A. L., Silva, J. S., Maia, K. P., Saraiva, A. M., ... & Kleinert, A. M. (2015). Native and non-native supergeneralist bee species have different effects on plant-bee networks. PloS one, 10(9), e0137198.

[34]Goldenberg, M. G., Oddi, F. J., Gowda, J. H., & Garibaldi, L. A. (2020). Effects of firewood harvesting intensity on biodiversity and ecosystem services in shrublands of northern Patagonia. Forest Ecosystems, 7(1), 1-14.

[35]Hipólito, J., Viana, B. F., & Garibaldi, L. A. (2016). The value of pollinator-friendly practices: Synergies between natural and anthropogenic assets. Basic and Applied Ecology, 17(8), 659-667.

[36]Huaylla, C. A., Nacif, M. E., Coulin, C., Kuperman, M. N., & Garibaldi, L. A. (2021). Decoding information in multilayer ecological networks: The keystone species case. Ecological Modelling, 460, 109734.

[37]Joseph, J., Santibáñez, F., Laguna, M. F., Abramson, G., Kuperman, M. N., & Garibaldi, L. A. (2020). A spatially extended model to assess the role of landscape structure on the pollination service of Apis mellifera. Ecological Modelling, 431, 109201.

[38]Kleijn, D., Bommarco, R., Fijen, T. P., Garibaldi, L. A., Potts, S. G., & Van Der Putten, W. H. (2019). Ecological intensification: bridging the gap between science and practice. Trends in ecology & evolution, 34(2), 154-166.

[39]Martin, E. A., Dainese, M., Clough, Y., Báldi, A., Bommarco, R., Gagic, V., ... & Steffan-Dewenter, I. (2019). The interplay of landscape composition and configuration: new pathways to manage functional biodiversity and agroecosystem services across Europe. Ecology letters, 22(7), 1083-1094.

[40]Pérez-Méndez, N., Andersson, G. K., Requier, F., Hipólito, J., Aizen, M. A., Morales, C. L., ... & Garibaldi, L. A. (2020). The economic cost of losing native pollinator species for orchard production. Journal of Applied Ecology, 57(3), 599-608.

[41]Potts, S. G., Imperatriz Fonseca, V., Ngo, H. T., Biesmeijer, J. C., Breeze, T. D., Dicks, L., ... & Viana, B. F. (2016). Summary for policymakers of the assessment report of

the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services on pollinators, pollination and food production.

[42]Requier, F., Antúnez, K., Morales, C. L., Aldea Sánchez, P., Castilhos, D., Garrido, P. M., ... & Garibaldi, L. A. (2018). Trends in beekeeping and honey bee colony losses in Latin America. Journal of Apicultural Research, 57(5), 657-662.

[43]Tálamo, A., Barchuk, A. H., Garibaldi, L. A., Trucco, C. E., Cardozo, S., & Mohr, F. (2015). Disentangling the effects of shrubs and herbivores on tree regeneration in a dry Chaco forest (Argentina). Oecologia, 178(3), 847-854.

[44]Wanger, T. C., DeClerck, F., Garibaldi, L. A., Ghazoul, J., Kleijn, D., Klein, A. M., ... & Weisser, W. (2020). Integrating agroecological production in a robust post-2020 Global Biodiversity Framework. Nature Ecology & Evolution, 4(9), 1150-1152.

[45]Zamorano, J., Bartomeus, I., Grez, A. A., & Garibaldi, L. A. (2020). Field margin floral enhancements increase pollinator diversity at the field edge but show no consistent spillover into the crop field: a meta-analysis. Insect Conservation and Diversity, 13(6), 519-531.