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Article in *Mountain Research and Development* · December 2020

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Environmental Education as a Means for Valuing and Conserving Camelids and Pastoralism in the Argentinean Altiplano of Jujuy

Bibiana Vilá^{1,2,3*}, Yanina Arzamendia^{1,4}, and Verónica Rojo^{1,5}

* Corresponding author: bibianavila@gmail.com

¹ VICAM (Vicuñas, Camélidos y Ambiente), Luján, 6700 Buenos Aires, Argentina

² CONICET (Consejo Nacional de Investigaciones Científicas y Técnicas), Godoy Cruz 2290, Ciudad Autónoma de Buenos Aires C1425FQB, Argentina

³ Department of Social Sciences, National University of Luján, Avenida Constitución and National Route 5, 6700 Buenos Aires, Argentina

⁴ INECON (Instituto de Ecorregiones Andinas)-CONICET-UNJu (National University of Jujuy), Alberdi 47, 4600 San Salvador de Jujuy, Argentina

⁵ Department of Technology and Department of Basic Sciences, National University of Luján, Avenida Constitución and National Route 5, 6700 Buenos Aires, Argentina

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Andean pastoralism, like other pastoral systems around the world, is under stress due to climate change, land tenure regimes, pressures to become sedentary, difficulties in interacting with market-based economies, isolation, and youth emigration. Over the years, we have proposed different environmental education (EE) strategies targeting local Andean stakeholders and university students, including interventions in primary schools. This paper presents the results of 4 EE interventions focusing on mountain environments, their biodiversity, environmental calendars, and llama caravans. School children participated creatively in this process by writing

poems, drawing, and playing. The resulting work showed sensitivity, experiential knowledge, and a comprehensive vision of the environment. Most of the artworks were printed and disseminated in the children's local communities, where they are highly appreciated. We recognize that the usefulness of EE is constrained by social and economic pressures, including extractive activities. However, we also underscore its huge potential to guarantee sustainability during the inevitable process of change in traditional Andean pastoralism.

Keywords: environmental education; Andean pastoralism; mountain biodiversity; local schools.

Peer-reviewed: September 2020 **Accepted:** December 2020

Introduction

Jujuy, the most northwestern province of Argentina, has the largest percentage of mountainous landscape (over 93%) in the country (IGN and SEGEMAR 2019). This includes a wide range of ecosystems. The Puna or Altiplano is a dry, cold, high-elevation (>3500 m above sea level) Andean ecosystem, with a semidesert vegetation community that consists mainly of shrub-steppe, with tussocks and short grasses. Peatlands, locally known as *vegas*, develop in restricted areas where groundwater is near the surface (Cabrera 1971).

The Altiplano ecosystem's functions and services support one of the most important, long-lived, and culturally distinctive socioecological systems in the world, Andean pastoralism. The uniqueness of the Altiplano ecosystem includes endemic fauna and livestock, with 4 species of South American camelids: wild vicuñas (*Vicugna vicugna*) and guanacos (*Lama guanicoe*), and domestic llamas (*Lama glama*) and alpacas (*Vicugna pacos*). Most of the llama breeders in Jujuy are members of indigenous communities and practice subsistence economies. They live in isolated places, with high mobility between different elevational ranges (Wawrzyk and Vilá 2013; Vilá et al 2018). In these rangelands, livestock and

wild vicuñas share grazing lands. In some cases, depending on human attitudes and animal densities, the wild species are displaced. In other places, there is a certain degree of harmony and potential for the sustainable production of several species (Rojo et al 2012; Arzamendia and Vilá 2015). Vicuñas were in danger of extinction due to hunting, because of the high market value of their fine fiber. Although conservation efforts have reversed this trend, and vicuña hunting is prohibited by law, vicuñas are still subject to poaching. Local communities play a key role in conservation, and situated environmental education (EE) can make a big difference in bringing these communities on board. In some areas of northwest Argentina, projects that promote the sustainable management of wild vicuñas have employed *chakus*, a traditional practice of vicuña capture, shearing, and later release, to obtain the valuable fiber and stimulate local economies (Vilá et al 2010; Arzamendia et al 2010, 2014; Arzamendia and Vilá 2012). Although this may seem encouraging, pastoralism on the Altiplano of Jujuy faces the same challenges as other pastoral systems around the world (comprising approximately 25% of the land surface worldwide supporting 20 million households; Dong et al 2011). It is vulnerable to climate change, land tenure

regimes, pressures on pastoralists to become sedentary, difficulties in interacting with market-based economies, isolation, and youth emigration from the area (Dong et al 2011; Coppock et al 2017). Ancestral practices, such as llama caravans, are becoming or are already extinct (Vilá 2018, 2019).

Dialogue between the scientific and local communities within an EE framework is a first step to addressing this negative scenario. This would involve the coconstruction of interventions such as *chakus*, design policies (Arzamendia et al 2012), and biocultural conservation events, for example, *Ashka llama* fairs, workshops about rangeland management, and others. This Andean EE dialogue can promote the social construction of knowledge through the exchange of ideas, feelings, representations, beliefs, concepts, practices, narratives, desires, and experiences (Salas 2013). It also includes the biocultural values of the pastoral world, which are largely ignored by educational institutions.

As stated by the United Nations Educational, Scientific and Cultural Organization (UNESCO) in its official definition:

the aim of environmental education is to succeed in making individuals and communities understand the complex nature of the natural and the built environments resulting from the interaction of their biological, physical, social, economic and cultural aspects, and acquire the knowledge, values, attitudes and practical skills to participate in a responsible and effective way in anticipating and solving environmental problems, and the management of the quality of the environment.

(UNESCO 1977)

The definition includes all the stakeholders in environmental management, so EE must be a cocreation process, respectful of the multicultural nature of Andean socioecosystems. In EE, classic biology dissolves into ethnobiology:

the scientific study of dynamic relationships among peoples, biota, and environments . . . It allows us to examine complex, dynamic interactions between human and natural systems.

(Argueta et al 2012: 21)

One important question is: What kind of EE is appropriate for communities that live embedded in and of nature? We need EE that includes a process of creating new values and knowledge linked to the transformation of reality (Leff 1999) in view of the responsibilities and rights that arise from planetary citizenship. It should also be grounded in the local material and symbolic embodiments of these responsibilities, such as the holistic concept of *Pachamama* in the Andean cosmovision. Only from this framework of integrated perspectives can EE help local communities to take charge of their own destiny and reproduce a culture of sustainability (Gutierrez and Prado 1997). As expressed by Leonardo Boff (1996), these new ways of giving meaning to the world envision the emergence of new values, new dreams, and new behaviors. An EE experience engages educators and students in a pedagogical setting that includes elements outside the school: the environment, the pastoral system, llamas, vicuñas, and so forth. In this scenario, we must build what Freire (2003) described as the possibility for students to produce knowledge—in our case, environmental

knowledge—in collaboration with the teacher, through the development of their curiosity.

Our research group has developed EE initiatives as a necessary complement to our camelid research program. These initiatives target different stakeholders and include a variety of formats. At the National University of Jujuy, research group staff members teach “learn by doing” courses for undergraduate and graduate students. These involve immersion in the process of sustainable management of vicuñas and encourage the intercultural exchange of knowledge and experiences among scientists, local communities, and students (Vilá et al 2020).

EE activities in local communities focus on technical aspects of wild vicuña management, including corral and funnel construction, procedures for animal capture and release, animal welfare, and risk management. One product of this interaction is the *Handbook on Vicuña Conservation and Sustainable Use* (Baldo et al 2013), which can be downloaded for free from the National Research Council’s website. This has been widely used as a foundation for management techniques by several governmental and nongovernmental organizations. Another focus of joint activities with communities is the exchange of ideas on rangeland management (vegetation, vicuñas, and livestock) and training for Altiplano school teachers (Vilá et al 2006, 2009; Vilá 2014). The purpose of these courses is to familiarize teachers with regional and global environmental issues and provide environmentally focused teaching methodologies that generate significant learning opportunities. These can foster a change in attitudes and motivations toward valuing the school’s situation in a mountain ecosystem.

A more informal and creative mode of these experiences at schools is what we call “EE interventions.” These are initiated either as a response to requests made by local school members or indigenous communities, or in the context of national (and international) environmentally significant dates (ie “environmental ephemerides”). EE interventions are short, intensive events with a hands-on approach. They usually take the form of workshops in primary or high schools, where children and teenagers develop a specific product or output.

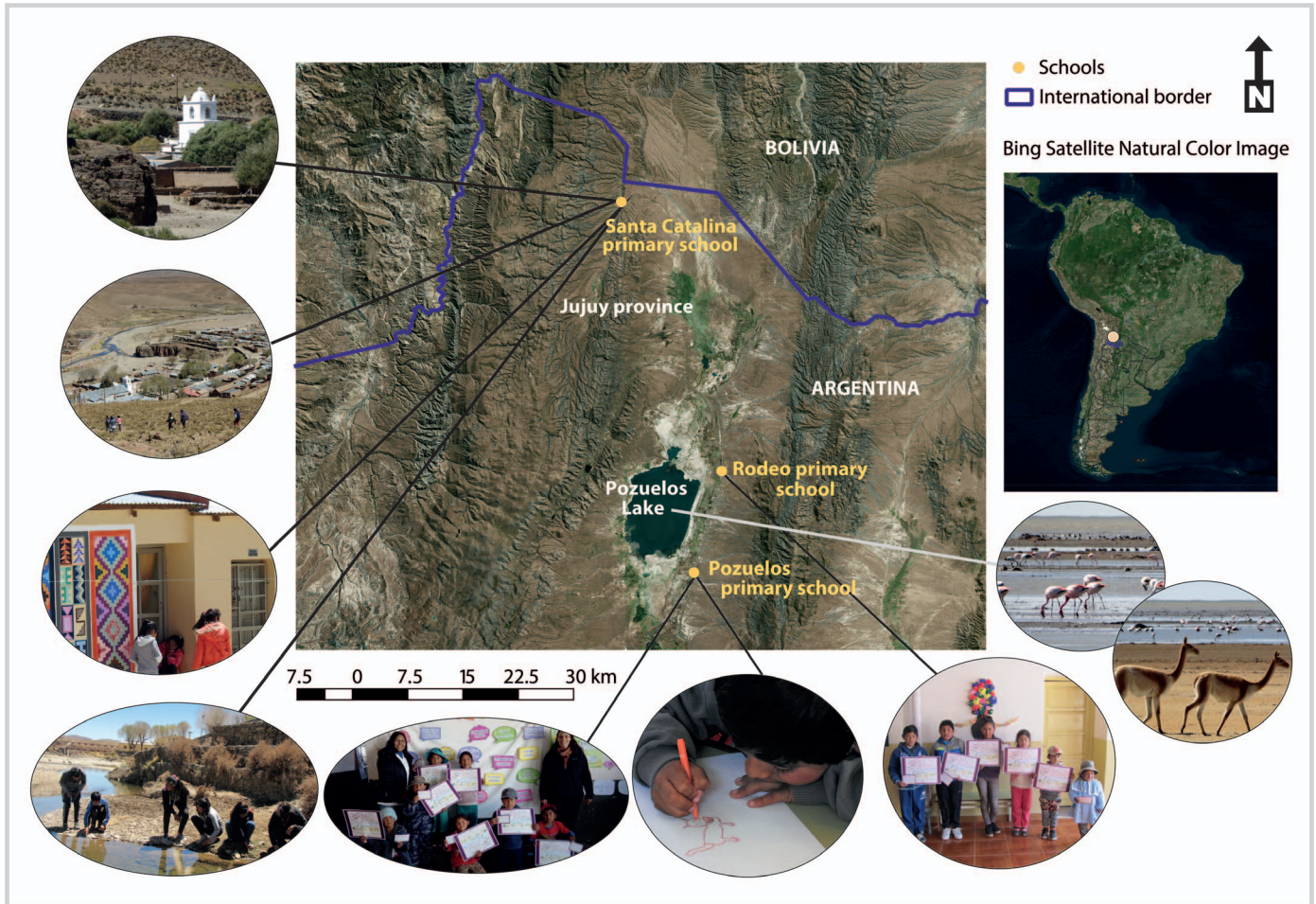
The objective of this paper is to describe 4 EE interventions focusing on mountain environments, biodiversity, the environmental calendar, and llama caravans at schools in the Pozuelos Basin (province of Jujuy, Argentina) and to present and analyze some of the resulting artworks, which have become part of the heritage of these communities.

Study area and methods

The fieldwork was carried out in the Pozuelos Basin, in the Laguna de los Pozuelos Natural Monument of the National Parks Administration within the Man and Biosphere Reserve (MAB-UNESCO) and Ramsar site (Figure 1).

Santa Catalina (21°56′47.47″S; 66°3′7.32″W) is the northernmost town in Argentina. It is situated near the border with the Plurinational State of Bolivia. Santa Catalina lies within the valley of the Santa Catalina River at ~3800 m above sea level, in the Rinconada mountain range. The area was inhabited by pre-Hispanic communities, as evidenced by petroglyphs showing camelid iconography discovered in the

FIGURE 1 Map of the Pozuelos basin and the 3 schools: Pozuelos, Rodeo, and Santa Catalina. (Photos by Bibiana Vilá, Yanina Arzamendia, and Verónica Rojo)



area. The community of Santa Catalina includes 4 indigenous groups, officially recognized as indigenous organizations (Atu Saphi, Aucarpina Chambi, Yurax Rumi, and La Cruz), and a cooperative of local landowners. Santa Catalina is the center of administrative, political, sanitary, commercial, religious, festive, and educational functions for nearby rural areas. The main sources of income in Santa Catalina are from breeding llamas and sheep to produce fiber, leather, and meat, governmental subsidies, and state employment.

Santa Catalina primary (no. 18 G. Rondeau) and secondary school students belong to indigenous groups. Some of them are Quechua speakers and define themselves as *Coyas*. The main language used in the school is Spanish, Argentina's official language, although they also have Quechua lessons. Only 30% of the students' families are able to meet their basic needs; 40% belong to families of herders and farmers, while the rest are underemployed or unemployed. The school provides 4 daily meals, and several students board in the school through the week.

Two primary schools were added to the initiative for the biodiversity EE intervention, Rodeo and Pozuelos, both located in the Laguna de los Pozuelos MAB Biosphere Reserve. These schools are similar to Santa Catalina's schools, but they have fewer children in attendance.

Teachers consider environmental ephemerides to be important within the educational agenda, and this

significance prompted an intervention. The school authorities and our research team coproposed celebrating key dates (Mountain Day, Biodiversity Day) as part of their school schedule, in line with the national and international agendas. We celebrated the National/International Mountain Day with interventions in the Santa Catalina primary school in 2017 and 2019, with the participation of teachers and 9 and 8 children, respectively. Biodiversity Day activities were carried out in 3 schools from 14 to 16 May 2018. The participants included school children, teachers, and headmistresses of the schools in Pozuelos (9 children and 3 teachers), Rodeo (4 children and 3 teachers), and Santa Catalina (5 children and 1 teacher).

The llama caravan intervention was planned to involve the Santa Catalina school in what was happening in the town, which was waiting for the llama caravans to arrive. The intervention was conducted in November 2017 with 10 seventh grade students and their teachers.

All school interventions were launched by asking the children to engage in a triggering activity related to the theme of the day, such as considering the color of animals as a way to approach the issue of biodiversity, or a class trip to climb the neighboring hills to reflect upon mountain landscapes, or imagining the everyday life of a llama caravanner. Then, following Freire (2003), we built a pedagogical space of trust in which the children could feel at ease and let their curiosity guide the development of the

FIGURE 2 Santa Catalina school children coming back from the mountain to the town. (Photo by Bibiana Vilá)



activity. We also proposed the creation of some form of lasting record, a material reminder of this shared experience, to which end participants were invited to engage in creative writing and drawing activities. All the exchanges and the children's productions were in Spanish.

Finally, the calendar work was developed as a response to a request made by the indigenous communities of Santa Catalina and its surrounding area, who demanded our collaboration in developing printable material that could be used to record local activities throughout the year. This activity involved 49 participants from Santa Catalina and other communities, including 38 adults—some from the local government (5) and the school staff (3)—and 11 children. The process was published in detail in Spanish (Vila and Arzamendia 2016).

In all interventions, we took notes and recorded dialogues between participants during the meetings and administered specific questionnaires. These were used to assess the participants' experience in the assigned tasks and their perceptions, attitudes, and beliefs regarding the intervention. In the case of the environmental calendar, the specific questionnaires inquired about environmental management actions undertaken and noteworthy natural processes that occurred in each month of the year. Preliminary responses were discussed with all the participants so that only the most relevant, according to their worldview, remained in the calendar. In the activities involving children, oral exchanges were documented and drawn, and written outputs were compiled. These reflected perceptions (ability to see, hear, or become aware of something through the senses), attitudes (learned tendency to evaluate things in a certain way), and beliefs (acceptance that something exists).

It is important to note that the authors have been working in the area for 10 years. Researchers are relatively familiar in the town, and we have established a very good rapport with the local people. All surveys were conducted following the Code of Ethics for Ethnobiological Research of the Latin American Society of Ethnobiology (SOLAE Ethics Committee et al 2018). All the original work by Santa Catalina community members presented here was translated to English by the authors.

Results

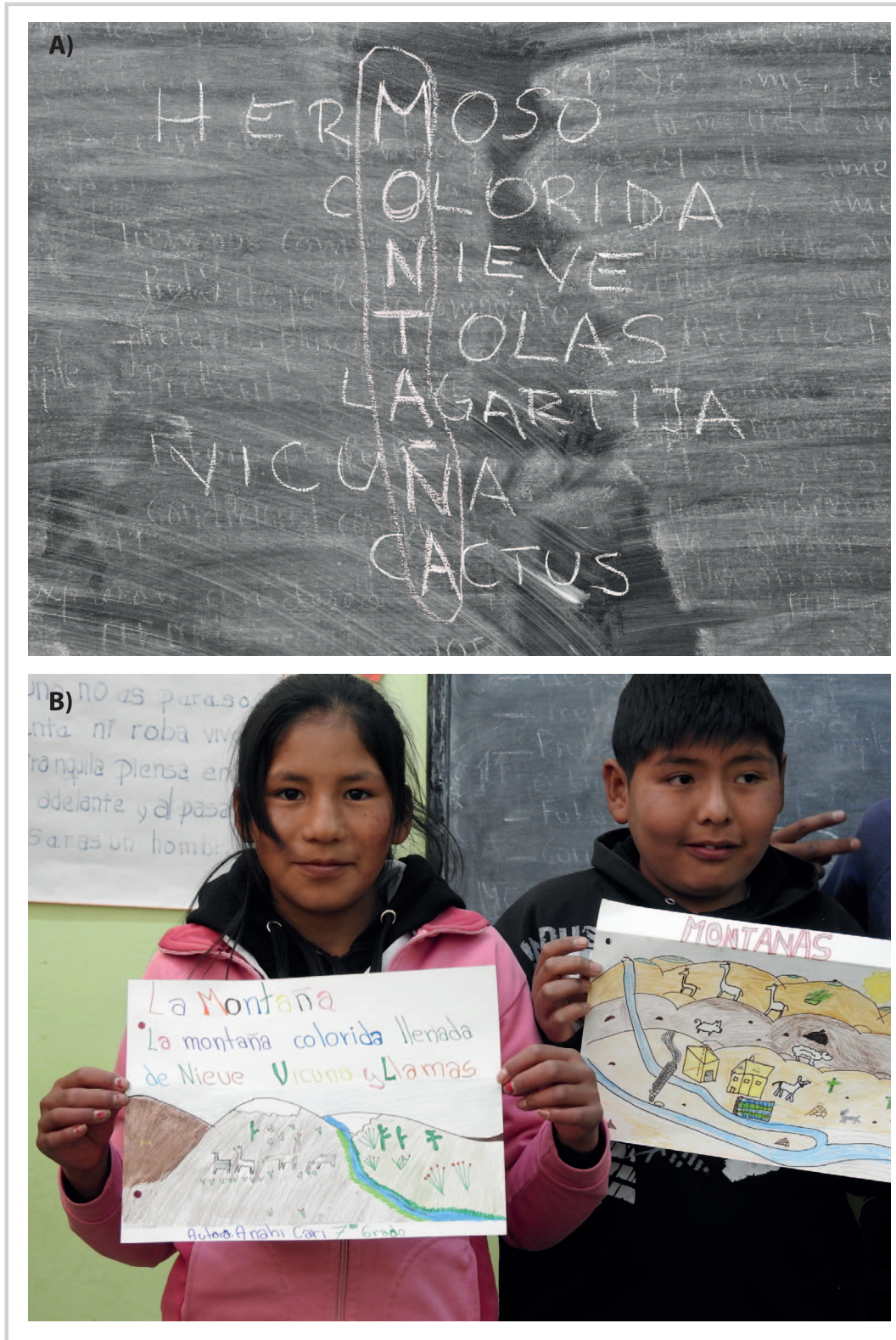
International Mountain Day

International Mountain Day is also celebrated as National Mountain Day in Argentina and is therefore part of the educational agenda. To celebrate mountains, we climbed a nearby hill to observe the town of Santa Catalina in its mountainous environment and the springs that feed the river that crosses the town (Figure 2).

From the top of the hill, the teacher named the surrounding mountains. Back in the classroom, we discussed mountains and their importance. A crossword with the word "mountain" was proposed, and we wrote it down together on the board (Figure 3A).

The students expressed concepts and elements that they associated with these environments, using words such as "beautiful," "colorful," "snow," "*tolas*" (a local plant), "lizard," "*vicuña*," and "cactus." These results demonstrate that physical perceptions of the environment were a significant part of the children's description of ecosystem components (animals and plants), showing a positive attitude and valuation of these components. In terms of nature's contribution to people, the children discovered intrinsic,

FIGURE 3 (A) Crossword on mountains; (B) children in seventh grade of Santa Catalina school, with their mountain drawings. (Photos by Bibiana Vilá)



instrumental, and relational values of mountains. They expressed that mountains are good because they have “good air” that is “nice to breathe,” they feed animals, they protect people, and they provide materials, such as rocks, minerals, and healing plants. The children clearly recognized that the

ice on top, as well as snow and rain in the mountains, are the sources of all rivers in the area. The children told us about their beliefs that mountains are *Apus*, sacred entities that protect the people. They also expressed that mountains can be harmful when there are landslides or earthquakes, and

FIGURE 4 Biodiversity collage made by children of 3 schools from the Laguna de los Pozuelos MAB Biosphere Reserve in Jujuy, northwest Argentina.



when volcanoes are “on” (*prendidos* in Spanish). Two other activities were proposed, drawing the landscape (Figure 3B) and writing poetry, with amazing results (the Spanish originals and further examples are provided in Appendix S1, *Supplemental material*, <https://doi.org/10.1659/MRD-JOURNAL-D-20-00009.1.S1>):

The mountain is very colorful/full of tolas and animals/It is very pretty, beautiful and with memories/On top it has very white snow/land from there the delicious water falls/and many people live [on it],/kind, good [people],/shepherdesses of sheep and llamas,/white and every color.

(group creation, 7th grade)

I like the mountains/because animals from/the dear Puna live there./Of melted snows,/the river falls like crystal clear water./Mountains of the Coyas/protected by the Pachakwith its llamas and its condors/and a yellow grass/that makes people fall in love.

(E.R.C. and U.G.B., 7th grade)

Celebrating biodiversity

The 3 schools where the intervention was conducted are located in the Laguna de los Pozuelos MAB-UNESCO Biosphere Reserve. Biodiversity and the importance of plants and animals are therefore a regular theme in schoolwork. As for Mountain Day, the International Day of Biodiversity is recognized as the National Day of Biodiversity and has a place in the educational agenda. We presented similar initial pedagogical triggers in the 3 schools. Using colors as conversation prompts, we discussed the different living beings and grouped them by color, such as lizards, cacti, frogs, and watermelons for the “green” category and llamas, vicuñas, armadillos (locally known as *quirquinchos*), potatoes, and kiwis for “brown.” The children from the Pozuelos school showed a remarkable perception of local biodiversity. They were able to identify 6 wild birds, toads, 7 wild and 2 domesticated mammals, 2 reptiles, and 2 insects

that lived in their immediate surroundings. As a group, we created a crossword with the letters of “biodiversity,” using local animals and plants to fill in each letter.

In the Rodeo school, located on the border of the lagoon, the perceived biodiversity was also remarkable. Children described 9 species of water birds, as well as other species, like shrimp, that are food for the flamingos, and 5 plant species. In agreement with the children, the 3 habitats in the area (lagoon, grassland, and mountains) were drawn on a large sheet. Then, the children made a group collage by drawing animals and plants and pasting them onto their habitat. The purpose of the group collage was to visually capture the local biodiversity. Interestingly, the children included both wild and domestic animals (production and pets) in their drawings; they also added their school, people (mostly women), and a “Hunting Prohibited” sign, showing a clear conservationist attitude. This reflects a holistic perception where biodiversity is part of the daily life of the school, interwoven in the children’s experience and imagination. The final image was photographed, edited, and printed on paper by the National Research Council (CONICET) press. Each child received a copy of this poster, and posters were also handed out to different institutions in the area, where they are permanently exhibited (Figure 4).

We conducted a similar activity in Santa Catalina. Since the children enjoy writing poetry, they wrote the following poem on biodiversity (for Spanish original, see Appendix S2, *Supplemental material*, <https://doi.org/10.1659/MRD-JOURNAL-D-20-00009.1.S1>):

Biodiversity

Biodiversity fascinates me/because it has living beings/that are beautiful and useful/plants and animals./We warm up with the wool/of llamas and sheep/in my town of Santa Catalina./The plants heal me/when my belly hurts/I take muña./If I’m cold I build a fire/with the tola and I get warm.

*You can knit with the wool of the vicuña,/that must be taken care of./
The condor flies in the sky to clear the way./The domestic animals,dogs
and cats are my “friends.”*

(group creation, 7th grade)

The poem shows that children have perceived the concept of nature's contributions in an intuitive or experiential way: plants and animals, both domestic and wild, can be enjoyed and used—for company, medicine, and warmth—but they also need to be cared for and protected. Care and protection were the main attitudes towards nature that emerged from this poem.

Environmental calendar

The environmental calendar was the result of an intensive 2 day workshop that brought together researchers, representatives from 3 communities (Canchillas-Peñas Coloradas, Santa Catalina, Tolamayo), 4 indigenous associations (Athu Saphi, Aucarpina Chambi, Yurax Rumi, and La Cruz), the school community (students of polymodal school no. 7 and primary school no. 18), town authorities, and governmental staff (technicians from the rural extension agency) of the province of Jujuy. The Santa Catalina annual calendar is circular, sliced by month, and composed of 5 rings: climate, nature, festivities, and agronomic and livestock cycles (Figure 5). Each section was illustrated and colored by participants and schoolchildren. For simplification, the climate ring was divided into two sections representing the warm and rainy summer season and the dry, cold, and very adverse winter. The calendar expressed a clear environmental perception and attitudes on environmental management using local knowledge, as well as the significance of the beliefs in *Pachamama* and Christianity. Agricultural and animal husbandry activities in the winter period consist primarily of the protection of resources against the inclement weather and the preparation of the land for summer activities. This includes specific ceremonies to give “payment” to *Pachamama* (Mother Earth), or *Pacha*, a deity embodied by Earth and nature, who makes life possible and favors food production and fertility. In return, people are obliged to offer payment to *Pacha* in a ritual that takes place in midwinter, during August, as well as in other significant cultural events.

The construction of this calendar represented a significant, positive interaction between actors; Box 1 offers testimonies.

In the process of building the calendar, the relationships among climate, environment, and the local cosmovision became clear. This was notable at the most climatically hostile time of year, the month of August, when *Pachamama* “opens” and has to be ritualistically fed (*chaya*) to foster her fertility. Certain activities occur at fixed times during the year, such as the harvest from January to April, the slaughter of livestock in April, the preparation of the land in July, *chaya* in August, and sowing during the spring. The elaboration of a calendar provided a rich opportunity for the development of a dialogue between complementary points of view regarding ethnoveterinary and western veterinary medicine treatments. This bridged the gap between scientific and nonacademic knowledge in the joint search for ways to facilitate local “good living.”

Llama caravans

In the EE llama caravan intervention, the children were asked to imagine an interview with a caravanner, to make up questions, and to think what the possible answers could be. They also took part in a creative writing exercise, where they had to describe their perceptions of what it would be like to be part of a llama caravan during a full day. Most of the children described exhausting, difficult itineraries in their “imaginary caravan day.” They showed a negative attitude in relation to the caravanning activity for their own lives, expressing their concerns regarding this activity (tiring, boring). They also wrote poems about caravanning:

*Puna Caravanner/You, who wake up early,/prepare your food/and load
your llamas/You walk your trails/in the sunny hills to the east.*

(F.C., 7th grade)

Students drew caravans (an example is provided in Appendix S3, *Supplemental material*, <https://doi.org/10.1659/MRD-JOURNAL-D-20-00009.1.S1>) and decided to make a caravan collage, where each of them created their own llama. They also painted a llama on a small stone, which they pressed against drawing paper, thereby creating a rock painting (Vilá in press).

We developed teaching guidelines for future use in the school, since llama caravans make excellent models for classroom activities. Llama caravans can be used as a topic to explore in different school subjects, for instance, history, geography, biology, and mathematics, as well as music, since there are beautiful tunes dedicated to this traditional Andean practice, such as the gorgeous *Camino de Llamas* by Argentine folk musician Uña Ramos.

Discussion

In the Andean Altiplano, the pastoralist livelihood is crucial for the survival of small rural indigenous communities and constitutes the main traditional production activity (Leon-Velarde et al 2000). However, several practices, such as llama caravan travel, are critically threatened. The last recorded caravan arrival at Santa Catalina Fair was in 2018; this event was probably the last of its kind in the region. The Altiplano ecosystem, and consequently its biocultural contribution, is suffering degradation, traditional livelihoods are being threatened, and both the people and the environment are under significant pressure from extractive activities, such as mining. This scenario calls for EE and the integration of science within the perspectives of local people, as socioenvironmental conservation and sustainability are based on practical experience and a mixture of knowledges (Gibbs et al 2008).

Although it is difficult to evaluate the long-term effectiveness of EE interventions, the artwork that constituted the main output provides insight into the participants' subjective environmental perceptions, attitudes, and beliefs, both during and after the intervention. In their poems about biodiversity, children were able to distinguish nature and nature's contributions to people, such as wild and domestic animals for food, fiber, and pets, and plant resources that are used for firewood and healing. In the pioneer ethnographic work on Andean pastoralism in Peru by Flores Ochoa (1974, 1977), the duality between wild and domestic camelids was expressed as *salqa-ullya* (wild-

FIGURE 5 Participatory calendar produced at Vicuñas, Camélidos y Ambiente's environmental calendar workshop in April 2016. The calendar classifies activities and events into 5 categories, 1 in each ring. These rings are (from the center) climate, nature, local festivities, agronomic activities, and livestock management. Each slice represents a month of the year, from January (enero) to December (diciembre).



BOX 1: Testimonies of participants in the development of the environmental calendar

The calendar seemed super important to me because it is a work [that brought together] several communities, integrating the school is also very important for us, for the people for our region ... since there are many things we do not do together. Now, seeing the- interest of other institutions, it is good to give it to them. We are going to share this with the indigenous institutions ... Yesterday I communicated with the local radio show, they asked about this calendar because no community had ever done it, we are the first to work on the calendar, in training, in workshops. Territorial participation of communities that can do things ... this will help us to continue improving and keep working together, because it is hard for us to get together.

(F., president of the Athu Saphi Aboriginal Community)

We thought it was good that our environmental calendar for Santa Catalina has been constructed. It is historical [meaning “significant”] that we unite everything: the culture, the customs that we have here in the puna. The work included the young and old, peasants, the whole community. This made it a more complex calendar and was beneficial for us. Anyone who comes here can know the days when activities are carried out. It's good to summon people, and for tourists and foreigners who can know what takes place here.

(M., member of the local municipal government)

Seeing the printed calendars was really amazing, the whole town felt identified in the work they had done as a community, with the participation of everyone. Feeling identified as a community was the most important thing to me, because livestock, agro-livestock activities, and the celebrations so typical of Santa Catalina were prioritized in that calendar. And thank you, CONICET, for supporting these initiatives in communities so far away in the far north, this allows us to get to know ourselves and look at the calendar and identify as a people and a community.

(E., headmistress of Santa Catalina primary school)

domestic). This differentiation is also remarkable in our study. The interactions and work produced by the EE participants revealed traditional knowledge relating wild and domestic animals, expressed in a *kosmos–corpus–praxis* (KCP) complex, where beliefs, knowledge, and practices are indivisible (Toledo and Barrera-Bassols 2008). Wild and domestic camelids were clearly differentiated in the biodiversity collage, poems, and in the calendar, where llamas were included in the livestock ring, and vicuñas were included in the nature ring. In November, two interesting changes were made to that calendar: Vicuñas were included in the productive circle, as an animal captured and sheared in the *chakus*, and the llamas were moved to the festivities circle, as part of the Santa Catalina caravan fair. The mechanisms underlying the conservation of the wild and domestic camelids differ (Vilá 2012). The main concern for wild vicuñas is to prevent poaching and anthropogenic disturbance (ie being chased by dogs) and secure a space

where the animals can live free under natural selection forces. In contrast, for a domestic llama, it is important to have human assistance, including sanitary care, herding practices, and housing. The human–animal relationship and associated practices are quite different, and this is the main reason that in the local *kosmos* people believe that vicuñas are the herds of *Pachamama* and *Coquena*, while llamas are the herds of humans.

While these activities and exercises of reflection alone might not stop the socioenvironmental deterioration of the Altiplano, we are confident that, at the very least, they could slow this process down and prepare communities for creative alternatives. In places where EE has been successfully implemented, local inhabitants are acutely aware that their camelids are valuable in many ways (including as scientific object of study) and that they have unique features (such as the single-domain antibodies in their blood). Although good news is, unfortunately, very scarce in the world of vertebrate conservation, investment in conservation measures has reduced the vulnerability and extinction risk of several species, particularly among ungulates (Waldron et al 2013; Hoffmann et al 2015). We believe that EE is a critical component of any comprehensive biodiversity conservation strategy and should not be dismissed as a secondary pursuit in conservation efforts, particularly in relation to camelids and pastoral lands.

Today, South American camelids are valued as important animal genetic resources (FAO 2013). They have become progressively more relevant in the international agenda, giving them a visibility that could be a significant driver of local development. EE can help to meet Aichi targets (CBD 2011) 12 and 13 regarding the protection of species and genetic diversity, with vicuñas and domestic camelids as the main examples in the Altiplano. The United Nations General Assembly in 2017 declared 2024 as the International Year of Camelids: “Noting further that camelids constitute the main means of subsistence for millions of poor families that live in the most hostile ecosystems on the planet, and that they contribute to the fight against hunger, the eradication of extreme poverty, the empowerment of women and the sustainable use of terrestrial ecosystems” and “Recalling the urgent need to raise public awareness of the importance of camelids for food security and ecosystem functions, and to promote actions that improve the management of camelids in order to contribute to the Sustainable Development Goals” (UN 2018). In addition, there is an international initiative promoted by the Food and Agriculture Organization of the United Nations to declare 2026 the International Year of Rangelands and Pastoralists.

However, recognition in international documents is meaningless if it is not supported by territorial actions that contribute to the empowerment of those responsible for the daily care of camelids. We consider EE to be a fundamental tool in achieving this goal. In situ EE helps local people, who are often part of ethnic minorities and are intrinsically less involved in national policy debates. If they are not properly informed, these people remain largely unaware of the importance of their camelids as a profitable resource in the international market. In certain areas of the developed world, there is a lot of interest in incorporating these animals as fiber and antibody producers (Gegner 2012). Of course, EE alone is not enough, it needs support in line with the value of nature’s contributions to people. Pastoralist

livelihoods and vicuña management can meet most of the environmental goals set by the IPBES (2019): resource efficiency, circular and other economic models, environmental and social certification of market chains, sustainable practices, and innovation. EE influences local people to conserve their territories, species, and habitats (Caro et al 2003).

Several Sustainable Development Goals (SDGs) can be achieved in well-managed rangelands. An example is SDG 15 “Life on land”: The sustainable use of terrestrial ecosystems via camelid management can help to reverse land degradation and biodiversity loss, and combat desertification. Traditional knowledge innovations and practices of indigenous and local communities also help to reduce poverty, addressing SDG 1 and Aichi targets 2 and 18.

Educational institutions that are deeply rooted in their surrounding community (Chapman et al 2002) can promote changes in the community’s attitude towards wildlife and nature (Uzzell 1999), which is necessary to achieve development goals. Creative, open, integrated EE that lets camelids be part of local school curricula helps to create a holistic and transformational education medium. This presents the environment in a new light, as an attractive and interesting component of the Andean ethos and network of socioecological relationships.

Some key messages can be derived from this work. Brief, intensive EE interventions with children can be very effective, especially on environmental ephemerides. Within a framework of acceptance and security in a playful environment, the children were actively engaged in the activities proposed by our team and were free to invent as they went along, enhancing their creativity. It was a different, thought-provoking experience within the familiar, comfortable setting of the school and its surroundings.

Another key message for environmental policy and education is that, to facilitate the continuity of pastoralism, rural life must be valued from within the school. The relational aspects of people with camelids must have its own space, not only “folklorized” as something of the past but as a dynamic, living component that is essential to the environmental sustainability of the Andes.

Environmental education is a powerful tool for conservation and is the only way to translate SDG and Aichi targets from paper to the real, everyday life of people, in this case, Andean communities. “Valued from the outside, neglected from the inside” is a dangerous situation for any natural resource. Without active and informed local communities, the needed transformative change becomes an unattainable goal. In this sense, EE shows great potential, and it is a beautiful way to value the environment, to “feel-think” (*sentipensar*) about humans and nonhuman beings in the Altiplano.

ACKNOWLEDGMENTS

We thank the headmistresses and teachers of the Santa Catalina, Rodeo, and Pozuelos schools, especially Ely Funes, who always joins these initiatives. We are grateful to the Altiplano children who shared their art and knowledge. We thank Jorge Baldo, a VICAM/National University of Jujuy staff member and teacher of undergraduate students. We are grateful to the communities of Santa Catalina Canchillas, Tolamayo, Morritos, and La Cruz, and the indigenous associations Athu Saphi, Yurax Rumi, and Aucarpina Chambi, the Santa Catalina High School community, town authorities, and governmental staff of the livestock secretary, province of Jujuy. We also thank Rocío Julian, who helped us in the Biodiversity intervention. We are grateful for the valuable comments by 2 anonymous reviewers.

REFERENCES

- Argueta Villamar A, Corona-M E, Alcántara-Salinas G, Santos-Fita D, Aldasoro Maya EM, Serrano Velázquez R, Teutli Solano C, Astorga-Domínguez M.** 2012. Historia, situación actual y perspectivas de la Etnozoología en México. *Etnobiología* 10(1):15–30.
- Arzamendia Y, Baldo J, Rojo V, Samec C, Vilá BL.** 2014. Manejo de vicuñas silvestres en santa catalina, jujuy: Investigadores y pobladores en búsqueda de la sustentabilidad y el buen vivir. *Cuadernos del Instituto Nacional de Antropología y Pensamiento Latinoamericano–Series Especiales* 2 1(2):8–23.
- Arzamendia Y, Baldo J, Vilá BL.** 2012. Lineamientos para un plan de conservación y uso sustentable de vicuñas en Jujuy, Argentina. San Salvador de Jujuy, Argentina: Ediunju.
- Arzamendia Y, Bonacic C, Vilá BL.** 2010. Behavioural and physiological consequences of capture for shearing of vicuñas in Argentina. *Applied Animal Behaviour Science* 125(3–4):163–170.
- Arzamendia Y, Vilá BL.** 2012. Effects of capture, shearing, and release on the ecology and behavior of wild vicuñas. *Journal of Wildlife Management* 76(1):57–64.
- Arzamendia Y, Vilá BL.** 2015. Vicugna habitat use and interactions with domestic ungulates in Jujuy, northwest Argentina. *Mammalia* 79(3):267–278.
- Baldo J, Arzamendia Y, Vilá BL.** 2013. La vicuña. *Manual para su conservación y uso sustentable*. 1st edition. Buenos Aires, Argentina: CONICET [Consejo Nacional de Investigaciones Científicas y Técnicas].
- Boff L.** 1996. *Ecología: Grito de la Tierra, grito de los pobres*. San Pablo, Brazil: Editora Atica.
- Cabrera AL.** 1971. Fitogeografía de la república Argentina. *Boletín de la Sociedad Argentina de Botánica* 14:1–42.
- Caro T, Mulder MB, Moore M.** 2003. Effects of conservation education on reasons to conserve biological diversity. *Biological Conservation* 114(1):143–152.
- CBD [Convention on Biological Diversity].** 2011. *Strategic Plan 2011–2020: Aichi-Targets*. <https://www.cbd.int/sp/targets/>; accessed on 3 March 2020.
- Chapman D, Barcikowski E, Sowah M, Gyamera E, Woode G.** 2002. Do communities know best? Testing a premise of educational decentralization: Community members’ perceptions of their local schools in Ghana. *International Journal of Educational Development* 22(2):181–189.
- Coppock DL, Fernández-Giménez M, Hiernaux P, Huber-Sannwald E, Schloeder C, Valdivia C, Arredondo JT, Jacobs M, Turin C, Turner M.** 2017. Rangeland systems in developing nations: Conceptual advances and societal implications. In: Briske DD, editor. *Rangeland Systems*. Cham, Switzerland: Springer, pp 569–641.
- Dong S, Wen L, Liu S, Zhang X, Lassoie JP, Yi S, Li X, Li J, Li Y.** 2011. Vulnerability of worldwide pastoralism to global changes and interdisciplinary strategies for sustainable pastoralism. *Ecology and Society* 16(2):10.
- FAO [Food and Agriculture Organization of the United Nations].** 2013. *In Vivo Conservation of Animal Genetic Resources*. FAO Animal Production and Health Guidelines No. 14. Rome, Italy: FAO. <http://www.fao.org/3/a-i3327e.pdf>; accessed on 3 March 2020.
- Flores Ochoa JA.** 1974. Enqa, Enqaychu illa y Khuya Rumi: Aspectos mágico-religiosos entre pastores. *Journal de la Societe des Americanistes* LXIII:246–261.
- Flores Ochoa JA.** 1977. *Pastores de Puna*. Lima, Peru: Instituto de Estudios Peruanos.
- Freire P.** 2003. *El grito manso*. Buenos Aires, Argentina: Siglo veintiuno editores.
- Gegner L.** 2012. *Llamas and Alpacas on the Farm*. Butte, MT: ATTRA Sustainable Agriculture Program. https://www.uaex.edu/farm-ranch/animals-forages/other-livestock/llamas-alpacas/llamaalpaca_attrapub.pdf; accessed on 3 March 2020.
- Gibbs J, Hunter M, Sterling EJ.** 2008. *Problem-Solving in Conservation Biology and Wildlife Management*. Oxford, United Kingdom: Blackwell Publishing.
- Gutiérrez F, Prado C.** 1997. *Ecopedagogía y ciudadanía planetaria*. San José, Costa Rica: Editorial Pec-Heredia.
- Hoffmann M, Duckworth JW, Holmes K, Mallon DP, Rodrigues ASL, Stuart SN.** 2015. The difference conservation makes to extinction risk of the world’s ungulates. *Conservation Biology* 29(5):1303–1313.
- IGN [Instituto Geográfico Nacional], SEGEMAR [Servicio Geológico Minero Argentino].** 2019. *Definición de áreas de montaña de la República Argentina*. Buenos Aires, Argentina: Instituto Geográfico Nacional.
- IPBES [Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services].** 2019. *The Global Assessment Report on Biodiversity and Ecosystem Services: Summary for Policymakers* [Díaz S, Settele J, Brondízio ES, Ngo HT, Guèze M, Agard J, Arneth A, Balvanera P, Brauman KA, Butchart SHM, et al, editors]. Bonn, Germany: IPBES Secretariat. https://ipbes.net/system/tdf/ipbes_global_assessment_report_summary_for_policymakers.pdf?file=1&type=node&id=35329; accessed on 2 April 2020.
- Leff E.** 1999. *La pedagogía del ambiente: Educación en ambiente para el desarrollo sustentable*. Buenos Aires, Argentina: Confederación de Trabajadores de la Educación de la República Argentina (CTERA).
- Leon-Velarde C, Quiroz R, Zorogastúa P, Tapia M.** 2000. Sustainability concerns of livestock-based livelihoods in the Andes. In: Tulachan PM, Saleem MAM, Maki-Hokkonen J, Partap T, editors. *Contribution of Livestock to Mountain Livelihoods: Research and Development Issues*. Kathmandu, Nepal: International Centre for Integrated Mountain Development, Systemwide Livestock Programme, Food and Agriculture Organization of the United Nations, and International Potato Center, pp 183–202. <https://lib.icimod.org/record/22953>; accessed on 1 April 2020.

- Rojo V, Arzamendia Y, Vilá BL.** 2012. Uso del hábitat por vicuñas (*Vicugna vicugna*) en un sistema agropastoril en Suripujio, Jujuy. *Mastozoología Neotropical* 19(1):127–138.
- Salas M.** 2013. *Visualising Food Sovereignty in the Andes: Voices and Flavours of the Earth*. Reclaiming Diversity and Citizenship Series. London, United Kingdom: IIED [International Institute for Environment and Development].
- SOLAE Ethics Committee, Medinaceli A, Cano EJ, Argueta A, Sanabria OL.** 2018. Latin American Society of Ethnobiology's code of ethics. *Ethnobiology Letters* 9(1):86–89.
- Toledo VM, Barrera-Bassols N.** 2008. *La memoria biocultural: La importancia ecológica de las sabidurías tradicionales*. Barcelona, Spain: Icaria Editorial.
- UN [United Nations].** 2018. *Resolution Adopted by the General Assembly on 20 December 2017*. A/RES/72/210. New York, NY: UN General Assembly. <http://undocs.org/A/RES/72/210>; accessed on 5 October 2020.
- UNESCO [United Nations Educational, Scientific and Cultural Organization].** 1977. *Intergovernmental Conference on Environmental Education, Tbilisi, USSR, Final Report*. Paris, France: UNESCO.
- Uzzell D.** 1999. Education for environmental action in the community: New roles and relationships. *Cambridge Journal of Education* 29(3):397–413. <https://doi.org/10.1080/0305764990290309>.
- Vilá BL.** 2012. *Camélidos Sudamericanos*. Buenos Aires, Argentina: EUDEBA.
- Vilá BL.** 2014. Una aproximación a la etnozootología de los camélidos andinos. *Etnoecológica* 10(2):43–58.
- Vilá BL.** 2018. On the brink of extinction: Llama caravans arriving at the Santa Catalina Fair, Jujuy, Argentina. *Journal of Ethnobiology* 38(3):372–389.
- Vilá BL.** 2019. *Caravanas de las alturas*. 2nd edition. Buenos Aires, Argentina: Vicuñas, Camélidos y Ambiente (VICAM).
- Vilá BL.** In press. The role of young people in the future of llama caravans to Santa Catalina. In: Clarkson P, Santoro C, editors. *Global Caravans*. Vol 1. Oxford, United Kingdom: Taylor & Francis.
- Vilá BL, Arzamendia Y.** 2016. Construcción de un calendario ambiental participativo en Santa Catalina, Jujuy, Argentina. *Etnobiología* 14(3):71–83.
- Vilá BL, Arzamendia Y, Rojo V.** 2020. Vicuñas (*Vicugna vicugna*), wild Andean altiplano camelids: Multiple valuation for their sustainable use and biocultural role in local communities. *Case Studies in the Environment* 4(1):1232692. <https://doi.org/10.1525/cse.2020.1232692>.
- Vilá BL, Garcia Gomez J, Wawrzyk AC.** 2009. Environmental education as a tool in the sustainable management of vicuña in the altiplano of South America. In: Gordon IJ, editor. *The Vicuña*. New York, NY: Springer-Verlag, pp 97–112.
- Vilá BL, Marcoppido G, Lamas HE.** 2018. Camélidos de la Puna argentina: Aspectos sobre su conservación y uso. In: Grau HR, Babot MJ, Izquierdo AE, Grau A, editors. *La Puna argentina Conservación y Cultura*. 1st edition. San Miguel de Tucumán, Argentina: Fundación Miguel Lillo, pp 443–462.
- Vilá BL, Wawrzyk AC, Arzamendia Y.** 2010. El manejo de vicuñas silvestres (*Vicugna vicugna*) en Jujuy (Argentina): Un análisis de la experiencia del proyecto MACS, en Cieneguillas. *Revista Latinoamericana de Conservación* 1(1):38–52.
- Vilá BL, Wawrzyk AC, Garcia Gomez J.** 2006. La educación ambiental en el proyecto MACS. In: Vilá BL, editor. *Investigación, conservación y manejo de vicuñas*. Buenos Aires, Argentina: Proyecto Manejo de Camélidos Silvestres (MACS) Argentina, pp 175–190.
- Waldron A, Mooers AO, Miller DC, Nibbelink N, Redding D, Kuhn TS, Roberts JT, Gittleman JL.** 2013. Targeting global conservation funding to limit immediate biodiversity declines. *Proceedings of the National Academy of Sciences of the United States of America* 110(29):12144–12148.
- Wawrzyk AC, Vilá BL.** 2013. Dinámica de pastoreo en dos comunidades de la Puna de Jujuy, Argentina: Lagunillas del Farallon y Suripujio. *Revista de Antropología Chilena* 45(2):349–362.

Supplemental material

- APPENDIX S1** Mountain poems in Spanish.
- APPENDIX S2** Biodiversity poem in Spanish.
- APPENDIX S3** Drawing about living in the mountains.

Found at: <https://doi.org/10.1659/MRD-JOURNAL-D-20-00009.1.S1>.