Functional trophic guilds in a subtropical arid agroecosystem: which is the most beneficial?

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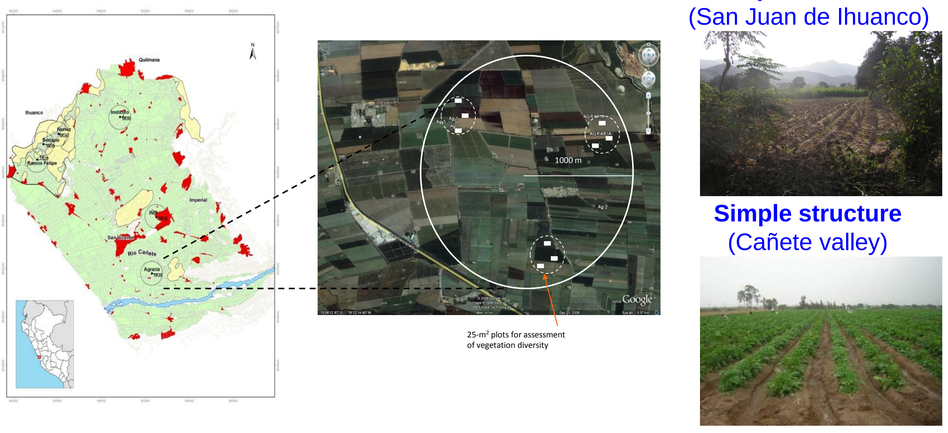
Introduction

Developing a habitat management program to promote the conservation and augmentation of biological control services requires a deep knowledge of the taxonomy and functional diversity of arthropods in a specific agroecosystem The objective of this study was evaluated the effect of the landscape structure on the arthropod community (taxonomic composition, abundance, functional groups and diversity) related to potato agroecosystem in the central coast of Peru

Materials and methods

This study was conducted in experimental potato (*Solanum tuberosum* L.) fields without the application of insecticides planted in the localities of San Juan de Ihuanco (complex landscape) and Cañete (simple landscape) in the province of Cañete, Lima (Fig. 1, Table 1). Arthropod samples were taken above plant canopy using Malaise traps and from the soil strata using pitfall traps during theentire cropping season.



Complex structure
(San Juan de Ihuanco)

Simple structure
(Cañete valley)

Fig. 1. Position of the localities, circular landscape sectors, fields and plots evaluated in the Cañete region. Solid-line circles indicate radii 1.0 km used for analysis of percent of arable land. Dashed-line circles indicate selected fields for analysis of vegetation diversity

Table 1. Structural features of the simple and complex agricultural landscape groups examined in two localities of the Cañete province.

Structural features	Landscape type		P
	Ihuanco	Cañete valley	
arable land	20.95 ± 4.71	81.66 ± 10.69	0.0095
hedgerows, field margins	4.61 ± 0.43	0.10 ± 0.06	0.0004
roads	1.90 ± 0.74	2.65 ± 0.23	0.3441 (NS)
settlement	0.18 ± 0.04	14.69 ± 11.11	0.1210 (NS)
irrigation channels	0.09 ± 0.03	0.17 ± 0.11	0.6170 (NS)

Results and discussion

Arthropods: Taxonomic composition

A rich arthropod fauna comprising a total of 58148 specimens classified in 379 morphospecies in 119 families, 19 orders and five classes were collected from potato agroecosystem in the Cañete region (Fig. 2). Differences in relative abundance were observed according to crop strata evaluated (Fig. 3). In the total arthropod community Diptera, Coleoptera and Hymenoptera not only had the highest taxonomic richness but were the most abundant orders.

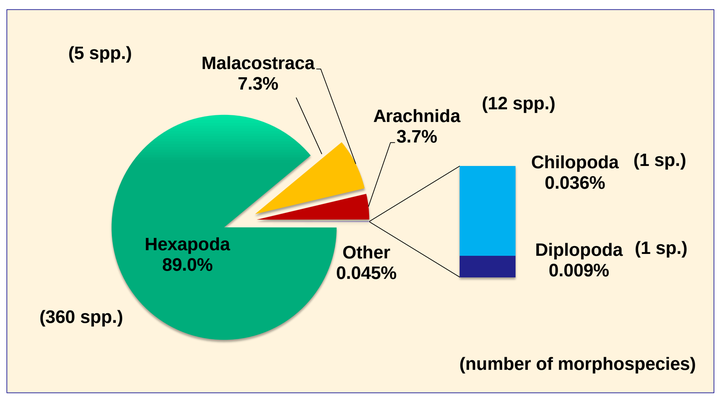
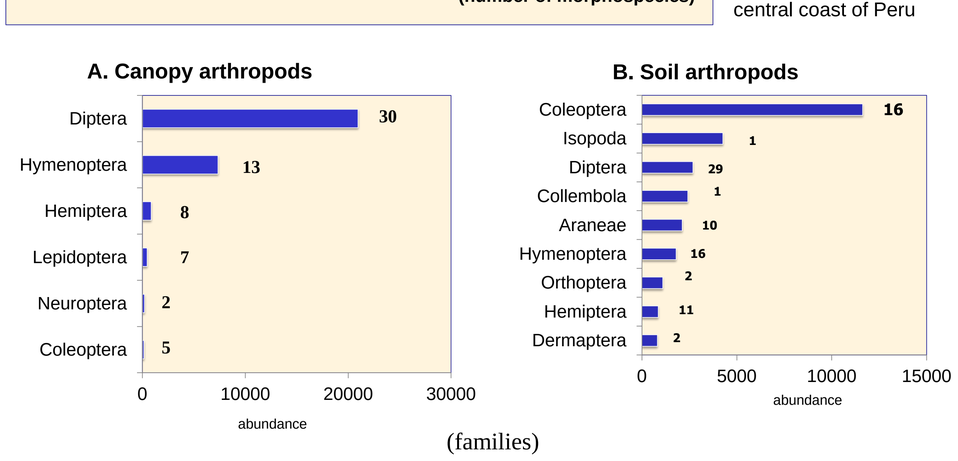


Fig. 2 Taxonomy composition and relative abundance of the arthropod community in potato agroecosystem of the Cañete region at the central coast of Peru.

Fig. 3. Abundance of arthropod orders in the canopy and soil strata of potato agroecosystems in the Canete valley of the central coast of Peru



Arthropod: Functional guilds

In the total arthropod community, a major abundance of natural enemies (32.5% of predators plus 15.9% of parasitoids) compared to phytophagous (16.5%) was observed. Indifferent arthropods formed one third of the arthropod population (Fig. 4). Some differences in the arthropod composition of functional groups were observed according to the trapping method used (pitfall or malaise trap) (Fig. 5).

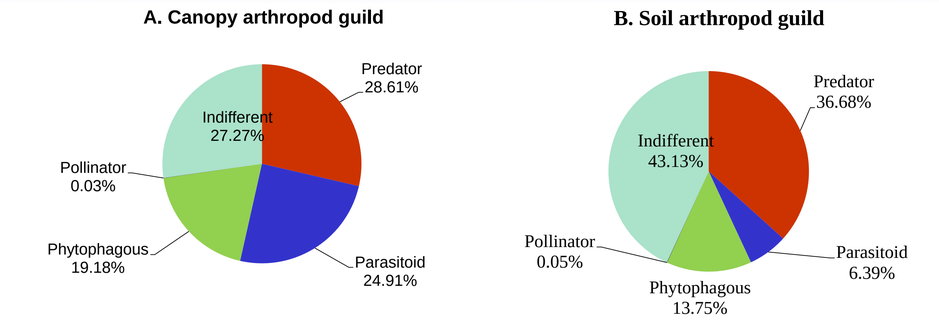


Fig. 4. Relative abundance of trophic guilds in the potato canopy (A) and soil (B) in the central coast of Peru.

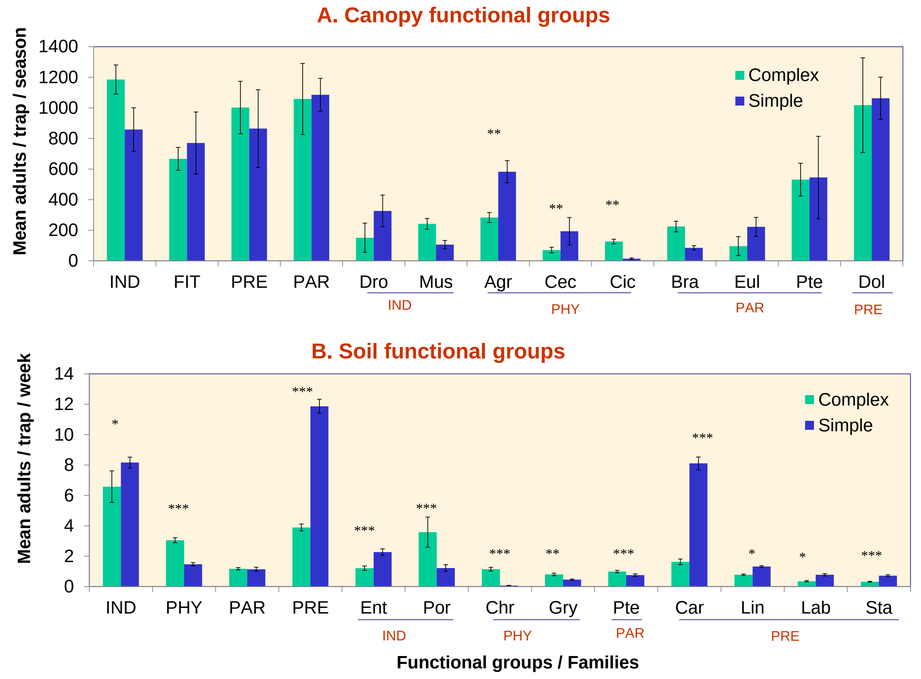


Fig.5. Mean abundance (±SE) of arthropod trophic guilds and main taxonomic families recorded in two strata of the potato crop from complex (Ihuanco) and simple (Cañete) landscapes (IND: Indifferent PHY: phytophagous, PAR: parasitoids, PRE: predators, Dro:Drosophilidae, Mus: Muscidae, Agr: Agromyzidae, Cec: Cecidomyiidae, Cic: Cicadellidae, Bra: Braconidae, Eul:Eulophidae, Pte: Pteromalidae, Dol: Dolichopodidae, Ent: Entomobryidae, Por: Porcellionidae, Chr: Chrysomelidae, Gry: Grillidae, Car: Carabidae, Lin: Lyniphidae, Lab: Labiduridae, Sta: Staphylinidae) .

Phytophagous species associated to potato crop

Twenty phytophagous species associated to potato crop were identified, with *Liriomyza huidobrensis* (Blanchard) (Agromyzidae) and *Prodiplosis longifila* Gagne (Cecidomyiidae) as the most important pests (Table 2).

Liriomyza huidobrensis

Prodiplosis longifila

Table 2. List of main potato pests identified in simple and complex landscapes of the Cañete province in the central coast of Peru. Damage intensity estimated by using a rating scale of four levels: no infestation (--), low (+), medium (++) and high (+++).

ORDER / Family	Specie	Localities		Total		Importance*
		Cañete	Ihuanco	n	%	
COLEOPTERA						
Chrysomelidae	*Diabrotica decolor*	8	690	698	8.13	+
	Diabrotica sp. (2 species)	1	19	20	0.23	+
	Epitrix sp.	30	522	552	6.43	+
Scarabaeidae	*Anomala undulata*	84	77	161	1.88	++
	Bothynus sp.	6	6	12	0.14	+
	Cyclocephala sp.	1	11	12	0.14	+
DIPTERA						
Agromyzidae	*Liriomyza quadrata*	59	79	138	1.61	+
	Liriomyza huidobrensis	2241	876	3117	36.32	+++
Cecidomyiidae	*Prodiplosis longifila*	628	258	886	10.32	+++
HEMIPTERA						
Aleyrodidae	*Bemisia tabaci*	42	232	274	3.19	+
Aphididae	*Myzus persicae*	66	482	548	6.38	+
Cicadellidae	*Empoasca kraemeri*	114	507	621	7.24	+
LEPIDOPTERA						
Gelechiidae	*Phthorimaea operculella*		4	4	0.05	+
	Tuta absoluta	5	191	196	2.28	+
Noctuidae	*Agrotis* sp. (2 species)	6	18	24	0.28	++
	Spodoptera frugiperda	100	158	258	3.01	++
ORTHOPTERA						
Gryllidae	*Grillus assimilis*	249	808	1057	12.32	+
THYSANOPTERA						
Thripidae	*Trips tabaci*	1	4	5	0.06	+
Grand Total		3641	4942	8583	100.00	

Table 3. Indicators of biocontrol diversity for richness species and abundance for complex and simple landscape at the central Peruvian coast.

Twenty phytophagous species associated to potato crop were identified, with *Liriomyza huidobrensis* (Blanchard) (Agromyzidae) and *Prodiplosis longifila* Gagne (Cecidomyiidae) as the most important pests.	Twenty phytophagous species associated to potato crop were identified, with *Liriomyza huidobrensis* (Blanchard) (Agromyzidae) and *Prodiplosis longifila* Gagne (Cecidomyiidae) as the most important pests.			Twenty phytophagous species associated to potato crop were identified, with *Liriomyza huidobrensis* (Blanchard) (Agromyzidae) and *Prodiplosis longifila* Gagne (Cecidomyiidae) as the most important pests.		
	Complex	Simple	Total	Complex	Simple	Total
parasitoid / phytophagous	2.8	1.8	3.1	1.1	1.1	1.1
predator / phytophagous	3.4	2.6	3.7	1.7	3.0	2.2
entomophagous / phytophagous	6.2	5.1	6.8	2.7	4.1	3.3

Conclusion

The complex landscape had a higher taxonomic and functional diversity than the simple landscape. Biological control services showed that richness of entomophagous (predators and parasitoids) species in relation to potato pests was higher in complex than simple landscape (table 3). However, ecosystem services of entomophagous abundance were superior in simple landscape. The potato agroecosystem shelter a diverse and abundant entomophagous guild that can be improved with adequate management strategies and consequently increase ecosystem resilience to pest outbreaks

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