Give predators a complement: Conserving natural enemy biodiversity to improve biocontrol

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Abstract:

The most popular biological controls for native weeds employed in various types biological control are members of the genus and nuts. The variety of pest-attacking species and its assets held are both reflected in natural enemies. Emerging research study demonstrates that enhanced pest control may result from higher enemy variety whenever natural enemies represent several, appropriate feeding areas. The diversification and efficacy of conserved biological control strategies as well as the molecular foundations of predatory ecological impacts have been well explored. In sustainable biological control we make an effort to lessen pest issues by boosting the abundance and variety of the population of natural enemies. Biocontrol specialists cannot disregard the fact that maintaining extremely rare circumstances predators can occasionally interfere with biological control, even if the weight of the research implies that the preservation of natural enemy biodiversity and biocontrol agents are complementary aims.

Keywords – *Biological control, Natural enemy, Predators, Ecosystem services, Functional biodiversity, Prey, Functional redundancy, Agro ecosystems, and Natural pest control.*

Introduction:

Predators are organisms that eat insects, including free-living species. Lady Beetles are an illustration of this group. Hoverfly larvae rapidly consume aphids and are useful. Organisms known as parasitoids assist to reduce the number of pests by laying their eggs inside the bodies of insects. Individuals have a crucial role to play, even though large-scale behavioural changes, legislation, and actions to safeguard biodiversity will be needed. Individuals can start changing their spending patterns by making deliberate decisions about the things, activities, and food they consume. Even though they nourish on a narrower variety of predatory species and have limited life cycles than other arthropod predators, insects and other arthropods are more frequently used in biocontrol agents. These predators may also experience population fluctuations in response to modifications in the concentration of about their prey (Tscharntke et al., 2016). Therefore, the weight of the data points to the compatibility, because in many instances, complementarity, of biological management and the management of natural enemy variety (Meena et al., 2017). The usage of biocontrol agents, also known as biological control, is primarily used to control pest populations and create pest-free crops. In order to combat pests naturally, conservation biological control (CBC) aims to reintroduce beneficial organisms into agricultural systems (Thorpe et al., 2016).

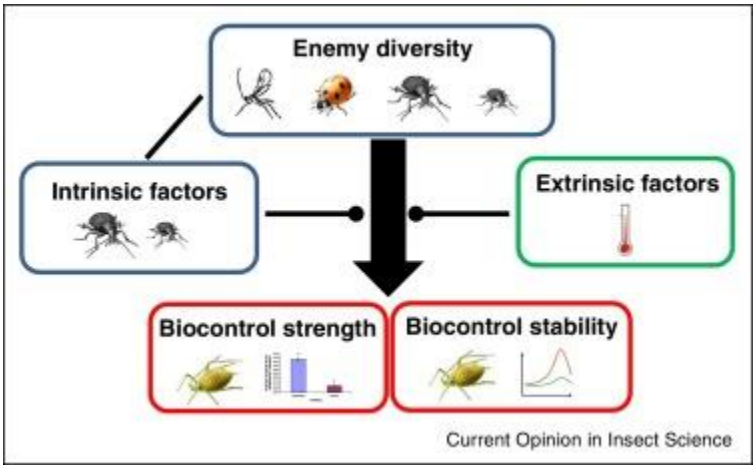

Fig.1. Association among biological control and the diversity of natural enemies

This approach is supported by current studies showing a connection between the preservation of natural habitats and fewer pest issues on agriculture (Letourneau et al., 2015). Most predators are free-living organisms that actively require a significant amount of prey over the course of their existence. Several of the predators utilised in biological management are insect larvae animals since invertebrates are a major agricultural pest (Villa et al., 2016). "Biological control is the effective management of insects and their harm by parasite, pathogens, and predators"(Biondi et al., 2015). The biocontrol offered by these living creatures, commonly referred to as "natural enemies," is crucial for lowering the prevalence of pests parasites and insects.

It is also successful to use natural enemies to biologically control weeds in rangelands and wild areas (Saunders et al., 2016). In several instances, specialized predators have effectively improved pest control by encouraging actual competition, that is the antagonistic relationship between preys that is managed by a common predator (Damien et al., 2017). Predatory parasites have been widely employed in numerous countries for biological control of agricultural pests, particularly in cultivated agriculture (Azevedo et al., 2015). The loss of naturally occurring vegetation ensembles in regional and landscapes level environments, which diminishes the variety of naturally occurring enemies and results in a decreased pest control effectiveness, is one explanation for the relationship among intensive agriculture and pest populations (Balzan & Bocci, 2016).

Literature review:

K. Birkhofer et.al 2015 described by these conflicting reactions of various species and biodiversity elements to certain management strategies for continuous meadows support the idea that no single approach may locally optimise the variety of insect predators. An important reference group for the "ecological advantages" that is intended to promote policies for protecting grasslands biodiversity are is insect predatory animals. Farm fields can be valuable supplements to natural areas as well as other conservation areas since these ecosystems' development of biodiversity encompasses many additional taxa in addition to intended diversity like varied crops. The method through which development is coordinated to produce advantages both

for farming and species may turn out to be environmental architecture (Birkhofer, Diekötter, et al., 2015)(Gurr et al., 2015).

Zhongxian Lu et.al 2015 explained the implementation of cultural practices, based mainly on agricultural uses, to improve integrated pest management or the "bottom-up" impacts which actually influence pests is included in the implementation of environmental technology for insect control. Biocontrol is supported by giving natural enemies supplies like nectar and pollen. While the pesticides weaken biological control since they decrease natural enemy densities. The impact of land management on the pressures from natural enemies was given particular attention. According to the natural enemy theory, a diversified forest's flowering plants offer extra elements such honey or pollination that are effective in drawing in and maintain more natural enemies (Lu et al., 2015)(International, 2016).

Jyotsna Nepal et.al 2017 demonstrated by the global investment in biological control measures has grown as a result of the rising demand for environmentally friendly goods. " Biological control refers to any methods used to reduce pest populations in fields by introducing natural enemies such as pathogens, predators, and parasitoids". There is a good chance that omnivory, by reducing predatory influence on the pooled resource, may also weaken rivalry between both the omnivorous predators and other natural adversaries in the same guild (Ghimire, 2017)(Chailleux et al., 2017).

Andrea L. et.al 2017 presented by even though the majority of bird predators are plant communities taxa, a sizeable portion of the professional pest control in tropical areas were provided by species that depend on their habitat, pointing to a connection among pest control services and environmental policy. Ecological systems that control pest populations are especially important in agricultural areas. Due to their relationship with apples growth, several members of an orchard's biodiversity have acquired agronomic relevance, making their promotion or disapproval particularly desired. The initial purpose of the environmental resource idea was to demonstrate the positive effects that natural ecosystems have on humanity and to promote biodiversity and ecological preservation. The global project “The Economics of Ecosystems and Biodiversity”, which aims to quantify biodiversity, regarded ancillary services to be biological activities but included environmental services as a separate term (Boesing et al., 2017)(Vispo et al., 2015)(Birkhofer, Diehl, et al., 2015).

Daniel Paredes et.al evaluated by Farm owners may be able to manipulate plants on a farm-wide scale to provide elements that support biological management, like habitats for natural enemies to take safety. Understanding the elements that affect the makeup of natural predators in agro ecosystems is essential for improving biological management of crop pests. Predator responses to prey density are a key component in the providing of biological control operations because they may be used either jointly or separately to predict when predators will be effective in containing pest epidemics and minimising crop damage. Although biocontrol has long been thought of as a possible substitute for pesticidal techniques for insect control, its

impact and degree of utilisation worldwide remain limited and uneven (Paredes et al., 2015)(Hanson et al., 2016)(Hintz, 2016).

Methodology:

Types of Natural Enemy:

"Parasites, pathogens, and predators are the primary groups used in biological control of insects and mites. The role of Natural enemy NEs in suppressing herbivore effects on plants represents the core aim of both conservation of NE biodiversity and biological control"(Azevedo et al., 2015).

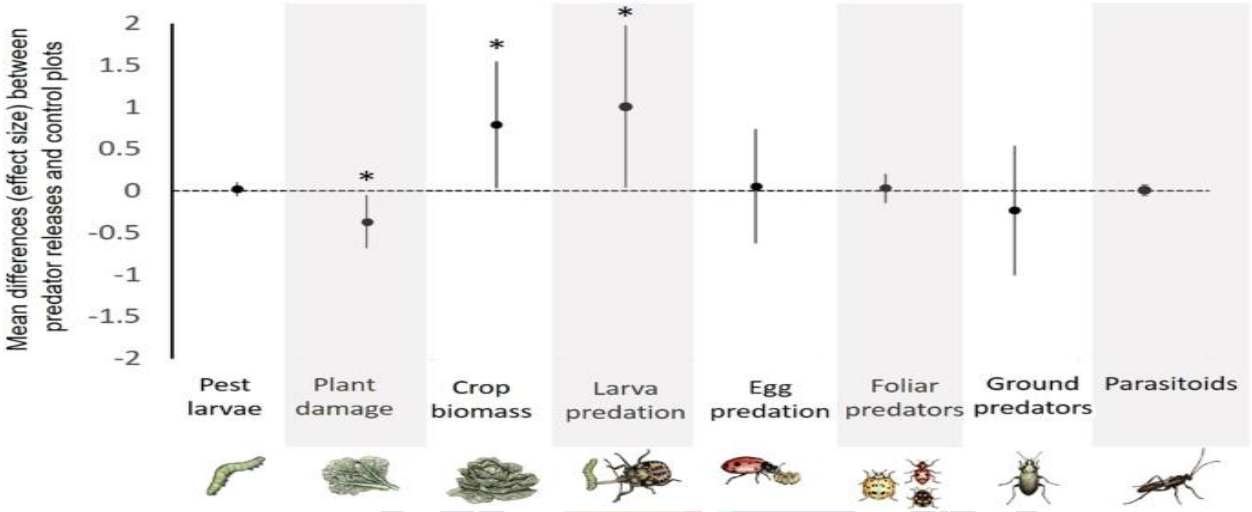

Fig.2. Effectiveness of biological control for predators and control plot

Parasites:

An insect that resides in or around hosts and depends on it is a parasite. On the interior or exterior of the host organism, insect parasites can grow. Frequently, only the parasite's adolescent phase consumes on the host. But in additional to the hosting fatality brought on by parasitic infection, the adult females of some parasites consume and destroy their hosts. This is an easily disregarded but crucial form of biological control (Villa et al., 2016).

Despite the use of the word "parasite" in this context, genuine parasites rarely cause the death of their hosts. It is more accurate to refer to the species used in biocontrol agents and detailed here as "parasitoids" because they destroy their hosts.

Pathogens:

Natural predators pathogens are microbes that really can attack and destroy the host, such as specific bacterium, fungus, nematode, parasites, and infectious agents (Balzan & Bocci, 2016). "Naturally occurring infections

can occasionally significantly diminish the numbers of some aphids, caterpillars, mites, and other invertebrates". This usually happens in situations where there is a protracted period of high humidity or a large number of pest populations. Some helpful pathogens are offered economically as biologically or microbiological insecticides in complement to a found naturally virus outbreak (Thorpe et al., 2016). This included entomophagous nematode, granulosis infections, and Bacillus subtilis, or Bt. Furthermore, many pesticides contain microbiological products like avermectins and spinosyns, but spraying these substances is not regarded as biocontrol agents (Sharma et al., 2017).

Predators

Over the course of their lifestyles, predators kill and consume an excessive number of individual targets. Numerous kinds of birds, animals, amphibians, and reptiles all have considerable insect predation. Many different pest insects or mites are consumed by predator's insects, wasps, hoverflies, true bugs, and bees. The majority of spiders only consume insects. spider mites are a common food source for predatory mites (Kenis et al., n.d.).

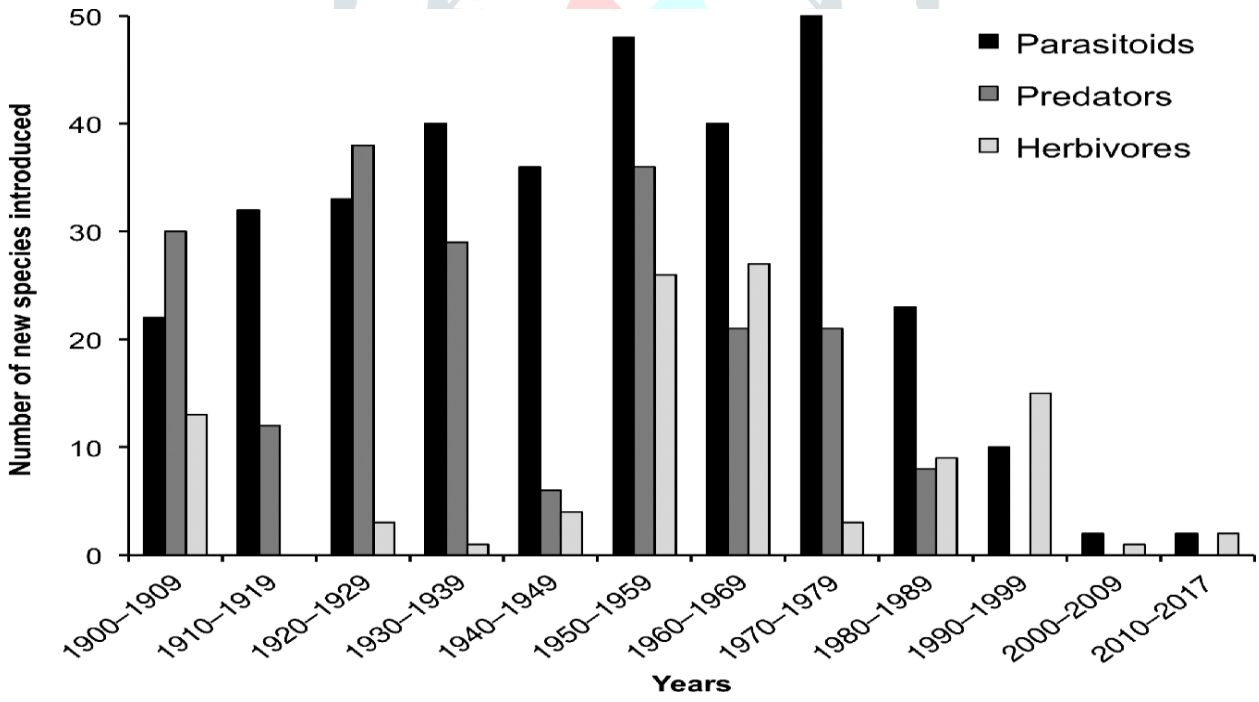

Fig.1. Natural enemies introduced.

Conclusion:

Whenever natural enemies target distinct pest populations or phases that are present in various locations or at various times, or even when competitors employ various hunting techniques, compatibility may result. The biodiversity of natural enemies is regarded to be crucial in the control of crop pests. Conversely, there is debate over how much natural enemy biodiversity contributes to pest control effectiveness. In both empirical and

observational experiments, the diversification of interaction across NE species may help to explain variations in the link among natural predators biodiversity and pest management. The range of natural enemies generally enhances biological control, but research findings have discovered both positive and negative consequences. For three interrelated reasons, it is imperative to create more efficient "biological control" methods for controlling agricultural pests.

References

Azevedo, L. H. De, Emberson, R. M., & Esteca, F. D. C. N. (2015). *Macrochelid Mites (Mesostigmata : Macrochelidae) as Biological Control Macrochelid Mites (Mesostigmata : Macrochelidae) as Biological Control Agents* (Issue January). https://doi.org/10.1007/978-3-319-15042-0

Balzan, M. V, & Bocci, G. (2016). Landscape complexity and field margin vegetation diversity enhance natural enemies and reduce herbivory by Lepidoptera pests on tomato crop Landscape complexity and field margin vegetation diversity enhance natural enemies and reduce herbivory by Lepidoptera pests on tomato crop. *BioControl*, *April*. https://doi.org/10.1007/s10526-015-9711-2

Biondi, A., Zappalà, L., Mauro, A., Garzia, G. T., Russo, A., Desneux, N., & Siscaro, G. (2015). Can alternative host plant and prey affect phytophagy and biological control by the zoophytophagous mirid Nesidiocoris tenuis ? Can alternative host plant and prey affect phytophagy and biological control by the zoophytophagous mirid Nesidiocoris tenuis ? *BioControl*, *October*. https://doi.org/10.1007/s10526-015-9700-5

Birkhofer, K., Diehl, E., Andersson, J., Ekroos, J., & Früh-müller, A. (2015). *Ecosystem services — current challenges and opportunities for ecological research*. *2*(January), 1–12. https://doi.org/10.3389/fevo.2014.00087

Birkhofer, K., Diekötter, T., Meub, C., Stötzel, K., & Wolters, V. (2015). Agriculture , Ecosystems and Environment Optimizing arthropod predator conservation in permanent grasslands by considering diversity components beyond species richness. *"Agriculture, Ecosystems and Environment," 211*, 65–72. https://doi.org/10.1016/j.agee.2015.05.014

Boesing, A. L., Nichols, E., & Metzger, J. P. (2017). Effects of landscape structure on avian-mediated insect pest control services : a review Effects of landscape structure on avian-mediated insect pest control services : a review. *Landscape Ecology*, *October*. https://doi.org/10.1007/s10980-017-0503-1

Chailleux, A., Droui, A., Bearez, P., & Desneux, N. (2017). *Survival of a specialist natural enemy experiencing resource competition with an omnivorous predator when sharing the invasive prey Tuta absoluta*. *July*, 8329–8337. https://doi.org/10.1002/ece3.3396

Damien, M., Lann, C. Le, Desneux, N., Alford, L., & Hassan, D. Al. (2017). *control but not trophic link diversity . Agriculture , Ecosystems and There may be differences between this version and the published version . Flowering cover crops in winter increase pest control but not trophic link diversity*. *August*, 418–425. https://doi.org/10.1016/j.agee.2017.07.015

Ghimire, B. (2017). *Use of Predators for the Biological control of Eriosoma lanigerum (wooly apple aphids) on apple*. *5*, 410–414. https://doi.org/10.3126/ijasbt.v5i4.18397

Gurr, G. M., Zhu, Z., & You, M. (2015). *The Big Picture : Prospects for Ecological Engineering to Guide the Delivery of Ecosystem Services in Global Agriculture*. 145–162. https://doi.org/10.1007/978-94-017-9535-7.7

Hanson, H. I., Palmu, E., Birkhofer, K., & Smith, H. G. (2016). *Agricultural Land Use Determines the Trait Composition of Ground Beetle Communities*. 1–13. https://doi.org/10.1371/journal.pone.0146329

Hintz, W. E. (2016). *Conservation Biological Control of Pests in the Molecular Era : New Opportunities to Address Old Constraints*. *6*(January), 1–9. https://doi.org/10.3389/fpls.2015.01255

International, A. (2016). *Forest management and natural biocontrol of insect pests*. *March*, 253–262. https://doi.org/10.1093/forestry/cpw019

Kenis, M., Adriaens, T., Brown, P. M. J., Katsanis, A., Martin, G. S., Branquart, E., Maes, D., Eschen, R., Zindel, R., & Vlaenderen, J. Van. (n.d.). *Assessing the ecological risk posed by a recently established invasive alien predator : Harmonia axyridis as a case study Which species are most at risk following the establishment of an invasive predator : Harmonia axyridis as a case study*. *41*(0).

Letourneau, D. K., Bothwell, S. G., Robert, A., Michael, R. K., & Iii, J. O. S. (2015). *Habitat eradication and cropland intensification may reduce parasitoid diversity and natural pest control services in annual crop fields*. 1–13. https://doi.org/10.12952/journal.elementa.000069

Lu, Z., Zhu, P., Gurr, G. M., & Zheng, X. (2015). *Rice Pest Management by Ecological Engineering : A Pioneering Attempt in Rice Pest Management by Ecological Engineering : A Pioneering Attempt in China*. *January*. https://doi.org/10.1007/978-94-017-9535-7

Meena, A., Meena, M., Kumar, R., & Meena, B. M. (2017). *Farmscaping : An ecological approach to insect pest management in agroecosystem*. *5*(3), 598–603.

Paredes, D., Cayuela, L., Gurr, G. M., & Campos, M. (2015). *Is Ground Cover Vegetation an Effective Biological Control Enhancement Strategy against Olive Pests ?* 1–13. https://doi.org/10.1371/journal.pone.0117265

Saunders, M. E., Peisley, R. K., Rader, R., & Luck, G. W. (2016). Pollinators , pests , and predators : Recognizing ecological trade-offs in agroecosystems. *Ambio*, *45*(1), 4–14. https://doi.org/10.1007/s13280-015-0696-y

Sharma, M., Tarafdar, A., Ghosh, R., & Gopalakrishanan, S. (2017). *Biological Control as a Tool for Eco-friendly Management of Plant Pathogens*. https://doi.org/10.1007/978-981-10-7380-9_8

Thorpe, P. T., Pryke, J. S., & Samways, M. J. (2016). *Review of Ecological and Conservation Perspectives on Future Options for Arthropod Management in Cape Floristic Region Pome Fruit Orchards Review of ecological and conservation perspectives on future options for arthropod management in Cape Floristic Regi*. *October*. https://doi.org/10.4001/003.024.0279

Tscharntke, T., Karp, D. S., Chaplin-Kramer, R., Batáry, P., DeClerck, F., Gratton, C., Hunt, L., Ives, A., Jonsson, M., Larsen, A., Martin, E. A., Martínez-Salinas, A., Meehan, T. D., O'Rourke, M., Poveda, K., Rosenheim, J. A., Rusch, A., Schellhorn, N., Wanger, T. C., … Zhang, W. (2016). When natural habitat fails to enhance biological pest control – Five hypotheses. *Biological Conservation*, *204*, 449–458. https://doi.org/10.1016/j.biocon.2016.10.001

Villa, M., Santos, S. A. P., Marrão, R., Pinheiro, L. A., López-saez, J. A., Mexia, A., Bento, A., & Alberto, J. (2016). Agriculture , Ecosystems and Environment Syrphids feed on multiple patches in heterogeneous agricultural landscapes during the autumn season , a period of food scarcity. *"Agriculture, Ecosystems and Environment," 233*, 262–269. https://doi.org/10.1016/j.agee.2016.09.014

Vispo, C., Knab-vispo, C., Bradford, K., Vispo, O., Valley, H., & Ecology, F. (2015). *The Role of Orchard Habitats and the Surrounding Landscape in Supporting Apple Production and Conserving Biodiversity : Report of a Hudson Valley Pilot Project* .