ETHNOBIOLOGY AND CONSERVATION

RESEARCH ARTICLE

Ethnobiology and Conservation, 13:16 (1 July 2024)
doi:10.15451/ec2024-07-13.16-1-25
ISSN 2238-4782 ethnobioconservation.com

Preventive, Curative, and Tolerance Practices: Family Farmers' Local Ecological Knowledge regarding Harmful Crop Arthropods in NW Patagonia

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ABSTRACT

Family farming systems face the challenge of carrying out their activities alongside Harmful Arthropods (HA), which cause damage to edible, wild, and cultivated plants that are fundamental for farmers. This case study, with farmers from the Nahuel Huapi Family Farmers Free Fair (FFAFNH, Spanish acronym), shows some distinctive elements of Local Ecological Knowledge about HA (LEKHA). We investigated LEKHA about seven HA among farmers regarding nomenclature, characterization, ecological aspects, cultivated species affected, ways of acquiring and transmitting knowledge, management practices, and HA's importance. We discussed how these aspects allow us to infer the hybrid character of LEKHA, which articulates traditional knowledge of peasant agriculture and Scientific Technical Knowledge (STK). A participatory workshop was carried out, which emerged as a request and demand from the members of the FFAFNH. Fifteen local names were registered, two of which were Mapuche. Most of the HA are recognized as harmful to more than one plant, and the majority (60%) have been with farmers for a long time. Regarding management, preventive practices predominated (57%) over curative practices (14%). We postulated a new HA management practice, "tolerance" (29%), which implies that HA coexist with people in their productive spaces and are deliberately allowed to follow their natural cycles. The predominant ways of acquiring and transmitting knowledge are idiosyncratic and oblique (35% each). The workshop was an instance of reinforcement and self-validation of LEKHA, where a dialogue of knowledge was established back and forth with the STK.

Keywords: Pest, management practices, Local Ecological Knowledge, horticulturist, free fair.

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SIGNIFICANCE STATEMENT

Our study on the Local Ecological Knowledge (LEK) of Harmful Arthropods (HA) among family farmers of the Nahuel Huapi Family Farmers Free Fair highlights the importance of integrating local and scientific knowledge in the management of HA. The hybrid character of horticulturist' knowledge is revealed. The emerging practice of "tolerance" reveals a strategy of coexistence that allows HA to follow their natural cycles, reflecting a holistic and sustainable approach. This work underlines the importance of participatory workshops as tools to enrich LEK and promote dialogue of knowledge between the local community and hegemonic science. The results suggest that the recognition and integration of LEK can be key to the development of locally adapted management strategies for HA.

INTRODUCTION

Family farming systems (FFS) face numerous social and economic challenges, aggravated by global socio-environmental changes that negatively affect productive systems (Blondeau and Korzenszky 2022). In this scenario, FFS struggle with Harmful Arthropods (HA) (Sharma 2010; Heeb et al. 2019): arthropods that live and thrive using space and components that are valuable to people, negatively impacting crops or associated wild plants (Birgi et al. 2020; Balbi et al. 2022). In this paper, we particularly refer to arthropods that cause damaging effects on edible plants, both wild and cultivated, which are central to the lives of farmers.

HA management is a major concern among technicians and farmers (Balbi et al. 2022). Faced with this central problem of horticulture (Birgi et al. 2020), farmers have developed management practices, defined as actions that increase or maintain the richness and abundance of plants of interest to farmers, often involving the management of other resources, such as harmful horticultural arthropods (Chamorro and Ladio 2021).

For HA management, FFS carry out both preventive and curative practices. Preventive practices aim to prevent HA from dominating and severely damaging crops (Barzman et al. 2015). These practices increase resilience, sustainability (Morales and Perfecto 2000; Barzman et al. 2015), and biodiversity (Altieri 1993). Examples of preventive practices include the choice of crop seasons, the plant varieties used, the choice of the place to grow, preparing the land, and fertilization (Morales 2002). Curative practices are reactive and are used to reverse damage (Morales 2002). Examples include the use of biological controllers and bioinputs. In some systems, curative practices utilize external inputs that are harmful to the environment (Barzman et al. 2015; Liere et al. 2020).

The Local Ecological Knowledge relationed to HA (LEKHA) is the cumulative body of knowledge, practices, and beliefs inherited and that evolves through the individual's own experience and through external sources of information (Reyes García 2009; Morales and Perfecto 2000; Truskanov and Prat 2018). LEKHA not only includes local management practices (Belmain et al. 2022), but also the recognition, classification, and nomenclature systems of HA (Martínez-Torres and Rosset 2010).

Classification systems for animals strongly depend on the place that animals occupy in human societies and the social and/or environmental conditions that societies inhabit (Berlin 1990). The identification of an organism implies the recognition of descriptive traits that allow the observer to associate the animal with a specific category, usually through a name (Zamudio and Hilgert 2012). Among the identification elements, we found morphological and sensory traits such as color, size, and shape, and those linked to taste or smell (Posey 1984; Santos-Fita and Costa-Neto 2009); utilitarian and cultural characters that imply aesthetic value, magical or playful properties (Turbay 2002); and behavioral characteristics typical of the ecology of the species (Posey 1984; Zamudio and Hilgert 2012).

In addition, LEKHA is culturally transmitted through various mechanisms, including enablement and enculturation (Cavalli-Sforza et al. 1982; Hewlett and Cavalli-Sforza 1986). In the first case, also called idiosyncratic learning, knowledge acquisition occurs through the individual's own experience, while in the second case, knowledge spreads from an emitter to a receiver. This interaction can be vertical when transmission is from parents to children, horizontal when it occurs among peers of the same generation, or oblique when it occurs between people of different generations, related or not (Hewlett and Cavalli-Sforza 1986; Lozada et al. 2006).

In FFS the transmission of knowledge from agricultural technicians constitutes an important source of innovation and enrichment of knowledge and practices (Eyssartier et al. 2008). The influence of Scientific Technical Knowledge (STK) has been key to facilitate the processes of knowledge hybridization with the Local Ecological Knowledge (LEK) of farmers (Eyssartier et al. 2011). According to Ladio and Alburquerque (2014), this process is inherent to traditional ecological knowledge systems, which incorporate and adjust knowledge flexibly and respond to local needs in the face of changes. However, in the interaction between LEK and STK, the power asymmetries that devalue LEK can be revealed, an aspect that must be considered (Ladio 2017).

Understanding the common and disparate elements between LEK and STK provides inclusive management tools for integrating both systems (Ladio 2017; Ludwig and El-Hani 2020; Turner et al. 2022). Inter-scientific dialogue is a valuable strategy for complementing knowledge from different cultures and societies (Delgado Burgoa et al. 2021). This dialogue is based on the principle that all knowledge systems in the world are sciences, including the LEK of peasant communities (Haverkort et al. 2012; Furlan et al. 2020). Therefore, studies that include both knowledge systems in dialogue are crucial for promoting interpretive agreements horizontally (Ladio 2017; Turner et al. 2022; Albuquerque et al. 2024).

Studies in Patagonia have shown that FFS posses a broad LEK involving soil management (Morales et al. 2023), water (Morales et al. 2020), cultivated and wild plant species (Eyssartier et al. 2009 and 2011; Chamorro and Ladio 2021), and animal production (Reising et al. 2022; Laborda et al. 2023). This vast knowledge has enabled families to cope with successive socio-environmental changes in recent years, such as droughts, volcanic eruptions, wool price changes, and economic crises (Collini et al. 2013; Solano-Hernández et al. 2020; Laborda et al. 2023).

As a case study of FFS in Northern Patagonia, the Free Fair of Family Farmers from Nahuel Huapi (FFAFNH) represents a paradigmatic case. This group of families has been selling their agricultural production surpluses for more than a decade, with the advice of technicians from governmental institutions and researchers (Ladio et al. 2013). In recent years, due to socio-environmental changes, families have faced numerous challenges, and collaboration between farmers and technicians is key to the sustainability of their activities (Ladio et al. 2023). Over the years, technicians have accompanied the FFAFNH, which has allowed its development and growth and helped them face and solve various concerns (Ladio et al. 2023). In particular, in the 2021-2022 season, various economically important crops, such as *Rubus idaeus* L. (raspberry) and *R. ulmifolius* Schott. (blackberry), *Vaccinium corymbosum* L. (blueberry), and *Prunus avium* L. (cherry) were affected by a pronounced drought season and by the prevalence of various harmful organisms.

In this study, we analyzed the LEKHA of members of the FFAFNH. Specifically, we aimed to investigate the nomenclature, characterization, and ecological aspects of HA, the relationship between horticulturists and HA, the affected plant species, the ways of acquiring and transmitting knowledge, and the importance of HA for FFS. In addition, we delve into the management practices of HA. This analysis allowed us to propose categories for the management of HA that can shed light on the subject. Finally, we discuss how these aspects allow us to infer the hybrid character of LEKHA, which articulates traditional knowledge of peasant agriculture with STK.

MATERIAL AND METHODS

Study Area and Characterization of the Nahuel Huapi Family Farmers Free Fair

The FFAFNH, comprising 14 family farmers at present, was established in 2009 through collaborative efforts involving various public institutions, notably the Ethnobiology group from INIBIOMA, of which we are members (Ladio 2011). In its early days, workshops were developed to provide technical assistance and encourage the use of 29 species of edible and medicinal weeds growing in horticulturists' gardens for their sustainable use (Ladio et al. 2013; Ladio et al. 2023). A total of 186 species and 315 local foods have been marketed, accounting for the contribution of this fair to local food sovereignty (Longo Blasón et al. 2022). The working axes of FFAFNH are agroecological production, non-intermediary sales, cooperation, knowledge exchange, and an environmental-friendly life philosophy (Ladio et al. 2023). To cultivate within their premises, they mainly use manual tools, intercropping (crops, aromatic, and ornamental species), and natural fertilizers (Ladio 2011), and make use of greenhouses and microtunnels (for a more complete description see Longo Blasón et al. 2022).

The fair's producers represent a mainly Creole population originating from European immigrants, mainly Spanish, and descendants of native people, such as the Mapuche (INDEC 2022). Their farms are mainly situated in two ecologically differentiated zones, the steppe and the forest, and the transition area between them (Figure 1).

The steppe families correspond to the localities of Corralito and Villa Llanquín, which are circumscribed within the Patagonian steppe ecoregion (Morello et al. 2012), dominated by grassy and shrubby-grassy vegetation. The most important economic activity is extensive sheep farming on natural pastures complemented by horticultural production, especially in the case of families with access to natural water sources (Ocaríz and Ojeda 2018). The locality of Ñirihuau is located in the forest-steppe ecotone.

The representative families of the forest correspond to inhabitants from San Carlos de Bariloche city and the rural setting of El Manso, both within the boundaries of Nahuel Huapi National Park. These sites belong to the Patagonian forest ecoregion (Morello et al. 2012), dominated by *Nothofagus*

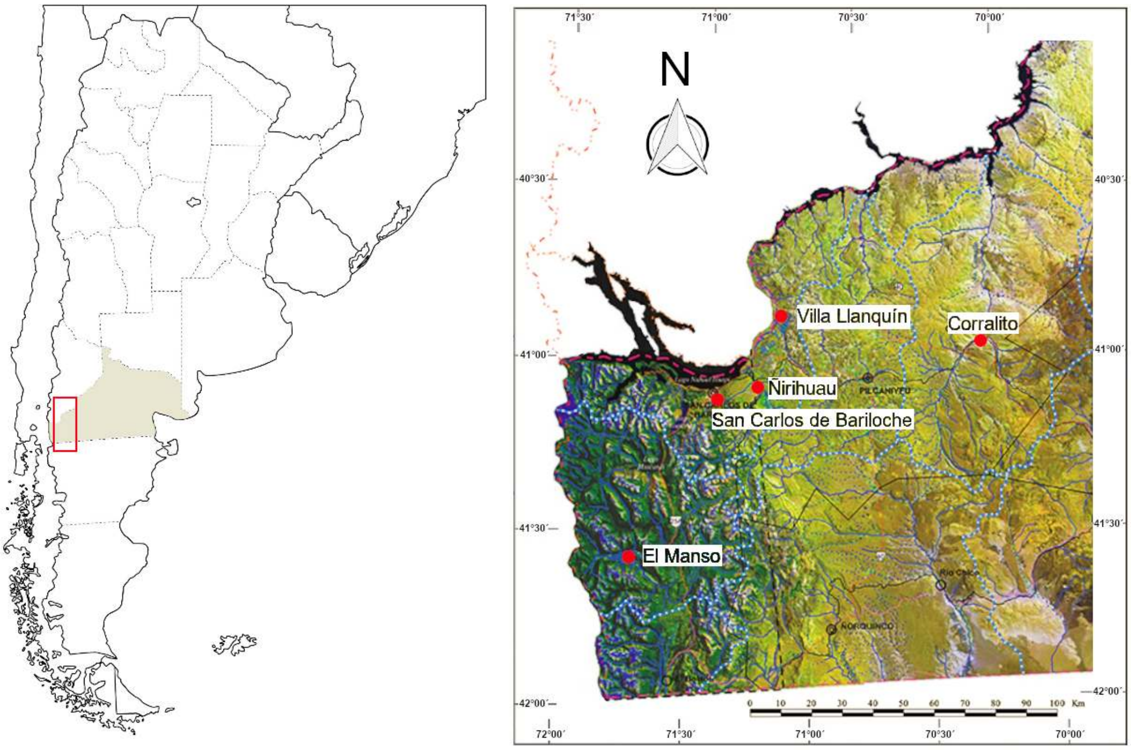

Figure 1. Location of FFAFNH producers' farms attending the workshop.

forests. In San Carlos de Bariloche, the main economic activity is tourism (Rovere 2022), whereas in El Manso, in addition to livestock activity and emerging tourist activity, the benign microclimate of the Manso River valley and access to water sources allows the cultivation of fruit trees and vegetables (Ocaríz and Ojeda 2018).

Field Work

As part of a broader research, visits were made to FFAFNH family farmers during the spring-summer seasons of 2021 and 2022. Free, Prior and Informed Consent (FPIC) was obtained at each meeting, following the guidelines of the International Society for Ethnobiology's Code of Ethics (ISE 2006). These visits included semi-structured interviews and/or tours of production sites with farmers as part of an ongoing crop research not included in this paper. However, these visits allowed us to observe the presence of HA and collect testimonies from the farmers about the increased presence of HA in their crops. In addition, the farmers expressed a need for scientific and technical information to address these issues.

Considering what was observed on the farms and the families' demands, it was proposed that the FFAFNH members hold a participatory workshop on HA. This participatory methodology allows researchers and collaborators to work in a more horizontal way.

Harmful Arthropods Selection

The HA covered in the workshop is the result of a stepwise selection process (Figure 2). In the first stage, 28 harmful organisms were identified during field observations, including arthropods, birds, mammals, and fungi. In the second stage, a literature review of scientific and technical data was carried out, selecting those organisms that were most representative of the area where producers live. These searches were carried out using search engines (Google, Google Scholar), databases (Scopus), and official websites of governmental institutions, such as the National Institute of Agricultural Technology (INTA), the National Agrifood Health and Quality Service (SENASA), and the National Pest Surveillance and Monitoring System (SINAVIMO).

The criteria used for the bibliographic search were identification of the HA (with its scientific name); local literature (country/region), only if not found, works from other regions or neighboring countries were used; technical information on HA (biological cycles, management practices, homemade recipes, etc.); and impact on production, economic income, and cultural importance for the region.

Fifty-seven documents were considered, including technical reports, degree theses, and research

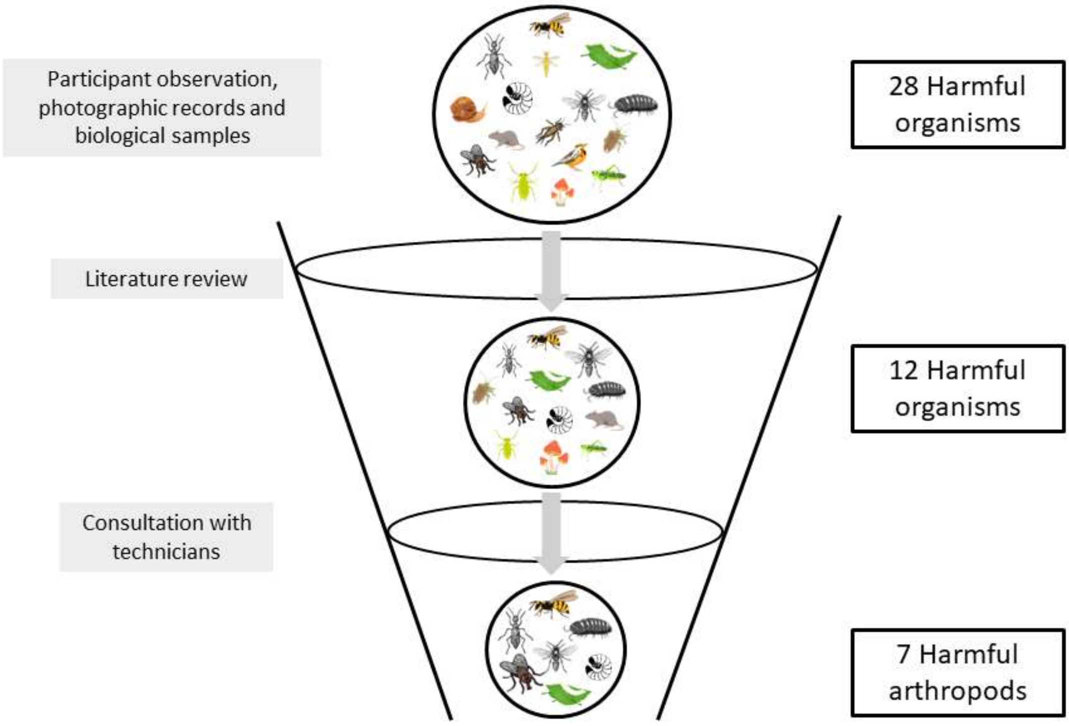

Figure 2. Criteria for the selection of harmful arthropods discussed at the participatory workshop.

and science communication articles. Specialists in the biology and management of HA were consulted (agronomist Claudia Funes, INTA Famaillá Experimental Station, Tucumán; agronomist María S. Mitidieri, INTA San Pedro Experimental Station, Buenos Aires; agronomist Cristian Maldonado, Faculty of Agronomy and Agroindustry, UNSE, Santiago del Estero).

As a result of the literature review and the technicians' answers, 12 HA were selected. These organisms were chosen based on their importance for the study area, the affected crops (i.e., those organisms that harmed crops of importance to the FFAFNH families were considered), and the abundance observed during the visits to the production areas. Based on this selection, agronomist Julio Ojeda (Agricultural Experimental Station INTA San Carlos de Bariloche) was consulted about the most significant HA for FFAFNH producers. He is a local extension technician who has collaborated with the FFAFNH since its beginnings. This interaction led to the final choice of the HA for the workshop (Table 1). Table 1 summarizes the updated information on HA obtained from the literature review.

Table 1. Scientific-technical information derived from the literature review on the 7 most relevant harmful arthropod species of the family farming systems of the Nahuel Huapi Family Farmers' Fair, in San Carlos de Bariloche. Details of references in Supplemental Material.

Local name	Scientific name and Order	Biogeographical origin and age in the region	Crop affected	Harm	Management practices	Reference
Babosita del peral, babosita de los frutales	*Caliroa cerasi* (Linnaeus, 1758), Hymenoptera	Exotic, ≈ ¿?	Fruit trees: pear, sour cherry, cherry, cherry plum, quince, apple and peach (rare). Also observed on rose bushes, *Crataegus*, *Sorbus*, *Cotoneaster* and blackberry.	Larvae consume leaves, leaving veins and lower epidermis. Leaves die, taking on a "dry tree" appearance. Intense attacks stunt growth and reduce fruit set. Attacks over several years can cause general decline and reduced fruiting capacity.	Focus on larval and nymph stages. Use of diatomaceous earth; soil tillage (10-15 cm) under the canopy of the fruit tree.	Raddatz Rosenberg 2004; Bado 2010; Villacide and Masciocchi 2011; Bado 2014
Bicho bolita	*Armadillidium vulgare* (Latreille, 1804), Isopoda	Native	Extensive crops: wheat, soya, maize, alfalfa, rape, sunflower and quinoa. In addition, various species of orchards and gardens.	Cause transverse and longitudinal lesions on seedlings at the hypocotyl level and different degrees of consumption of cotyledons and seeds.	Management of humidity and plant matter (factors that favour their proliferation). Use of diatomaceous earth or potassium soap in affected areas of the orchard.	Saluso 2001; Dughetti 2015; Cibils et al. 2017; Gopar et al. 2018
Carpocapsa, Gusano o polilla de la pera y la manzana	*Cydia pomonella* (Linnaeus, 1758), Lepidoptera	Exotic, ≈ 73 years	Fruit trees: apple, pear, walnut, quince, peach and apricot trees.	The larvae penetrate the fruit, making a gallery in the pulp towards the centre of the fruit. There they feed on the seeds, causing aesthetic damage with loss of fruit quantity and quality.	Thinning, harvesting and removal of attacked fruit (fallen and in the crown). Elimination of larvae with corrugated cardboard strips around the trunk; Encouraging the proliferation of natural enemies by means of flowering species around fruit trees. Sexual confusion systems with pheromones to modify adult behaviour. Release of parasitoids.	Cichón and Fernández 2003; Quintana and Cólica, 2011; Cichón et al. 2013; Bado 2014; López et al. 2019; SENASA 2022; Aubel et al. 2022
Mosca de alas manchadas, Drosófila de alas manchadas, Matsumura	*Drosophila suzukii* (Matsumura, 1931), Diptera	Exotic, ≈ 9 years	Fruit trees: raspberry, strawberry, blueberry, bilberry, blackberry, cherry, peach, plum, nectarine, apricot, persimmon, fig, apple, pear, grape (table or wine), guava, mulberry, kiwi. Wild plants: myrtle, blackberry, elderberry, wild berries, "maqui", murtilla and rosehip.	The larva consumes the fruit pulp, which is decomposed by the larva's damage or by the entry of another organism.	Monitoring and mass trapping of adults. Elimination of weed refuges for adults in diapause. Cleaning of fruit collection sites and tools. Efficient irrigation. Harvesting at optimum time. Pruning of fruit trees. Thinning, harvesting and elimination of attacked fruit (fallen and in the crown).	SAG 2017; De la Vega 2018; Funes et al. 2018; SAG 2021; Devotto 2021
Gorgojo de la papa, Cabrito, Gorgojo del tomate, arrocillo	*Phyrdenus muriceus* (E.F.Germar, 1823), Coleoptera	Native	Vegetables: potato, aubergine, tomato (Solanaceae).	Larvae live in the soil, feeding on roots and tubers, causing perforations and galleries that reduce marketable tuber quality. They can bore into the necks of plants, causing them to break and fall over. In severe infestations, they can even destroy branches, causing flowers and fruit to fall off.	Capture of adults with pitfall traps or vertical cloth. Interruption of adult migration (mechanical barriers). Elimination of spontaneous plants (guachas). Harvesting at optimum time and subsequent ploughing of the field. Healthy planting tools. Storage of seed tubers away from the soil. Crop rotation.	Edelstein and Walter 2014; Cabrera Bellido 2021; SINABIMO 2022

Pilme, Pilme de la papa	*Epicauta pilme* Molina, Coleoptera	Native	Vegetables: potato, tomato, artichoke, chilli, broccoli, asparagus, beetroot, beans, broad beans, carrot, beetroot. Fruit: strawberry. Forage: alfalfa, white and pink clover. Also some weeds.	Adults consume leaves, leaving the midrib visible. In addition, it can cause the foliage to dry out, taking on a burnt appearance due to the abundant black excrement.	Soil management (orchard and surrounding areas) to favour mechanical destruction of eggs and larvae and their exposure to predators and unfavourable environmental conditions. Early sowing (July-August) to decouple flowering from the stages of greatest abundance of the pest. Use of potato varieties with abundant trichomes (mechanical barrier). Elimination of refuge weeds. Pruning and thinning of attacked parts of the plant. Removal of crop residues and stubble. Use of potassium soap.	Lantschner 2016; Vallejo 2020
Chaqueta, Chaqueta amarilla	*Vespula germanica* (Fabricius, 1793), Hymenoptera	Exotic, ≈ 44 years	Damage fruit. In addition, they make harvesting tasks more difficult because of the risk to workers of being stung.	Adult wasps attack fruit to feed on the sugary secretions of the pulp.	Mechanical destruction of nests. Trapping with or without toxic bait.	Estay et al. 2003; Rizzuto 2003; Villacide and Masciocchi 2011; Masciocchi 2018

Participatory Workshop

Farmers from the FFAFNH were invited via instant messaging applications through group and individual chats. A flyer was produced for the workshop, indicating the location, date, title, topic, objectives and approximate duration. The workshop was held at the Instituto de Investigaciones en Biodiversidad y Medioambiente (INIBIOMA, CONICET-UNCo) in the city of San Carlos de Bariloche.

A total of 14 horticulturists attended, accounting for 70% of the active members surveyed in the 2021 season (Longo Blasón et al. 2022). The average age of the participants was 54 years and farmers of both sexes were present. Eight are urban or suburban farmers, from Ñirihuau (1) and San Carlos de Bariloche (7), and six are rural farmers from Corralito (1), Villa Llanquín (1) and El Manso (4). Considering ecological areas, three of them live and produce in the steppe and 11 in the forest.

The workshop consisted of three stages: the first moment of forming discussion groups and debates on two HA each; a second instance of sharing between groups and discussion with the participants as a whole; and finally, an instance of complementation with scientific and technical information. First, the participants were welcomed and thanked for their willingness to participate in the workshop; the working method, scope, and objectives were explained. FPIC was obtained from the film and audio recordings during the event. Groups of three or four members were then formed according to their place of origin (forest or steppe). Photos of two HA were given at random, either of the HA itself and/or of the damaged plants. Each group was also given an audio recorder and the following list of guiding questions: Do you know this harmful arthropod? What do you call it? How do you recognize this? On which plant do you usually it? What damage does it cause? At what time of the year? How long have you had it on your crops? How do you manage it? Who did you learn this form of management from?

It was proposed that, for approximately 20 minutes, each group discuss these questions and record their answers on a flipchart. During this time, the team could answer any queries from the groups.

In the second instance, with an expository dynamic, each group approached the front of the room and shared with the rest of the participants, what had been previously discussed, giving rise to debate among all those present.

In the third instance, the previously discussed information was supplemented by a brief presentation by the authors, as well as by the invited specialist Gerardo De la Vega (INTA-Bariloche), on the STK existing to date on the seven species chosen. The aim of this presentation was to provide them with strategies to mitigate or minimize damage and to establish management criteria. To this end, aspects related to life cycles, biology, feeding habits, favorable conditions for living and dispersing, refugia, and resting areas, as well as the stage of the biological cycle on which it is most appropriate to act, were presented.

In the spirit of providing feedback to our collaborators, we developed a booklet that brings together the main characteristics of each HA and the management practices: those proposed from a scientific-technical point of view and those mentioned by the participants during the workshop. This material was distributed among workshop participants and other members of the communities who required it.

Data Analysis

The information obtained at different stages of the workshop was analyzed qualitatively and quantitatively. The qualitative approach focuses on the analysis of the discourse of workshop participants (Albuquerque et al. 2019). The analysis of the recordings was based on the identification of key testimonies to understand the group's central ideas (Guber 2004). Discourse analysis is based on the fact that individuals who are part of a group share beliefs, values, and social representations; therefore, the analysis of individual discourse reflects the construction of collective thinking. By triangulating the information, we interpreted the different meanings of what the informants said and did in their own words (*emic* categories) (Guber 2004). Fragments of discourse/sayings were selected to make the opinions of the farmers visible. The participants were coded by assigning them the letter P (participant) followed by a number so that each sentence was accompanied by its author.

Based on an analysis of the discourses that emerged in response to the guiding questions, the responses were recategorized in ethical categories. The ethical dimension is based on a generalized classification system that researchers use to compare and analyze human behavior with the aim of finding patterns and regularities that explain it from a scientific point of view (Mostowlansky and Rota 2020). Table 2 shows the variables and ethical categories used to characterize LEKHA. In the analysis of management practices, we have separated "Active" from "Non-active" practices with emphasis on those actions (or omissions of actions) that are based on human decisions. The "Active" category has several levels depending on whether they are preventive (direct or indirect) or curative actions following Morales (2002). The "Non-active" category includes decisions related to tolerance as described by Blancas et al. (2010) for plant species that we will discuss in the results.

The variables in Table 2 were quantitatively analyzed using frequencies and percentages. The proportions of the different categories referring to local names and management practices were analyzed using the 'ggplot2' package (Wickham 2016) and the proportion of LEKHA cultural transmission forms was analyzed using a radar plot with the 'fmsb' package (Nakazawa 2023). Both packages were used in R software version 4.2 (R Core team 2023).

Table 2. Variables and their *ethical* categories used for the analysis of the FFAFNH farmers' discourse on LEKHA.

Variable	Category		Description
Local Name (LN) Local names about HA were registered from the flipchart, group recordings and the exposition. Names were categorised according to linguistic root (Spanish or native). It was also taken into account whether or not the names given were similar to those expressed by the STK and to which they were linked.	Language		Spanish. The linguistic root of the arthropod is derived from the Spanish language. Mapudungun. The linguistic root of the arthropod is derived from the Mapudungun (Mapuche language).
	Associated with		Associated with crops and arthropods. Name of HA is linked to the crop or group of crops it damages and some stage of development of the arthropod (adult, larva, worm, imago, among others). Associated with crop only. Name of HA is linked only to crop or group of crops it affects. No associated
	Name structure		Mononomials. Name registered for HA consists of only one word. Binomials. Registered name of HA consists of two words, excluding articles and connectors. Trinomials. Registered name of HA consists of three words, not including articles and connectors.
Recognising	Morphology		HA morphology. Recognised by aspects of its body, colour and size. Crop morphology. Morphological features are observed on the plant or fruit that show traces of the arthropod.
	Behavioral		The HA is recognised for its avoidance or protective behaviour, in the face of danger or presence of humans.
Time of year	All year		The HA is seen and detected throughout the year, regardless of the time of year.
	Period		The HA is detected in spring-summer, either at the beginning of the production cycle when crops are growing or during harvest times.
Time spent with HA	Recent		The HA was detected and appeared for the first time less than 5 years ago.
	Moderate		The HA was detected and appeared between 5 and 25 years ago.
	Several years		The HA has been known and detected for more than 25 years.
Management practices	Active	Preventive Direct***	Actions carried out by farmers to prevent the occurrence of HA or the increase of their populations. The action is carried out on the arthropod or one of its life stages.
		Preventive Indirect***	Actions taken by farmers to prevent the occurrence of HA or the increase of their populations. This can be done by generating adverse conditions for HA cycle or strengthening the crop, among other practices.
	Non-active (Tolerance)	Healing***	Actions taken by farmers aimed at managing HA once they do major damage.
			Management action is carried out by non-anthropic agents. While there is a human decision, it involves letting natural control cycles occur, this may be through wild animals or climatic conditions.
Acquisition and transmission of knowledge	Idiosyncratic*		Through personal observations or experiences.
	Vertical**		The transmission of knowledge is between members of different generations within the family nucleus. One-to-many.
	Horizontal**		Transmission of knowledge is between members of the same generation within or outside the nuclear family. One to a few.
	Oblique**		Transmission knowledge takes place between members of different generations outside the family nucleus. From one to many or from many to some.

*Benz et al. 1994 and 2000; Lozada et al. 2004; **Cavalli-Sforza et al. 1982; ***Morales 2002

RESULTS AND DISCUSSION

Local Ecological Knowledge About Harmful Arthropods and its Different Attributes

Nomenclature of HA

Farmers assigned local names to the seven HA and registered 15 local names (Table 1). The names that people give to HA allow them to classify them and convey meanings and distinctions (Charmaz 2006). The importance of communities naming the components of nature is that it allows them to better identify and understand the environment and its components (Juárez et al. 2019).

Regarding the name languages, 13 are in Spanish and 2 in Mapudungun (Mapuche language), both referring to the same HA, *Epicauta pilme* Molina, commonly known as "pilme" or "pilque" (Figure 3). This coleopteran damages potatoes, one of the most traditional crops in Patagonia, and its center of origin has been suggested for the region (Ladio 2006). The long horticultural tradition of potatoes is a key element for the knowledge of its main HA, and for this reason, its name in the original language would have been maintained. In addition, the pilme is considered an important arthropod that affected crops and agricultural systems, even before its entomological description in 1782 (Durán 1986). Its name comes from the Mapuche "pülmi", which, according to the first mention by Jesuit chroniclers, describes it as a "black fly" (Villena Arraya 2017). These first descriptions date back to 1765, when it was described as a voracious insect that fed on plants in orchards (Sánchez Cabezas 2010) and potato plants (Catrileo Chiguailaf 2021).

Name association

The HA names used by farmers are associated with different elements: the crop and the arthropod, only the crops, or neither (Figure 3). Of the names showing an association, most were related to the affected crop and arthropods. For example: "potato maggot", "apple maggot" and "fruit fly". Epithets linked only to the affected crop are also observed in the names, e.g. "potato bug." This implies that names identifying HA have a strong utilitarian (Berlin 1990) or mnemonic character (Zamudio and Hilgert 2012). Similar results on the local names given to HA in productive spaces were recorded in Tsolsil communities in México (López de la Cruz et al. 2018), where the HA names were linked to the harmed crops or to HA's features of HA.

Name structure

The local name structure of HA comprises nine binomial, five mononomial, and one trinomial forms (Figure 3). The binomial form was recorded in various studies conducted in rural communities in Argentina and Chile, where animals and plants had names with two epithets, generally nouns, referring to their quality or perception. These include the work of Villagrán et al. (1999), who explored the Mapuche nomenclature of animals and plants; that of Suárez (2020) on plant nomenclature in Wichis communities in the Chaqueña region (Argentina); and those of Zamudio and Hilgert (2012 and 2015), who worked with the nomenclature of stingless bees in Misiones (Argentina). Binomial nomenclature is often used among groups with morphologically similar individuals, incorporating mnemonic elements referring to distinctive features (Begossi et al. 2008), such as affected plants, arthropods, or damaging stages. An example of this is "potato worm", a name that includes the epithet "worm" refering to the stage of the arthropod observed in the crop and producing damage, and the word "potato" refering to the affected plant.

Mononomial names tend to be less explanatory and are generally used to describe organisms of groups with markedly different morphologies (Begossi et al. 2008), or that are well known and have high community agreement (Zamudio and Hilgert 2015). As an example of the first option, our results highlight the "jacket", a wasp species easily recognized and distinguished from other wasps in the region by the arrangement of black and yellow bands on the abdomen. As an example of a HA of great nomenclatural agreement among the members of the fair, we find the "pilme" or the "suzukii," both HA of high prevalence in production systems.

Recognition of HA

All HA were recognized by local producers. Different criteria are used for recognition, including the assignment of a name and characterization according to various aspects of the arthropod, elements associated with the arthropod, or the damaged plant. The use of multidimensional criteria was also observed in the recognition of stingless bees by Creoles in Misiones, Argentina (Zamudio and Hilgert 2012; 2015). Thirteen mentions were identified regarding characteristics used for recognition, grouped into morphological attributes of the organism (five mentions), morphological attributes of the damage (six mentions), and behavioral attributes (two mentions). These results agree with those of other ethnobiological studies from Argentina, where the recognition of organisms is mainly based on morphological attributes, including arthropods (Zamudio and Hilgert 2012; 2015), plants

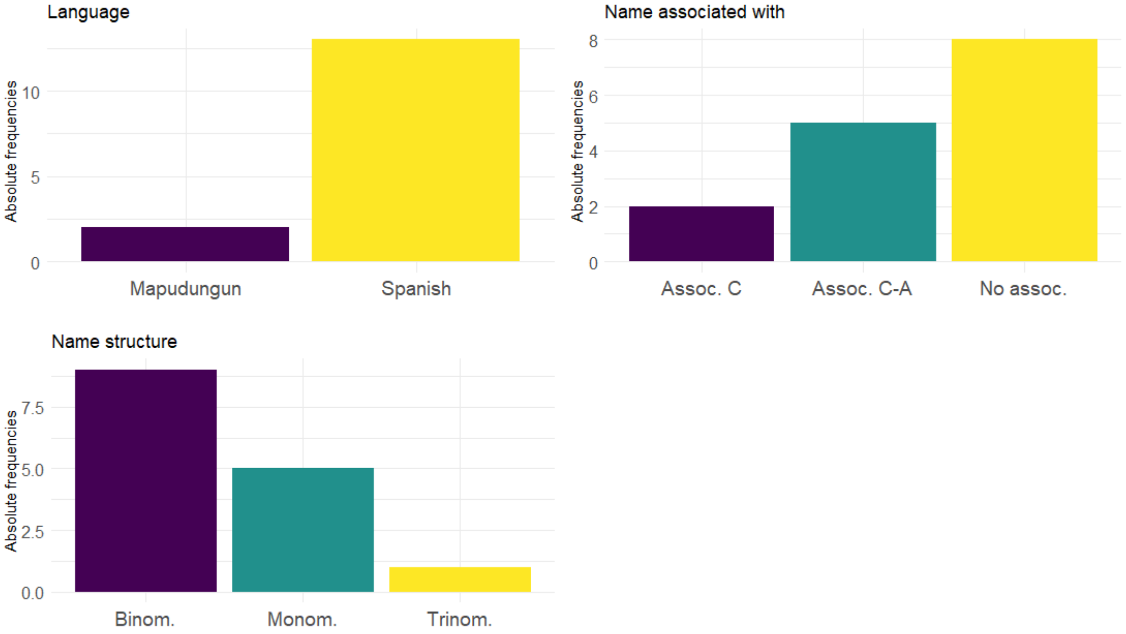

Figure 3. Absolute frequencies of local names categories (LN) given to the HA. Language: Mapudungun or Spanish; Assoc. C = name associated with crop; Assoc.C-A = name associated with crop and arthropod; No assoc. = no associated; Trinom. = trinomial; Monom. = mononomial; Binom. = binomial.

(Suárez 2020), animals (Villagrán et al. 1999; Ibarra et al. 2023) and soils (Morales et al. 2023) are recognized.

Species affected and damage

HA were found to be detrimental to 17 plant species and 5 plant groups. Among the latter, "sweet fruits", "red fruits", "fine fruits", "tree fruits" and "tender vegetables". From personal pre-field interviews and visits to farms, we know that these plant groups refer to sets of species. Among the fine, sweet, or red fruits, blackberry (*Rubus ulmifolius* Schott.), strawberry (*Fragaria × ananassa* Duchesne ex Rozier), and raspberry (*Rubus idaeus* L.). Tree fruits: plum (*Prunus domestica* L.), apple (*Malus domestica* (Suckow) Borkh.), elderberry (*Sambucus nigra* L.) and walnut (*Juglans regia* L.). Among the tender vegetables, chard (*Beta vulgaris* L. var. *cicla*), cabbage (*Brassica oleracea* L. var. *capitata*), lettuce (*Lactuca sativa* L.) and pumpkins (*Cucurbita* spp.). HA include some arthropods affecting fruit crops and other damaging leafy crops or other edible parts.

Types of damage

During the group discussions, 10 mentions were recorded regarding the types of damage caused to the crops. Of these, 40% of HA cause general damage and 60% cause specific damage to plants. General damage includes "*damages production*", and specific damage includes "*eats leaves*", "*destroys fruit*", "*eats shoots*" and "*eats potatoes*". The higher percentage of citing specific damage accounts for the precise knowledge about the effects of HA on their production, knowledge that comes from daily observations of the plants, and the environment of their orchards.

In this sense, there are detailed descriptions of damage, such as that caused by worms in potatoes: "*when you start to break the potato, it is all drilled*"; or damage to the leaf blades and the physiological consequences of this "*affects the process of photosynthesis, and because it affects photosynthesis, the plant cannot make its own food*" (P2). These testimonies reinforce the idea of dynamism and flexibility of LEKHA, which, in the face of contact with other knowledge systems, incorporates new concepts and creates an accumulation of hybrid knowledge (Aswani et al. 2018). These processes of hybridization and the incorporation of other sources of knowledge allow farmers to engage in dialogue with technicians in an assertive manner and seek solutions that include alternative points of view (Ladio and Albuquerque 2014).

Time spent with HA

Most of the HA selected for the workshop had long been cohabiting with farmers (60%). This is followed by HA, that have recently arrived (28%), and HA that has lived with them for an intermediate period (12%).

The "pilme" and the "bicho bolita" were classified by the producers as "endemic" due to the years of its presence in the region. This perception regarding the age of occurrence and coexistence is reflected in the studies and data provided by STK (Table 2). We can mention the "Suzukii" fly among the second most recently emerged, and the "Jacket" wasp among the intermediate ones. According to the data provided by the STK, the Suzukii fly is the most recent fly to enter the Argentine Patagonian region, possibly via Chile, and was first recorded in 2013 in Valparaíso (Funes et al. 2018). Similarly, *Vespula germanica* was estimated to have entered Argentina in 1980 from adjacent Chilean regions (Masciocchi 2013). For the other HA, literature shows a historical interaction between arthropods and local inhabitants of the region (Table 2).

Ladio (2011) suggested that the more time people interact with species, the more knowledge they acquire about them, compared to more recent ones. Most of the HA chosen for this workshop have been living with farmers for a long time, who have recognized specific attack habits and detailed behaviors. For example, for the pilme: "… *in one night they strip off the plant…* [In one night they attack the plant and produce complete defoliation] *the plant turns black* [due to the number of insects that are black in color], *they leave it bare*' (P5).

Of the species treated in the workshop, farmers detected HA present throughout the year (e.g., Suzukii, Woodlouse, Jacket), and others were observed only in spring-summer, either during crop development (e.g., Woodlouse, Pear slug, apple worm, potato worm, and pilme) or during harvest (e.g., Suzukii, Potato worm). These results suggest that HA monitoring involves a constant and dynamic task, as the emergence of new organisms and adaptation of existing organisms can change the dynamics of production systems. Such constant monitoring is one of the most recommended practices in agricultural, livestock, forestry and beekeeping production systems (Poggi 2018, Céspedes et al. 2023).

Management practices

Fourteen HA management practices were recorded, the majority of which were active (71%). These practices are preventive in 57% of cases and, to a lesser extent, curative (14%). The rest of the practices corresponded to the non-active category (29%) linked to tolerance practices (Figure 4). Practices were specified for each individual, except in the case of the "pear slug".

Among the preventive practices, half correspond to direct preventive practices (the use of bait traps, 25%), and to a lesser extent to biological control with chickens and the "Pilme scare" (Figure 4). Similarly, Indirect preventive practices include sowing in seedbeds, weeding, conditioning of productive spaces, postharvest practices, and early sowing (Figure 4). Among curative practices is manual control and the use of organic insecticides (Figure 4).

The implementation of bait traps relies on plastic bottles selected for their structure and shape, as specified by the target HA. Generally, traps have entrance holes and an attractant substance. These practices are carried out for Suzukii and yellow jackets. Another direct practice is the "Pilme scare" (Figure 4), where "pilme" adults are tied from the region between the head and thorax, and by binding together several individuals, a kind of collar or garland is formed. This is done because the insects "*shout, they communicate with each other, and say: I am tied up, don't come here*" (P7); that is, they warn others that it is not a good feeding zone. This practice of leaving samples or warnings is also used in other communities to scare away pumas, foxes (Castillo and Ladio 2018) and snakes (Ibarra et al. 2023).

According to our results, the use of natural enemies can be a direct preventive or curative strategy. In the case of a preventive practice, it implies the release of chickens within the orchards once the land is ploughed. However, chickens can also be used once HA has greatly increased in abundance and causes great harm to the affected crops, with the aim of preventing HA from disturbing other crops. This type of practice is quite common among the FFS of Argentina (Eyssartier et al. 2008 and 2011; Paleólogos and Flores 2014), Mexico (Morales et al. 2010), Guatemala (Morales and Perfecto 2000), and tropical zones (Morales 2002), and India (Rathore et al. 2021). In general, they are multipurpose management practices (for example, the management of HA and nutrient cycling) that are common among rural communities, helping agricultural production and the livelihoods of the inhabitants (Kremen et al. 2012).

Within indirect preventive practices, sowing in a seedbed implies seeds germinating in a substrate and place different from where the plant will later develop, flourish, and bear fruits. Raising it from the ground implies that the seeds and seedlings are protected from possible HA. Weeding and conditioning of productive spaces are important, as they eliminate or reduce factors favoring HA development, such as vegetation, waste, humidity, temperature, and lighting, among others (FAO 2024).

As an indirect preventive practice, early sowing implies a lag between the development of the crop and the appearance of HA. In agricultural settings, where farming families reside and cultivate crops, this practice can pose a risk of losses due to summer frosts. According to INTA records (2024), in December (2023)

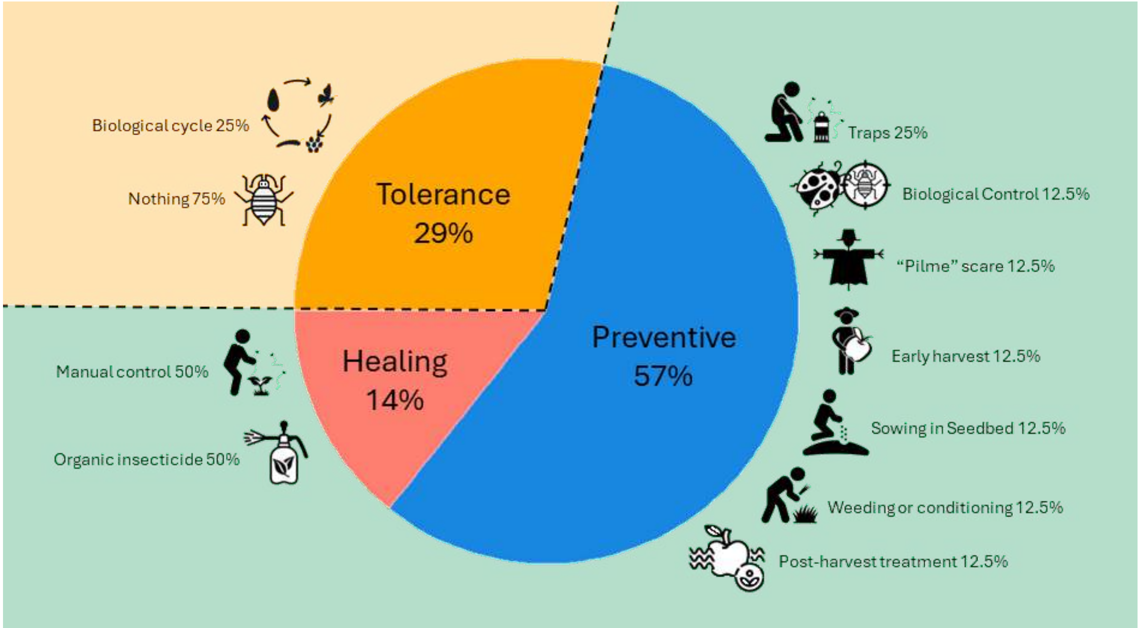

Figure 4. Frequency of management practices performed on harmful arthropods. With a green background, active practices and with an orange background, Non-active practices.

and January (2024), there were three episodes of frost in El Manso.

Finally, post-harvest practices also involve farmers' efforts to prevent harm from HA. For example, in the case of fine fruit attacked by the fruit fly, farmers emphasize care during storage. Not taking this into consideration can have serious consequences, as observed in this statement: "*Yes, it also happened to me with the harvest, you see? and I said 'I'm not going to clean it'. The next day I go to see it and it was just full of worms. I had to throw everything away*" (P6). The problems of fruit and seed preservation and storage are common among the Creole rural communities of central Argentina, who use in their "pirhuas" or "trojas" (storage structures of various dimensions and shapes) plants such as *Dysphania ambrosioides*, *Atamisquea emarginata*, *Flaveria bidentis* to ward off insects that cause damage (Navarrete 2021). These include corn grains (*Zea mays*) and cucurbit fruits (García 2014; Bravo Miaña 2018; Navarrete 2021). In the construction of "trojas", successive layers of the crop or fruit are arranged, interspersed with fresh branches or leaves, or ashes from repellent plants are used. This perception of HA linked to their impact on production and storage was also observed in the Tharu farming communities of Nepal (Gurung 2003).

The use of preventive HA management practices should be recognized as a good management strategy in agricultural systems (Morales and Perfecto 2000; Morales 2002). Studies show that preventive practices against HA are the most prevalent in family farming systems. This is the case in tropical agroforestry systems (Morales 2002; Morales et al. 2010), among farmers in the district of Bageshwar, Uttarakhand, India (Rathore et al. 2021). Prevention implies the anticipation of harmful events, generally based on the LEK of families who have been able to learn from previous experiences, their own or others', to secure their production from possible risks (Morales 2002). Adaptive management is key to fostering resilience processes and minimizing the impact of future adverse situations.

Among the curative practices, manual control of adults involves crushing them by hand while walking through the productive space or pulling out weeds. This is a time-consuming practice and is performed as a complement to other activities. Organic products are also used to affect HA. These products are sprinkled among crops, either directly on the HA or in the areas where they usually are. Curative practices are important because they allow repairing the damage and partial restoration of the affected crop. In studies on gardeners in three coastal counties in California (United States), the authors observed curative practices carried out by people with little time dedicated to monitoring their gardens (Liere et al. 2020).

Finally, we found that almost one-third of the practices were non-active and linked to tolerance. These involve directly tolerating HA by allowing natural cycles to occur in the field. According to the testimonies, this is the case when wild birds (*Vanellus chilensis* "southern lapwing" and *Enicognathus ferrugineus* "parrots") are allowed to feed on the fruits or insects associated with these fruits, and environmental changes occur with temperature. In response to the question, '*What to do to solve the presence of HA?*' we have answers like: "*Ehhhh parrots, with the parrots* [referring to *Enicognathus ferrugineus*, which descend in autumn-winter from the mountains to lower areas to feed]" (P2), "*Let nature take care of it*" (P3), "*It must be because of the cold that there are no bugs* [the cold decreases the abundance of insects]" (P4). This indicates that the conceptions of horticulturists would be associated with allowing processes that are not necessarily immediate but respond to the times of natural cycles. This happens in productive spaces where temporality plays an important role in sowing, cultivation, harvest, and other activities; therefore, letting the HA be controlled by natural processes implies coexistence. This practice is applied to the "codling moth": fruits that fall to the ground and contain worms are left to be consumed by chickens (*Gallus gallus domestius*) and parrots. In addition, southern lapwing is often seen in the larvae of fallen fruits.

According to Blancas et al. (2010) and Chamorro and Ladio (2021), tolerance implies leaving, for example, plant species (generally wild) standing in productive spaces, because they constitute important elements for their sovereignty and culture. These are species that are especially safeguarded despite the landscape modifications implied by agricultural activity. In the FFAFNH case, HA are "left standing" on the farmers' premises as it's anticipated that various ecological and environmental interactions will naturally regulate their abundance. This appears to include two dimensions. On the one hand, "tolerate" the HA without active actions towards them, and on the other hand, "tolerate or not interrupt" natural processes such as predation, or the climate controlling action (for example by frosts). This type of management practice should be studied in greater depth in future studies, but it seems to be associated with deep knowledge and respect for natural cycles and co-existence with other animals. These biocentric paradigms have been described in the Mapuche and Creole communities of Patagonia for the management of different elements of nature (Ladio and Molares 2017), so these practices have a local root.

Tolerance practices are carried out by some farmers for a particular HA; however, other can manage the same HA differently. For example, in the case of "woodlouse," some farmers may tolerate it, but others carry out manual actions or conditioning of the cultivation site; another example is the "pilme," for which there is manual control and tolerance.

Acquisition and Transmission of Knowledge Associated with HA

Regarding LEKHA transmission (Figure 5), the idiosyncratic and oblique pathways were the most frequent (35% each). Examples of idiosyncratic acquisition are: "*we learned from observation*" (P2); "*I don't know, we learned to see it*" (P5); from life experience "*Own experience*" (P6); "*from living in Bariloche*" (P7); "*the hard way*" (P10); and "*own knowledge*" (P11). Examples of oblique are reading or searching for audiovisual material "*brochures*" (P12); "*documentaries*"; "*technicians*" (P1);" (P14); "*WhatsApp group*" (P14). Horizontal transmission (30%) occurs when interacting with farmers from the area or the fair "*word of mouth*" (P3); "*The Jujeña* [friend from Jujuy province] *told me...*" (P4); "*we teach each other*" (P8); "*asking*" (P3); "*exchanging talks*" (P9); "*knowledge of a partner*" (P13).

In addition to these ways of knowledge transmission, farmers express difficulties when referring to the management of some HA with LEK acquired up to that moment. At this stage, they appeal to technicians: '*we don't know how to handle them, that's why we came to the workshop*' (P9).

Our findings are similar to other ethnobiological studies carried out in productive systems in Argentina. In Creoles communities in Misiones (Argentina), where stingless bees are managed, the forms of knowledge transmission and acquisition that predominate are idiosyncratic, horizontal, and vertical (Zamudio and Hilgert 2012). In beekeeping systems in northern Argentina, the predominant forms of knowledge acquisition and transmission are idiosyncratic and oblique (Céspedes et al. 2023). In FFS of Patagonia, the transmission of knowledge about plants in the FFS of Patagonia records a high proportion of vertical transmissions (Ladio and Lozada 2004; Lozada et al. 2006; Eyssartier et al. 2008 and 2011). This is the first work carried out on the processes of transmission and acquisition of knowledge linked to HA, accounting for the fact that learning pathways about different components of nature can follow different ways, even in culturally similar societies.

The fair has been a space with a strong presence of government institutions, which could explain the relevance of the oblique pathway to knowledge about HA. Horizontal transmission accounts for the functioning and circulation of information within the collective of farmers. In this sense, Ladio et al. (2023) highlighted connectivity among farmers as a key foundation for learning. On the other hand, oblique transmission and idiosyncratic learning are methods with a strong adaptive element that allow societies to learn new things and develop more resilient responses to environmental changes (Lozada et al. 2006; Reyes García

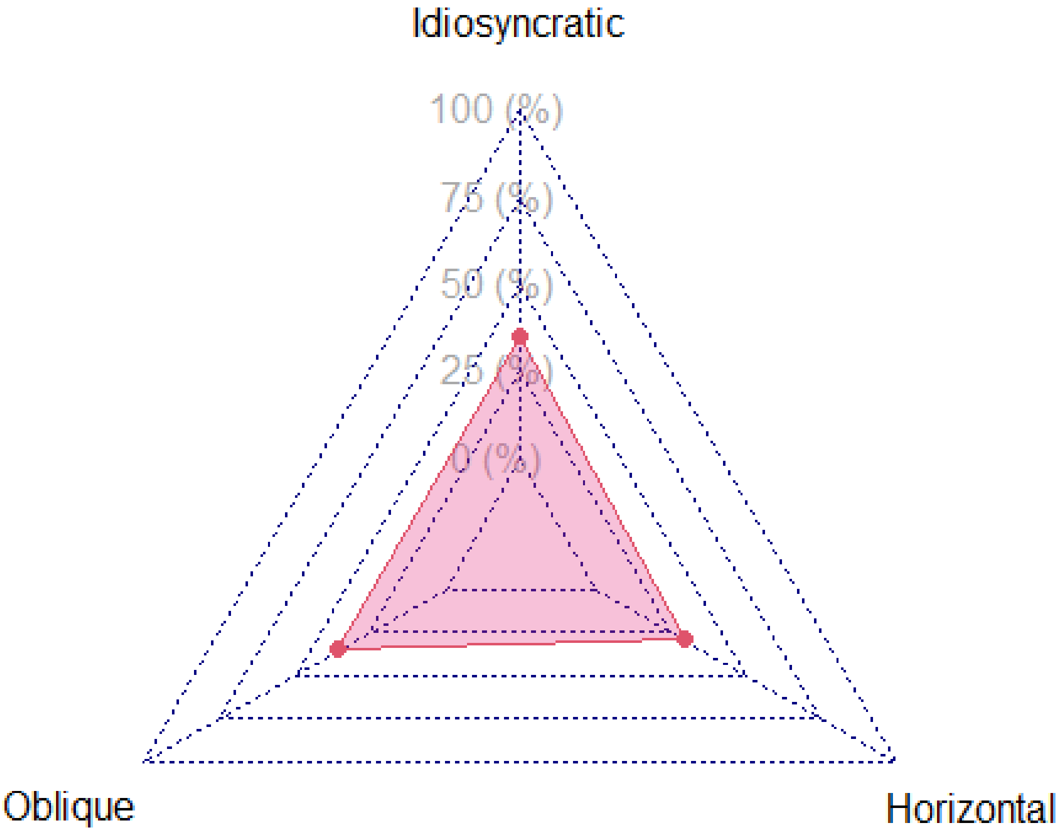

Figure 5. Social forms of LEKHA transmission.

2009; Ladio 2017; Céspedes et al. 2023).

Numerous studies of FFS show that farmers learn substantially about their environment by having a continuous opportunity to "observe", work with the land and their crops, interact with their peers, having the opportunity to learn and teach "by doing" (Lozada et al. 2006; Céspedes et al. 2023), in the process of dialogue and feedback (Eyssartier et al. 2008). In agreement with Truskanov and Prat (2018), we observed that when idiosyncratic learning is active, the adjustment to changes can be more appropriate, which would allow reducing vulnerability to socio-environmental phenomena.

Integration of Knowledge

During the second stage of the workshop, a reinforcement and self-validation of the LEKHA took place, where a dialogue of knowledge was established, back and forth with the STK. The experience began with the exposure of different groups in front of the room and sharing with their colleagues. They showed photos of the assigned arthropods and their poster, which answered the guiding questions. At this stage, each group socialized what they built from the LEK and a dialogue between the different social actors, horticulturists, and STK staff. During the debate, life experiences, management methods, and names emerged, nourishing diverse views.

CONCLUSION

This case study shows some distinctive elements of LEK about seven HA. These animals are known to farmers, especially for their morphological and behavioral characteristics. There is a range of practices, mainly preventive, for their management. The LEKHA seems to have been learned mainly by peers and technicians, a fact experienced in the workshop where hybridization and flexibility in the incorporation of knowledge could be noticed, and its importance for local development agendas.

The importance of including LEK in the management of HA is highlighted as it can provide useful and relevant information for the development of effective local management strategies. For example, considering local sowing calendars, considering the crops and plants importance to families, including the LEK regarding forms of recognition, (re)using practices already known by families for the management of other HA and promoting practices related to the ways of life and production of farmers. For this, scientists could adopt a position of dialogue, making the LEK and STK continue to intersect and provide solutions. Enhancing interactions with rural communities is essential when seeking solutions to environmental and food-related issues (Alemán Santillán 2022).

In the management of HA among the horticulturists of the FFAFNH, the agroecological logic of "coexist, manage and maintain" is shown, as long as there are no major economic damages (Paleólogos and Flores 2014). Linked to this logic, we observed a particular form of linkage with HA tolerance. Tolerance in our case does not have implications for the domestication of plants or animals, as was suggested by Casas et al. (1997). In our results, tolerance implies letting natural processes function, such as herbivory, biological cycles, competition, predation, and nutrient cycling.

The LEK and local practices of HA management in the FFS allow us to observe the importance and ways of linking farmers and other components of nature, which can be harmful. However, they are tolerated or managed in such a way that the functioning of natural processes is sought in harmony with their knowledge, ways of life, and production.

ACKNOWLEDGMENT

We deeply thank all the people of the fair who have providedus with their knowledge and time for the development of this and other works for many years. The first author thanks the accompaniment, support, and contributions of the entire working group that made this manuscript possible. The authors thank the Institute of Research in Biodiversity and Environment for providing us with space for editing the workshop. We thank the National Council for Scientific and Technical Research (CONICET) for providing resources to develop scientific and technical activities. This investigation was also supported by the Agencia Nacional de Promoción de la Investigación, el Desarrollo Tecnológico y la Innovación (PICT 2022).

DATA AVAILABILITY

The data used to support the findings of this study are available from the corresponding author upon reasonable request.

CONFLICT OF INTEREST

There is no conflict of interest.

CONTRIBUTION STATEMENT

Conceived of the presented idea: AL
Carried out the Workshop: PAG, FNC, CRL, MSLB and AL
Carried out the data analysis: PAG, FNC and AL
Wrote the first draft of the manuscript: PAG
Review and final writing of the manuscript: PAG, AL, CRL, MSLB, and FNC
Supervision: AL

REFERENCES

Albuquerque UP, Farias Paiva de Lucena R, Fernandes Cruz da Cunha LV, Alves RRN (2019) **Methods and Techniques in Ethnobiology and Ethnoecology**. 2 ed. Springer, New York, USA. doi: 10.1007/978-1-4939-8919-5.

Albuquerque UP, Alves RRN, do Carmo RFR (2024) **Is there a neocolonial stance in ethnobiology?** *Ethnobiology and Conservation* 13. doi: 10.15451/ec2024-01-13.06-1-4.

Alemán Santillán T (2022) **Agricultura campesina...¿Ecología sin ciencia?** *Etnobiología* 20: 142-154.

Altieri MA (1993) **Ethnoscience and biodiversity: key elements in the design of sustainable pest management systems for small farmers in developing countries**. *Agriculture, Ecosystems & Environment* 46. doi: 10.1016/0167-8809(93)90029-O.

Aswani S, Lemahieu A, Sauer WHH (2018) **Global trends of local ecological knowledge and future implications**. *PLoS ONE* 13: e0195440. doi: 10.1371/journal.pone.0195440.

Balbi EI, Defagot MAV, Gadban LC (2022) **Herramientas de control cultural para el manejo de artrópodos plaga en agricultura extensiva**. EEA Marcos Juárez, INTA. [.2cm
Barzman M, Bàrberi P, Birch ANE, Boonekamp P, Dachbrodt-Saaydeh S, Graf B, Hommel B, Jensen JE, Kiss J, Kudsk P, Lamichhane JR, Messéan A, Moonen AC, Ratnadass A, Ricci P, Sarah JL, Sattin M (2015) **Eight principles of integrated pest management**. *Agronomy for sustainable development* 35. doi: 10.1007/s13593-015-0327-9.

Begossi A, Clauzet M, Figueiredo JLD, Garuana L, Lima RV, Lopes PF, Ramires M, Silva AL, Silvano RA (2008) **Are biological species and higher-ranking categories real? Fish folk taxonomy on Brazil's Atlantic Forest Coast and in the Amazon**. *Current Anthropology* 49. doi: 10.1086/527437.

Belmain SR, Tembo Y, Mkindi AG, Arnold SE, Stevenson PC (2022) **Elements of agroecological pest and disease management**. *Elementa Science of the Anthropocene* 10. doi: 10.1525/elementa.2021.00099.

Benz BF, Cevallos J, Santana F, Rosales J, Graf S (2000) **Losing knowledge about plant use in the Sierra de Manantlan biosphere reserve, Mexico**. *Economic Botany* 54. doi 10.1007/BF02907821.

Benz BF, Santana F, Pineda R, Cevallos J, Robles L, Niz D (1994) **Characterization of Meztizo plant use in the Sierra de Manantlan, Jalisco-Colima, México.** *Journal of Ethnobiology* 14: 23–41.

Berlin B (1990) **The chicken and the egg-head revisited: further evidence for the intellectualist bases of ethnobiological classification**. *Ethnobiology: implications and applications* 1: 19-33.

Birgi JA, Peri PL, Ceconello MM, Gargaglione VB (2020) **La Agricultura familiar en Santa Cruz, Patagonia Argentina: Caracterización de los núcleos agrícolas familiares**. *Informes Científicos Técnicos-UNPA* 12. http://doi.org/10.22305/ict-unpa.v12.n2.730.

Blancas J, Casas A, Rangel-Landa S, Moreno-Calles A, Torres I, Pérez-Negrón E, Solís L, Delgado-Lemus A, Parra F, Arellanes Y, Caballero J, Cortés L, Lira R, Dávila P (2010) **Plant management in the tehuacán-cuicatlán Valley, Mexico**. *Economic Botany* 64. doi: 10.1007/s12231-010-9133-0.

Blondeau S, Korzenszky A (2022) **Agricultura Familiar**. Nota de orientación jurídica 8. Roma, FAO. doi: 10.4060/cb8227es.

Bravo Miaña HE (2018) **Prácticas tradicionales de almacenamiento de los productos del cerco en el Departamento Figueroa de la provincia de Santiago del Estero**. Tesis de Grado. Facultad de Agronomía y Agroindustrias, Universidad Nacional de Santiago del Estero. 45 pp.

Casas A, Caballero J, Mapes C, Zarate S (1997) **Manejo de la vegetación y domesticación de plantas y origen de la agricultura en Mesoamérica**. *Boletín de la Sociedad Botánica de México* 61. doi: 10.17129/botsci.1537.

Castillo L, Ladio AH (2018) **Mammals and birds as ethno-indicators of change: their importance to livestock farmers in Arid Patagonia (Argentina)**. *Environment, Development and Sustainability* 20. doi: 10.1007/s10668-017-9983-z.

Catrileo Chiguailaf M (2021) **Diccionario Lingüístico-Etnográfico de la Lengua Mapuche**. 1 ed. AUACh, UNRN y EDUVIM. Viedma, Argentina.

Cavalli-Sforza LL, Feldman MW, Chen KH, Dornbusch SM (1982) **Theory and observation in cultural transmission**. *Science* 218. doi: 10.1126/science.7123211.

Céspedes FN, Grimaldi PA, Ladio AH (2023) **Between flowers, humans, and honeybees: Local ecological knowledge associated with apiculture in two areas of Silípica department, Santiago del Estero, Argentina**. *Elementa: Science of the Anthropocene* 11. doi: 10.1525/elementa.2023.00009.

Chamorro MF, Ladio AH (2021) **Management of native and exotic plant species with edible fruits in a rural community in a protected area of NW Patagonia**. *Ethnobiology and Conservation* 10. doi: 10.15451/ec2021-02-10.14-1-24.

Charmaz K (2006) **The power of names**. *Journal of Contemporary Ethnography* 35. doi: 10.1177/0891241606286.

Collini E, Osores MS, Folch A, Viramonte JG, Villarosa G, Salmuni G (2013) **Volcanic ash forecast during the June 2011 Cordon Caulle eruption**. *Natural Hazards* 66. doi: 10.1007/s11069-012-0492-y.

Delgado Burgoa F, Silvestre Rojas CA, Montecinos Llerena DA, Céspedes Quiroga M (2021) **Avances Teóricos Metodológicos y Experiencias de Diálogo Intercientifico en Países Andino Amazónicos**. Ministerio de Educación, La Paz, Bolivia.

Durán LM (1986) **El "Pilme" o "Padrecito", Epicauta pilme Molina (Coleoptera: Meloidae), observaciones sobre su metamorfosis**. *Revista Chilena Entomología* 13: 7-11.

Eyssartier C, Ladio AH, Lozada M (2008) **Cultural transmission of traditional knowledge in two populations of north-western Patagonia**. *Journal of Ethnobiology and Ethnomedicine* 4. doi: 10.1186/1746-4269-4-25.

Eyssartier C, Ladio AH, Lozada M (2009) **Uso de plantas medicinales cultivadas en una comunidad semi-rural de la estepa patagónica**. *Boletín Latinoamericano y del caribe de plantas medicinales y aromáticas* 8: 77-85.

Eyssartier C, Ladio AH, Lozada M (2011) **Traditional horticultural knowledge change in a rural population of the Patagonian steppe**. *Journal of Arid Environments* 75. doi:

10.1016/j.jaridenv.2010.09.006.

FAO (2024) Food and Agriculture Organization. **Manejo integrado de plagas y plaguicidas**. [`https://www.fao.org/pest-and-pesticide-management/ipm/principles-and-practices/es/`] Accessed 04 may 2023.

Funes CF, Kirschbaum DS, Escobar LI, Heredia AM (2018) **La mosca de las alas manchadas, Drosophila suzukii (Matsamura). Nueva plaga de las frutas finas en Argentina.** 1 ed. INTA, Famailla-Tucumán, Argentina.

Furlan V, Jiménez-Escobar ND, Zamudio F, Medrano C (2020) **"Ethnobiological equivocation" and other misunderstandings in the interpretation of natures**. *Studies in History and Philosophy of Science Part C: Studies in History and Philosophy of Biological and Biomedical Sciences* 84. doi: 10.1016/j.shpsc.2020.101333.

García P (2014) **Conocimiento y conservación de semillas agrícolas originarias cultivadas por familias campesinas en el Salado Centro, Santiago del Estero**. Tesina de grado. Facultad de Ciencias Forestales, Universidad Nacional de Santiago del Estero. 90 pp.

Guber R (2004) **El salvaje metropolitano. Reconstrucción del conocimiento social en el trabajo de campo**. Paidós, Barcelona, Spain.

Gurung AB (2003) **Insects–a mistake in God's creation? Tharu farmers' perception and knowledge of insects: A case study of Gobardiha Village Development Committee, Dang-Deukhuri, Nepal**. *Agriculture and Human Values* 20. doi: 10.1023/B:AHUM.0000005149.30242.7f.

Haverkort B, Delgado Burgoa F, Shankar D, Millar D (2012) **Towards Cocreation of Sciences: Building on the Plurality of Worldviews, Values and Methods in Different Knowledge Communities**. Nimby Books, New Delhi, India. doi: 10.18733/C3Z30S.

Heeb L, Jenner E, Cock MJ (2019) **Climate-smart pest management: building resilience of farms and landscapes to changing pest threats**. *Journal of pest science* 92. doi: 10.1007/s10340-019-01083-y.

Hewlett BS, Cavalli-Sforza LL (1986) **Cultural transmission among Aka Pygmies**. *American Anthropologist* 88. doi: 10.1525/aa.1986.88.4.02a00100.

Ibarra CM, Leynaud GC, Pereyra LC, Arias Toledo B (2023) **Saberes y leyendas: El etnoconocimiento como herramienta para mejorar la convivencia entre serpientes y pobladores del sur de la Región Chaqueña, Córdoba, Argentina**. *Ecología Austral* 33. doi: 10.25260/EA.23.33.1.0.1922.

INDEC (2022) Instituto Nacional de Estadísticas y Censos. **Censo Nacional de Población, Hogares y Viviendas 2010: Jurisdicción Río Negro**. [`https://www.indec.gob.ar/indec/web/Nivel4-Tema-2-41-165`] Accessed 04 june 2023.

INTA (2024) Instituto Nacional de Tecnología Agropecuaria. **Sistema de Información y Gestión Agrometeorológica**. [`https://siga.inta.gob.ar/#/`] Accessed 04 january 2024.

ISE (2006) International Society of Ethnobiology. **Code of Ethics** [http://ethnobiology. net/code-of-ethics] Accessed 15 april 2023.

Juárez SM, Castillo OC, Gómez ET (2019) **La lengua Ngigua como elemento de la diversidad biocultural de la región de Tehuacán**. *RD-ICUAP* 5. doi: 10.32399/icuap.rdic.2448-5829.2019.14.389.

Kremen C, Iles A, Bacon C (2012) **Diversified farming systems: an agroecological, systems-based alterna- tive to modern industrial agriculture**. *Ecology and Society* 17. doi: 10.5751/ES-05103-170444.

Laborda L, Easdale MH, Fallot A, Ocaríz MP, Tittonell PA (2023) **Rise from the ashes! Resilience patterns in Patagonia pastoralist communities**. *Sustainable Development* 32 doi: 10.1002/sd.2679.

Ladio AH, Lozada M (2004) **Patterns of use and knowledge of wild edible plants from distinct ecological environments: A case study of a Mapuche community from Northwestern Patagonia**. *Biodiversity and Conservation* 13. doi: 10.1023/B:BIOC.0000018150.79156.50.

Ladio AH (2006) **Etnobotánica en la Patagonia: conocimiento local e importancia actual de los recursos vegetales en las comunidades rurales**. *Revista de la Asociación Colombiana de Ciencias Biológicas* 18: 13-29.

Ladio AH (2011) **Etnobotánica aplicada y pequeños horticultores**. *Desde la Patagonia difundiendo saberes* 8: 28-34.

Ladio AH, Molares S, Ochoa J, Cardoso B (2013) **Etnobotánica aplicada en Patagonia: la comercialización de malezas de uso comestible y medicinal en una feria urbana de San Carlos de Bariloche (Río Negro, Argentina)**. *Boletín*

Latinoamericano y del Caribe de Plantas Medicinales y Aromáticas 12: 24-37.

Ladio AH, Albuquerque UP (2014) **The concept of hybridization and its contribution to urban ethnobiology. *Ethnobiology and Conservation* 3. doi: 10.15451/ec2014-11-3.6-1-9.**

Ladio AH, Molares S (2017) **Etnoconservacionismo y prácticas locales en Patagonia: avances y perspectivas**. In: Casas A, Torres-Guevara J, Parra Rondinel F (eds) Domesticación en el continente americano: Investigación para el manejo sustentable de recursos genéticos en el Nuevo Mundo. 1 ed. Morellavalladolid, Morelia, México, pp. 391–411.

Ladio AH (2017) **Ethnobiology and research on Global Environmental Change: what distinctive contribution can we make?** *Ethnobiology and Conservation* 6. doi: 10.15451/ec2017-07-6.7-1-8.

Ladio AH, Longo Blasón M, Molares S (2023) **Resilience processes and positioning of agroecological farmers in an urban horticultural fair in northwest Patagonia**. *Ethnobotany Research and Applications* 25: 1-35.

Liere H, Egerer M, Sanchez C, Bichier P, Philpott SM (2020) **Social context influence on urban gardener perceptions of pests and management practices**. *Frontiers in Sustainable Food Systems* 4. doi: 10.3389/fsufs.2020.547877.

Longo Blasón MS, Molares S, Ladio AH (2022) **Las etnoespecies comercializadas en la feria de agricultores de Bariloche (Rio Negro, Argentina) y su versatilidad en alimentos locales: Contribuciones hacia la soberanía alimentaria local**. *Boletín de la Sociedad Argentina de Botánica* 57. doi: 10.31055/1851.2372.v57.n3.37329.

López De La Cruz E, Ruíz Montoya L, Gómez Gómez B, Castro Ramírez AE, Sánchez Cortés MS (2018) **Conocimiento y percepción tsotsil sobre los insectos perjudiciales para la milpa en la reserva de la selva El Ocote (Chiapas, México)**. *Estudios de cultura Maya* 52. doi: 10.19130/iifl.ecm.2018.52.882.

Lozada MA, Ladio AH, Weigandt M (2004) **Aspectos de la adquisición y transmisión del conocimiento sobre plantas silvestres en una comunidad rural del Noroeste de la Patagonia.** Bariloche, Argentina: Reunión Internacional Mente y Cultura: 14. Available at `https://www.conicet.gov.ar/new_scp/detalle.php?keywords=&id=22014&articulos=yes&detalles=yes&art_id=315187`. Accessed November 2023.

Lozada M, Ladio AH, Weigandt M (2006) **Cultural transmission of ethnobotanical knowledge in a rural community of northwestern Patagonia, Argentina**. *Economic Botany* 60. doi: 10.1663/0013-0001(2006)60[374:CTOEKI]2.0.CO;2.

Ludwig D, El-Hani CN (2020) **Philosophy of ethnobiology: Understanding knowledge integration and its limitations**. *Journal of Ethnobiology* 40. doi: 10.2993/0278-0771-40.

Martínez-Torres ME, Rosset PM (2010) **La Vía Campesina: the birth and evolution of a transnational social movement**. *The Journal of Peasant Studies* 37. doi: 10.1080/03066150903498804.

Masciocchi M (2013) **Dinámica de la dispersión y actividad de la avispa exótica Vespula germanica F. (Hymenoptera: Vespidae) en Argentina**. Tesis de Doctorado. Centro Regional Universitario Bariloche, Universidad Nacional del Comahue, San Carlos de Bariloche, Argentina. [http://rdi.uncoma.edu.ar/handle/uncomaid/181] Accessed 11 may 2023.

Morales H, Perfecto I (2000) **Traditional knowledge and pest management in the Guatemalan highlands**. *Agriculture and Human Values* 17. doi: 10.1023/A:1007680726231.

Morales H (2002) **Pest management in traditional tropical agroecosystems: Lessons for pest prevention research and extension**. *Integrated Pest Management Reviews* 7. doi: 10.1023/B:IPMR.0000027502.91079.01.

Morales H, Ramírez P, Liere H, Rodas S, López JC (2010) **Revalorando viejas prácticas mayas de manejo de plagas del maíz almacenado para la agricultura del futuro**. *Agroecología* 5: 63-71.

Morales D, Molares S, Epele L, Ladio A, Manzo P, Aldai G (2020) **An inteerdisciplinary Approach to perception of water quality for human consumption In a Mapuche community of arid Patagonia, Argentina**. *Science of the Total Environment* 720. doi: 10.1016/j.scitotenv.2020.137508.

Morales D, Molares S, Ladio A (2023) **Patagonian Ethnopedology and Its Role in Food Security: A Case Study of Rural Communities in Arid Environments of Argentina**. *Journal of Ethnobiology* 43. doi: 10.1177/027807712311763.

Morello J, Matteucci SD, Rodriguez AF, Silva ME (2012) **Ecorregiones y complejos Ecosistémicos de Argentina**. 1 ed. – Orientación Gráfica, Buenos Aires, Argentina.

Mostowlansky T, Rota A (2020) **Emic and etic.**

In: Stein F, Lazar S, Candea M, Diemberger H, Robbins J, Sanchez A, Stasch R (eds) The Cambridge Encyclopedia of Anthropology, University of Cambridge, Cambridge, UK, pp. 1-16. http://doi.org/10.29164/20emicetic.

Navarrete RA (2021) **Almacenamiento de los productos del cerco en los Departamentos Guasayán y Figueroa, provincia de Santiago del Estero**. Tesis de Grado. Facultad de Agronomía y Agroindustrias. 42 pp.

Nakazawa M (2023) **fmsb: Functions for Medical Statistics Book with some Demographic Data**. R package version 0.7.5 [`https://CRAN.R-project.org/package=fmsb`] Accessed 04 April 2023.

Ocaríz P, Ojeda J (2018) **La Feria Franca de Horticultores "Nahuel Huapi" Bariloche, Río Negro, Argentina**. Relato de experiencia. VII Congreso Latinoamericano de Agroecología, 2-5 octubre. Guayaquil, Ecuador. [`https://repositorio.inta.gob.ar/handle/20.500.12123/3924`] Accessed 22 january 2023.

Paleólogos MF, Flores CC (2014) **Capítulo 10: Principios para el manejo ecológico de plagas**. En Santiago Javier Sarandón & Claudia Cecilia Flores (eds). Agroecología: bases teóricas para el diseño y manejo de Agroecosistemas sustentables. 1 ed. - La Plata, Universidad Nacional de La Plata. ISBN 978-950-34-1107-0.

Poggi DR (2018) **Sistemas de vigilancia y monitoreo de plagas en la República Argentina**. Trabajo de Especialidad. Facultad de Ciencias Agrarias, Universidad Nacional de Litoral. Santa Fé. [`https://bibliotecavirtual.unl.edu.ar:8443/bitstream/handle/11185/1154/TFI.pdf?sequence=1&isAllowed=y`] Accessed 04 january 2023.

Posey DA (1984) **Hierarchy and utility in a folk biological taxonomic system: patterns in Classification of Arthropods by the Kayapo Indians of Brazil**. *Journal of Ethnobiology* 4: 123-140.

Rathore S, Chandola M, Raghuvanshi R, Kaur M, Singh KV (2021) **Indigenous pest management practices of indian hill farmers: Introspecting their rationale and communication pattern for secure ecosystems**. *Sustainability* 13. doi: 10.3390/su132111608.

R Core Team (2023) **R: A language and environment for statistical computing**. R Foundation for Statistical Computing, Vienna, Austria. [`https://www.R-project.org/`]. Accessed 11 April 2023.

Reyes García V (2009) **Conocimiento ecológico tradicional para la conservación: dinámicas y conflictos**. *Papeles* 107: 39-55.

Reising CA, Lanari MR, Ladio AH (2022) **The other sheep, resistant but forgotten: Archetypal characterization of Linca sheep farmers in Argentine Patagonia**. *Ethnobiology and Conservation* 11. doi: 10.15451/ec2022-10-11.25-1-21.

Rovere AE (2022) **Los canteros urbanos como parte del paisaje biocultural de Bariloche (Argentina): riqueza de especies y decisiones de manejo**. *Boletín de la Sociedad Argentina de Botánica* 57. doi: 10.31055/1851.2372.v57.n3.37477.

Sánchez Cabezas G (2010) **Los mapuchismos en el DRAE**. *Boletín de filología* 45. doi: 10.4067/S0718-93032010000200008.

Santos-Fita D, Costa-Neto EM (2009) **Sistemas de clasificación etnozoológicos.** In: Costa-Neto EM, Santos-Fita D, Clavijo MV, (eds) Manual de Etnozoología: una guía teórico-práctica para investigar la interconexión del ser humano con los animales. Tundra Ediciones, Valencia, España, pp. 67-94.

Sharma HC (2010) **Global warming and climate change: impact on arthropod biodiversity, pest management, and food security**. In: National Symposium on Perspectives and Challenges of Integrated Pest Management for Sustainable Agriculture, 19-21.

Solano-Hernandez A, Bruzzone O, Groot J, Laborda L, Martínez A, Tittonell P, Easdale MH (2020) **Convergence between satellite information and farmers' perception of drought in rangelands of north-West Patagonia, Argentina**. *Land Use Policy*, 97. doi: 10.1016/j.landusepol.2020.104726.

Suárez ME (2020) **Morfología botánica wichí: un estudio etnobiológico**. *Revista del Museo de Antropología*, 13. doi: 10.31048/1852.4826.v13.n3.27844.

Truskanov N, Prat Y (2018) **Cultural transmission in an ever-changing world: trial-and-error copying may be more robust than precise imitation**. *Philosophical Transactions: Biological Sciences* 373. doi: 10.1098/rstb.2017.0050.

Turbay S (2002) **Aproximación a los estudios antropológicos sobre la relación entre el ser humano y los animales**. En Rostros Culturales de la Fauna. La relación entre los humanos y los animales en el contexto colombiano. Fundación Natura, Instituto Colombiano de Antropología e Historia, Colombia, pp. 87-111.

Turner NJ, Cuerrier A, Joseph L (2022) **Well grounded: Indigenous Peoples' knowledge,**

ethnobiology and sustainability. *People and Nature* 4. doi: 10.1002/pan3.10321.

Villagrán C, Villa R, Hinojosa LF, Sánchez G, Romo M, Maldonado A, Cavieres L, La Torre C, Cuevas J, Castro S, Papic C, Valenzuela A (1999) **Etnozoología Mapuche: un estudio preliminar**. *Revista Chilena de Historia Natural* 72: 595-627.

Villena Araya B (2017) **Diccionario Mapudungún-Español y Español- Mapudungún Fray Félix José de Augusta**. Ediciones de la Universidad Católica de Temuco, Temuco, Chile.

Wickham H (2016) **ggplot2: Elegant Graphics for Data Analysis**. Springer-Verlag New York. [`https://ggplot2.tidyverse.org`] Accessed 10 may 2023.

Zamudio F, Hilgert NI (2012) **Descriptive attributes used in the characterization of stingless bees (Apidae: Meliponini) in rural populations of the Atlantic forest (Misiones-Argentina)**. *Journal of ethnobiology and ethnomedicine* 8. doi: 10.1186/1746-4269-8-9.

Zamudio F, Hilgert NI (2015) **Multidimensionality and variability in folk classification of stingless bees (Apidae: Meliponini)**. *Journal of ethnobiology and ethnomedicine* 11. doi: 10.1186/s13002-015-0029-z.

Received: 18 April 2024
Accepted: 13 June 2024
Published: 01 July 2024

Editor: Ulysses Albuquerque

Additional Files

Add File 1. Scientific-technical bibliography consulted on the 7 most relevant Harmful Arthropods (HA) among family farmers of the Nahuel Huapi Family Farmers Free Fair, in San Carlos de Bariloche.

Aubel AJ (2022) **Estudio de nuevas herramientas de control de plagas de nogales con énfasis en Cydia pomonella L. en el Valle Inferior del Río Negro. Primera experiencia.** Tesina de grado. Universidad Nacional de Río Negro. 79 pp. [https://rid.unrn.edu.ar/bitstream/20.500.12049/8995/1/Aubel_Agust%C3%ADn-2022.pdf] Accessed 18 september 2022

Bado SG (2010) **Dinámica poblacional de *Caliroa cerasi* L. (Hymenoptera: Tenthredinidae) en cultivos de cerezo (*Prunus avium* L.) del Valle Inferior del Río Chubut (Región Patagonia Sur-Argentina)**. Idesia, 28(3): 51-60.

Bado SG (2014) **Estudios preliminares del efecto del incremento de biodiversidad vegetal sobre la dinámica poblacional de *Caliroa cerasi* L. (Hymenoptera: Tenthredinidae) y *Trichogramma minutum* R. (Hymenoptera: Trichogrammatidae) en un cultivo de cerezo de El Virch (Región Patagonia Sur-Argentina)**. Revista Agronomía y ambiente, 34: 25-36.

Bado SG (2014) **Carpocapsa: sistema de alarma para control.** INTA Trelew. [https://inta.gob.ar/noticias/carpocapsa-sistema-de-alarma-para-control] Accessed 10 september 2022

Cabrera Bellido EH (2021) **Tecnologías amigables para la eliminación del gorgojo de los Andes (Premnotrypes suturicallus Kuschel: Phtorimaea operculella) en cultivos de papa: Revisión sistemática.** Tesina de grado. Escuela Profesional de Ingeniería Ambiental, Facultad de Ingeniería y Arquitectura, Unversidad Cesar Vallejos. Lima, Perú. 56 pp. [https://hdl.handle.net/20.500.12692/75461] Accessed 10 september 2022

Cibils X, Waller A, Zervino S (2017) **Biología y manejo del "bicho bolita" (bicho de la humedad)**. Revista INIA, 48: 38-41.

Cichón L, Fernández D (2003) **Aspectos relevantes en el control de Carpocapsa en el Alto Valle de Río Negro y Neuquén.** INTA General Roca. [https://inta.gob.ar/sites/default/files/inta_aspectos-relevantes-control-carpocapsa-alto-valle.pdf] Accessed 10 september 2022

Cichón L, Garrido S, Lago J, Ahmad S (2013) **Fajas de cartón corrugado: Control complementario de carpocapsa.** Instituto Nacional de Tecnología Agropecuaria. [https://inta.gob.ar/sites/default/files/inta_fajas-de-carton-corrugado.pdf] Accessed 18 september 2022

De la Vega G (2018) "Mosca de alas pintada" Drosophilla suzukii. En Masciocchi M, Lantschner V, Villacacide J (eds) Serie divulgación sobre insectos de importancia ecológica, económica y sanitaria. Cuadernillo N° 20. Grupo de Ecología de Poblaciones de Insectos. INTA EEA Bariloche. 12 pp. ISSN Digital: 2525-149X. [[https://repositorio.inta.gob.ar/xmlui/handle/20.500.12123/4213?locale-attribute=en]] Accessed 18 september 2022

Devotto Moreno L (2021) **Manejo fitosanitario de Drosophilla suzukii en cerezo.** PEC Magazine, 2: 32-36.

Dughetti AC (2015) **Plagas de la Quinua y sus enemigos naturales en el Valle inferior del río Colorado, Buenos Aires, Argentina.** 1era Ed. Ediciones INTA: Buenos Aires, Argentina, pp. 1–63.

Edelstein JD, Walter S (2014) Manejo Integrado de Plagas (MIP) del gorgojo Phyrdenus muriceus en papa. INTA Manfredi. [https://inta.gob.ar/sites/default/files/script-tmp-inta_gorgojo_en_papa.pdf] Accessed 10 september 2022

Estay P, Gerding M, Aguilar V (2003) **Chaquetas amarillas ¿Qué sabemos de ellas?** Chillán: Informativo INIA Quilamapu. N°. 77. [`https://hdl.handle.net/20.500.14001/4097`] Accessed 15 september 2022

Funes CF, Kirschbaum DS, Escobar LI, Heredia AM (2018) **La mosca de las alas manchadas, Drosophila suzukii (Matsamura). Nueva plaga de las frutas finas en Argentina.** 1° Ed. Ediciones INTA, 30 pp. ISBN 978-987-521-923-6. [`https://repositorio.inta.gob.ar/xmlui/handle/20.500.12123/3615`] Accessed 15 september 2022

Gopar A, Melis OA, Knudtsen J, Real Ortellado MR, Lonegro DA (2018) **S.O.S: ¡Exceso de Bichos Bolitas en la Huerta!** [`https://inta.gob.ar/noticias/sos-%C2%A1exceso-de-bichos-bolitas-en-la-huerta#:~:text=Si%20no%20se%20tiene%20esta,%2C%20temprano%2C%20o%20el%20atardecer`] Accessed 10 september 2022

Lantschner V (2016) **"Pilme" *Epicauta pilme*.** En Masciocchi, M., Lantschner, V., y Villacacide, J. (eds) Serie divulgación sobre insectos de importancia ecológica, económica y sanitaria. Cuadernillo N° 16. Grupo de Ecología de Poblaciones de Insectos. INTA EEA Bariloche. 8 pp. ISSN Digital: 2525-149X. [`https://inta.gob.ar/documentos/cuadernillo-n%C2%B016-pilme-epicauta-pilme`] Accessed 18 september 2022

López S, Sauka D, Segura D, Viscarret M (2019) **Desarrollo de herramientas para el manejo integrado de artrópodos perjudiciales: resúmenes de actividades.** Editores literarios: Silvia N. López. . . [et al.] – Buenos Aires: Ediciones INTA, 2019. 88 pp. [`https://inta.gob.ar/sites/default/files/inta_libro_pnpv_1135033.pdf`] Accessed 10 september 2022

Masciocchi M (2018) **Avispas sociales invasoras en la Patagonia Argentina.** Desde la Patagonia, Difundiendo Saberes, 15: 22-29.

Quintana G, Cólica JJ (2011) Carpocapsa: plaga clave en nogal. Aspectos morfológicos y biológicos relevantes para un control adecuado. Informe técnico Nº 1. INTA. ISSN 0329-3122. [`https://inta.gob.ar/sites/default/files/script-tmp-inta_quintana-colica_carpocapsa.pdf`] Accessed 10 september 2022

Raddatz Rosenberg LV (2004) **Emergencia de la generación invernante y diapausa de Caliroa cerasi (L., 1758) bajo condiciones de campo en Valdivia, Décima Región de Los Lagos.** Tesis de grado. Universidad Austral de Chile. Facultad de Ciencias Agrarias, Escuela de Agronomía. 94 pp.

Rizzuto S (2003) La avispa "chaqueta amarilla" (Vespula germanica). Biología y control en Esquel. [`https://inta.gob.ar/sites/default/files/script-tmp-inta_medioambiente02_vespula_germanica.pdf`] Accessed 10 september 2022

SAG (2017). Servicio Agrícola y Ganadero. **Detección de insectos adultos de Drosophila suzukii por medio del uso de trampas.** Ficha técnica N°2. División Protección Agrícola y Forestal, Servicio Agrícola y ganadero. 12 pp. [`https://www.sag.gob.cl/sites/default/files/ficha_drosophila_n2.pdf`] Accessed 18 september 2022

SAG (2021). Mosca de alas machadas. Drosophilla suzukii: Drosófila de alas manchadas. 2° Edición. División Protección Agrícola y Forestal, Servicio Agrícola Ganadero de Chile. [`https://www.sag.gob.cl/sites/default/files/folleto_drosophila_21_baja.pdf`] Accessed 18 september 2022

Saluso A (2001) Bicho bolita: plaga emergente de siembra. INTA EEA Paraná. 9 pp. [`https://inta.gob.ar/documentos/bicho-bolita-plaga-emergente-de-siembra-directa`] Accessed 18 september 2022

SENASA (2022) Servicio Nacional de Sanidad y Calidad Agroalimentaria. **Carpocapsa**. [https://www.argentina.gob.ar/senasa/programas-sanitarios/cadenavegetal/frutales/frutales-produccion-primaria/carpocapsa] Accessed 10 september 2022

SINAVIMO (2022) Sistema Nacional de Vigilancia y Monitoreo de plagas. ***Phyrdenus muriceus.*** [https://www.sinavimo.gob.ar/plaga/phyrdenus-muriceus] Accessed 10 september 2022

Vallejos LE (2020) **Manejo y control de Epicauta pilme Molina (Coleoptera: Meloidae) en cultivos anuales y hortalizas, Osorno, Chile.** Ficha Técnica INIA Remehue. 119. [https://hdl.handle.net/20.500.14001/67258] Accessed 10 september 2022

Villacide J, Masciocchi M (2011) **"Babosita del peral", "babosita de los frutales" -** ***Caliroa cerasi.*** En Villacide J, Masciocchi M (Eds). Serie divulgación sobre insectos de importancia ecológica, económica y sanitaria. Cuadernillo N° 4. Grupo de Ecología de Poblaciones de Insectos. INTA EEA Bariloche. 6 pp. ISSN 1853-5852.

Villacide J, Masciocchi M (2011) **"Chaqueta amarilla"** – ***Vespula germanica.*** En Villacide J, Masciocchi M (Eds). Serie divulgación sobre insectos de importancia ecológica, económica y sanitaria. Cuadernillo N° 1. Grupo de Ecología de Poblaciones de Insectos. INTA EEA Bariloche. 18 pp. ISSN 1853-5852. [https://inta.gob.ar/sites/default/files/script-tmp-inta-boletin_chaquetas_dist.pdf] Accessed 10 september 2022