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Running title: Students' perception of species in Argentina

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Abstract

Exotic species seriously affect local biodiversity in Argentina. This paper investigates how students in San Juan province perceive native and exotic species. With the help of a written questionnaire, 865 students (9-17 years old) were asked to name the plant and animal they liked most, disliked most, and perceived as most useful, to name local species and describe their uses in the region. Students' preferences and perceptions were strongly directed towards exotic domestic species. Consequently, workshops were developed in which students were introduced by local ecologists to the diversity of native wild species and their importance for the ecosystem.

Keywords

Chaco, Monte, exotic domestic species, exotic wild species, native species, overgrazing, biodiversity, young people, gender role

Introduction

Climate change, habitat fragmentation and the introduction of exotic species are major threats to global biodiversity (Vitousek et al., 1996; Millennium Ecosystem Assessment, 2003). "Exotic" or "non-native" species, i.e. organisms that have been accidentally or purposefully introduced to an area outside of their area of origin, can cause population reduction or extinction of native species by, for instance, competition, predation or changes in nutrient and decomposition cycles (MacDonald et al., 1989; Caughley & Gunn, 1996; Byers et al., 2001; Vilá & Weiner, 2004; Mooney et al., 2005). In Argentina, a variety of exotic species have been shown to be harmful (Di Paola & Kravetz, 2004; Novillo & Ojeda, 2008), but little information is available on the abundance of exotic species (Boelcke, 1986; Marzocca, 1994; Di Paola & Kravetz, 2004).

Conservation of local biodiversity not only requires proactive measures, such as the establishment of ecological reserves, the restoration of ecosystems and the control of exotic species, but also the dissemination of public information and education about native organisms, their value and the consequences of species introductions (Colton & Alpert, 1998; Trombulak et al., 2004). Several studies indicate that, at least in Western European countries, knowledge and perception of local biodiversity is very limited (Balmford et al., 2002; Lindemann-Matthies, 2002; Bebbington, 2005; Lindemann-Matthies & Bose, 2008). In a study in Switzerland, almost 7000 young people between the age of eight and 18 were asked about organisms in their immediate environment. They could, on average, name only six animals and five plants, and unspecified taxa like "birds", "flowers", or "trees" were among the most commonly listed in all age-groups (Lindemann-Matthies, 2002).

Recent studies have shown that people are the more knowledgeable about local wild animals and plants, the less developed their country and the more rural the community they live in is (Chand & Shulka, 2003; Pilgrim et al., 2007). However, people's knowledge and perception of local biodiversity is not only influenced by their place of living but also, for instance, by their age, sex, and source of taxonomic knowledge. Studies have shown that with increasing age the interest of children in plants and animals strongly decreases and that in all age-groups girls are more aware of and also know more about animals and plants (Lindemann-Matthies, 2002). Girls were found to show a greater affection for large, attractive pet animals whereas boys showed a greater interest in wildlife (Kellert, 1985; Lindemann-Matthies, 2005). Moreover, in less developed countries such as India community elders rather than the formal education system were found to be most important for transferring knowledge about biodiversity to young people (Chand & Shulka, 2003).

Hardly anything is known about people's environmental knowledge in South America (González-Gaudiano, 2007). This study is the first to investigate children's and adolescents' perception and knowledge of species in Argentina. The region where the study was carried out, the Valle Fértil[1] in the province of San Juan, is characterized by Chaco and Monte vegetation, and by a dry desert climate with an annual precipitation of 250 mm (Cabrera, 1994; Pereyra, 2000). The population, a mix of indigenous tribes and white settlers, lives mainly from farming. Overgrazing by exotic domestic herbivores such as goats, cattle and sheep as well as introduced exotic wild species such as the European hare are seriously affecting local biodiversity (Guevara et al., 1996; Ojeda et al., 1998; Márquez, 1999). There are hardly any environmental education activities and it is feared that locals are unaware of the

[1] Location of Valle Fértil: http://www.maplandia.com/argentina/san-juan/valle-fertil/

69 negative consequences of overgrazing, uncontrolled logging and hunting (Ojeda et al., 1998).
70 This study provides baseline data for conservation education activities that take into account
71 the existing preferences, perceptions and knowledge of local students. Moreover, it contributes
72 to international research on public perception and knowledge of biodiversity (e.g. Balmford et
73 al., 2002; Lindemann-Matthies, 2002; Bebbington, 2005; Lucherini & Merino, 2008). The
74 main objectives were to investigate:

75 (1) which animals and plants students in Valle Fértil like most, dislike most and perceive as
76 most useful,

77 (2) whether their preferences and perceptions are directed towards native species,

78 (3) whether their perceptions are influenced by age, sex and source of taxonomic knowledge,

79 (4) which local animals and plants they perceive, and how much they know about their uses.

80

81 **Methodology**

82 Data were collected in nine schools during normal teaching hours with the help of a written
83 questionnaire. The schools were selected based on their accessibility. Due to the remote
84 locations of the villages in the Valle Fértil, some schools had only a few students. The number
85 of students in the schools varied from six to 237. In total, 865 students (468 girls and 397
86 boys) participated in the study. They were between 9 and 17 years old (mean age = 13 years).

87 In the questionnaire[2] (see Appendix), students were first asked to name the animal and the
88 plant they liked most, disliked most and the one they perceived as most useful. To investigate
89 how informed young people living in the Valle Fértil were about their local fauna and flora,

[2] The questionnaire (in Spanish) is available from the authors.

they were asked to name five animals and five plants of the region and to describe their uses. Knowledge about uses is regarded as a significant indicator of indigenous biodiversity knowledge (Hynes et al., 1997; Chand & Shulka, 2003). Moreover, all students were asked about their age, sex and main source of taxonomic knowledge (teacher, family, friends, others).

To investigate whether students' age, sex (coded as 0: male, 1: female) and source of knowledge about species (coded as 0: school, 1: family) influenced the probability that certain answers to the open questions (sorted into broad categories) were given, the data were analyzed by binary logistic regressions with backward elimination of non-significant variables. We controlled for the influence of the schools in which the surveys had been carried out by including them as a categorical variable in the analyses. All analyses were carried out with SPSS for Windows 12.0.1.

Results

Animals and plants students liked most, disliked most and perceived as most useful

Students showed a clear preference for dogs and horses. Dogs and horses were most liked (by 50% of the students) and also perceived as most useful (by 60% of the students; Table 1). In contrast, the dislikes of students were less obvious. The cat, although among the ten most liked animals, was clearly the most disliked one (see Table 1). Among the ten most disliked animals were two native ones: the grey fox (*Pseudalopex griseus*) and the skunk (*Conepatus chinga).*

In total, 59 different animal taxa were named as most liked, 83 as most disliked and 27 as most useful. About 99% of the students named the animal they liked most, 95% the one they disliked most, and 94% the one they considered as most useful at the genus or species level.

Insert Table 1 about here

More than a third of all students named the rose (*Rosa* spec.) as their favorite plant (Table 2). Other plants favored were mesquite (*Prosopis* spec.) and daisy (*Bellis perennis*). Both the rose and the mesquite were also considered useful plants. The cactus and the garabato *(Acacia furcatispina)*, two thorny native plants, were named most often as most disliked (see Table 2). In total, 78 different plant taxa were named as most liked, 97 as most disliked and 70 as most useful. About 96% of the students named the plant they liked most, 81% the one they disliked most, and 74% the one they perceived as most useful at the genus or species level.

Insert Table 2 about here

Exotic domestic animals and exotic plants were clearly preferred and thought to be useful whereas native animals and plants were often disliked (see Table 1 and 2). A preference for a native animal was correlated with a preference for a native plant (Chi-square test: df 1, 807, Chi-square value = 10.22, $p = 0.001$).

Of the tested variables, sex had the strongest influence on the naming of organisms that students liked most, disliked most and perceived as most useful. Girls more often than boys named the dog and the rose as liked most, whereas boys more often named the horse and the mesquite (Table 3). However, with increasing age, the affection of girls for horses increased (significant interaction in Table 3). Overall, girls favored exotic domestic animals and exotic shrubs and herbs, whereas boys favored exotic wild animals and exotic trees. Boys more often

than girls found that the horse was the most useful animal. However, girls more often than boys and older students more often than young ones, considered the rose as the most useful plant. Girls more often disliked cats, whereas boys more often disliked native animals (see Table 3).

About 76% of the students stated that the school was the source of their taxonomic knowledge, the others referred to family members such as parents and grandparents. The source of taxonomic knowledge hardly influenced the naming of individual species (see Table 3).

Insert Table 3 about here

Animals and plants of Valle Fértil and their uses

About 73% of the students could name five animals and 79% five plants of Valle Fértil. Only 3% and 2% of the students, respectively, could not name any animal or any plant at all. On average, students could name 4.5 taxa of plants and animals each. In total, 87 different animal and 116 different plant taxa were named. Only two of the ten most frequently named taxa were native animals (75% of all responses), whereas seven were native plants (51% of all responses; see Table 1 and 2). Livestock and mesquite (*Prosopis* spec.) were named most often.

In total, 11 different uses for animals and 15 for plants were given. The assessment of the uses of animals reflects the farming way of life in the Valle Fértil area. About 73% of all answers referred to meat or milk production, and transport (Table 4). In the view of the students dogs guard the house and cats fight plagues such as mice or insects. The leather of guanacos (*Lama guanicoe*) and their hides are used for clothing, whereas wild birds are captured and sold as

154 pets. Some students considered the conservation of animals as a type of use. Students also
155 mentioned that animal parts are used for tool making; knives, for instance, made from parts of
156 the ñandu (*Rhea americana*) or the quirquincho (*Zaedyus pichiy*). Moreover, the shell of the
157 quirquincho has ornamental value.

158 In the view of many students, plants were used for herbal teas and as spices, but also as
159 medicines against common illnesses (see Table 4). The students also mentioned the use of
160 plants as fire wood or to provide shade which is important for both humans and cattle during
161 the hot summer months. They also stated that plants (e.g. the poplar) are used to make beds,
162 chairs, tables or broomsticks, and to construct houses. Artifacts made of cactus wood are also
163 sold to tourists.

164 Insert Table 4 about here

165

166 **Discussion**

167 Throughout the study, students named a variety of animals and plants. It is particularly
168 remarkable that most of these organisms were named at the genus or species level, which is in
169 strong contrast to the results of a comparable study from Switzerland (Lindemann-Matthies,
170 2002). The result indicates a greater familiarity with organisms in Valle Fértil, Argentina, as
171 students can obviously only name organisms they know. Overall, students' preferences and
172 perceptions followed universal patterns of "like" and "dislike" (Kellert, 1993), and were
173 strongly directed towards useful animals and plants, indicating a strong utilitarian attitude
174 towards nature (Kellert, 1996; Bizerill, 2004).

Humans like animals, especially mammals, with large round eyes, flat and expressive faces, considerable intelligence and the capacity for social bonding (Morris & Morris, 1966; Katcher & Wilkins, 1993; Ward et al., 1998; Lindemann-Matthies, 2005); or, in the words of Kellert (1985) "loveable animals". In contrast, they tend to avoid invertebrates like insects and spiders because they are small as well as being morphologically and behaviorally unlike humans (Morris & Morris, 1965; Kellert, 1993). Such patterns of like and dislike were also found in Valle Fértil. Nine of the ten favored animals were "loveable mammals", among them the native puma (*Puma concolor*). As locals often refer to the puma as "lion", "mountain lion" or "American lion" (Lucherini & Merino, 2008), "puma" and "lion" (forth and fifth in the preference list) might have meant one and the same species. The parrot, the only bird among the ten favorite animals also fulfils criteria of a loveable animal, as it interacts socially with humans, sits upright, and handles objects with its "hands" (Morris & Morris, 1966). Moreover, many parrot species have warm, reddish colors which make them attractive to humans (Wandersee & Schussler, 2001; Stokes, 2007).

Dogs and horses were by far the most favorite animals. Similar results were found in a large study from Switzerland (Lindemann-Matthies, 2005). However, whereas in Switzerland dogs and horses are kept as pets, in rural areas of Argentina they are kept as farm animals and, consequently, considered to be the most useful. Dogs are present in virtually all houses in the Valle Fértil. They are important for guarding the houses against thieves and to protect livestock against predators such as the grey fox (*Pseudalopex griseus)*, but are also used for hunting. The horse is one of the most common means of transport in Valle Fértil, and students (mainly boys) frequently told the researchers that they come to school on horseback. In contrast to the Swiss study (Lindemann-Matthies, 2005), horses were especially liked and

198 considered as the most useful by the boys. There are two, not mutually exclusive, explanations
199 for this finding: (1) Perceptions and preferences reflect the main sphere of life of each gender.
200 In the farming communities of Valle Fértil, the roles of men and women are strictly defined.
201 While boys help their fathers with the farming, girls stay at home and help their mothers with
202 the home duties (see also Chand & Shulka, 2003). These different loci of "biodiversity
203 learning" (farm vs. home) shape the children's cognition of species differently. As perceptions
204 and preferences are closely linked (Lindemann-Matthies, 2005), girls are more likely to
205 perceive and like species in the vicinity of their home, e.g. dogs and roses, whereas the
206 attention of boys is more focused on farmland species, e.g. horses and mesquite. (2)
207 Preferences and aversions depend on the image of species that people, influenced by culture
208 and tradition, have generated (examples in Shepard, 1997). The horse is a symbol for the
209 Argentinean gaucho who is perceived as an honorable, courageous, resolute, hardworking man
210 and excellent rider (Foster et al., 1998). Boys might strongly want to identify with such a
211 positive role model. In contrast, pigs and skunks were disliked as they are representatives of
212 organisms to which negative attributes (dirt, stench) are attached (Katcher & Wilkins, 1993;
213 Shepard, 1997).

214 In contrast to other countries, where cats are always liked (Morris & Morris, 1966), cats were
215 strongly disliked in Valle Fértil, especially by girls. In this rural region, cats are usually not
216 kept as pets but to control pests such as rats, mice and snakes and might thus be associated
217 with their prey. Moreover, as semi-wild animals they might not want to be cuddled by their
218 human owners. Another potentially "loveable" mammal, the native grey fox, was also disliked
219 because it attacks sheep and other small domestic animals (Lucherini & Merino, 2008).
220 Consequently, the grey fox is frequently hunted, and because its fur is quite valuable is

perceived as a useful animal. In total, more than half of the disliked animals were native, among them snakes, spiders and vinchuca (*Triatoma infestans*). Rattlesnakes and other poisonous snakes, scorpions and poisonous spiders are typical for the region, and indeed potentially dangerous to local people. Moreover, the bug *T. infestans* carries a parasite that causes the Chagas' disease which leads to severe health problems and the early death of people in the region (Gorla & Schofield, 2008).

Roses, which have been introduced to the Valle Fértil as garden plants, as well as daisies, jasmines and pinks were strongly liked. These are all plants with colorful, large or fragrant flowers frequently seen in daily life. Such plants were also favored by children in European countries (Tunnicliffe, 2001; Lindemann-Matthies, 2005). It has been assumed by evolutionary biologists that people's preferences for certain species or features of species are genetically based (Wilson, 1984). Bright colors in plants, for instance, may have signaled "food" to our ancestors which would partly explain modern humans' predisposition to them (Heerwagen & Orians, 1993). Other plants might simply be overlooked, as humans have a considerable "plant blindness" towards inconspicuous species (Flannery, 1991; Wandersee & Schussler, 2001). Cacti were both liked and disliked as they have large, bright colored flowers and edible fruits, but also thorns. Cacti as well as the garabato (*Acacia furcatispina*), a spiky shrub typical of the region, might also have been perceived as "weeds" as they are rarely grazed by livestock.

The short list of local native animals which were considered as useful included guanaco (*Lama guanicoe*) and other species which are hunted for their meat and fur. It is thus remarkable that some students stated the conservation of the endangered guanaco and puma (*Puma concolor*) as a use. Half of the plants perceived to live in Valle Fértil were native ones and, in line with

other studies, students were quite familiar with their uses (Chipeniuk, 1995; Chand & Shulka, 2003; Pilgrim et al., 2007). The mesquite (*Prosopis* spec.), which indeed is an important resource in arid regions for both humans and animals (Burkart, 1952, 1976; Mares et al., 1977), was stated most often as a useful plant.

Conclusions

Overall, students in Valle Fértil appeared to be quite ignorant of inconspicuous, "useless" native plants and animals as well as their (hidden) beauty, appeal, or uniqueness. However, students who favored a local animal also favored a local plant, indicating that perceptions can be directed towards native organisms if students get to know them. A similar relationship was found in a study from Switzerland (Lindemann-Matthies, 2005). Although the study area was a remote and rural region, in which elder community members typically disseminate biodiversity knowledge (Chand & Shulka, 2003), the students hardly mentioned their grandparents or parents as a source of such knowledge. School education was thought to be more important. However, personal communication with teachers in Valle Fértil and other studies from South America (González-Gaudiano, 2007) have shown that ecological and environmental topics were rarely included in school curricula, indicating a strong need for environmental education programs. Suitable programs not only increase students' perception of local plants and animals but also, in parallel, their attractiveness (Lindemann-Matthies, 2005), and thus in the view of young people, their worthiness that needs to be conserved (Ashworth et al., 1995).

As part of a plan for the sustainable use of semi-arid and arid areas, it is essential to introduce students to the diversity of local organisms, including less attractive and "useless" species. Moreover, conservation education has to emphasize the consequences of species introductions

and habitat degradation for local biodiversity. The present study was closely linked to the educational project "Awareness of local biodiversity in the Ischigualasto Provincial Park" (Resol. 575 SPU/07). The project was carried out by the National University of San Juan and the University of Zurich in collaboration with local teachers and park rangers from the "Ischigualasto Provincial Park". As part of the project and to apply the results of the present study, one-day workshops for schools in the area of Valle Fértil were developed. Moreover, booklets, posters and educational CDs about local wild species, exotic ones and the consequences of species introductions were designed by the researchers and given to all schools in the area[3]. This was important as hardly any educational material about local wild species and the ecology of the region existed.

The workshops were carried out by ecologists from the University of San Juan, and involved both teachers and their classes. They took place in the schoolyards or the near vicinity of the schools. During the workshops, the students were introduced to native and exotic species with the help of species expositions, environmental games and species identification tasks. They learned about the uses of local wild plants and animals, their ecological importance and adaptations to the local environment. The success of these workshops is currently being evaluated. However, one-day workshops are only a start, and both pre-service and in-service teacher education with regard to biodiversity, its importance and the threats to it are strongly needed in the region.

Acknowledgements

[3] http://sites.google.com/site/interbiodes/education/educacion-ambiental-extension/material-didactico-didactic-material

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References

Ashworth, S., Boyes, E., Paton, R., & Stanisstreet, M. (1995). Conservation of endangered species: what do children think? *Journal of Environmental Education and Information*, *14*, 229-244.

Balmford, A., Clegg, L., Coulson, T., & Taylor, J. (2002). Why conservationists should heed Pokemon. *Science, 295*, 2367.

Bebbington, A. (2005). The ability of A-level students to name plants. *Journal of Biological Education*, *39*, 62-67.

Bizerill, M. X. A. (2004). Children's perceptions of Brazilian cerrado landscapes and biodiversity. *The Journal of Environmental Education*, *35*, 47-58.

Boelcke, O. (1986). *Plantas vasculares de la Argentina nativas y exóticas. Ilustraciones*. Buenos Aires: Editorial Hemisferio sur S.A.

Burkart, A. (1952). *Las leguminosas argentinas silvestres y cultivadas*. Buenos Aires: Acme.

Burkart, A. (1976). A monograph of the Genus *Prosopis* (Leguminosae, Subfam Mimosoideae). *Journal of the Arnold Arboretum, 57*, 219-249.

307 Byers, J. E., Reichard, S., Randall, J., Parker, I., Smith, C., Lonsdale, W., Atkinson, I.,
308 Seastedt, T., Williamson, M., Chornesky, E., & Hayes, D. (2001). Directing research to
309 reduce the impacts of nonindigenous species. *Conservation Biology*, *16*, 630-640.

310 Cabrera, A. L. (1994). Enciclopedia Argentina de agricultura y jardinería: Regiones
311 fitogeográficas Argentinas. Buenos Aires: Acme.

312 Caughley, G., & Gunn, A. (1996). *Conservation biology in theory and practice*. Cambridge:
313 Blackwell Science.

314 Chand, V. S., & Shulka, S. R. (2003). 'Biodiversity contests': indigenously informed and
315 transformed environmental education. *Applied Environmental Education &*
316 *Communication*, *2*, 229-236.

317 Chipeniuk, R. (1995). Childhood foraging as a means of acquiring competent human cognition
318 about biodiversity. *Environment and Behaviour*, *27*, 490-512.

319 Colton, T. F., & Alpert, P. (1998). Lack of public awareness of biological invasions by plants.
320 *Natural Areas Journal*, *18*, 262-266.

321 Di Paola, M. E., & Kravetz, D. G. (2004). Invasive alien species: legal and institutional
322 framework in Argentina. In Miller, M. L., & Fabian, R. N. (Eds.), *Harmful invasive species:*
323 *legal responses* (pp 71-88). Washington, DC: Environmental Law Institute.

324 Flannery, M. C. (1991). Considering plants. *The American Biology Teacher*, *53*, 306-309.

325 Foster, D. W., Fitch Lockhart, M., & Lockhart, D. B. (1998). *Culture and customs of*
326 *Argentina*. Westport: Greenwood Press.

327 González-Gaudiano, E. (2007). Schooling and environment in Latin America in the third
328 millennium. *Environmental Education Research*, *13*, 155-169.

Gorla, D. E., & Schofield, C. J. (2008). Population dynamics of *Triatoma infestans* under natural climatic conditions in the Argentine Chaco. *Medical and Veterinary Entomology*, 3, 179-194.

Guevara, J. C., Cavagnaro, J. B., Estevez, O. R., Le Houérou, H. N., & Stasi, C. R. (1996). Productivity, management and development problems in the arid rangelands of the central Mendoza plains (Argentina). *Journal of Arid Environments, 35*, 575-600.

Heerwagen, J. H., & Orians, G. H. (1993). Humans, habitats, and aesthetics. In Kellert, S. R. & Wilson, E. O. (Eds), *The biophilia hypothesis* (pp 138-172). Washington, DC: Island Press.

Hynes, A. L., Brown, A. D., Grau, H. R., & Grau, A. (1997). Local knowledge and the use of plants in rural communities in the montane forests of northwestern Argentina. *Mountain Research and Development, 17,* 263-271.

Katcher, A., & Wilkins, G. (1993). Dialogue with animals: its nature and culture. In Kellert, S. R. & Wilson, E. O. (Eds.), *The biophilia hypothesis* (pp 173-197). Washington, DC: Island Press.

Kellert, S. R. (1985). Attitudes toward animals: age-related development among children. *The Journal of Environmental Education, 16*, 29-39.

Kellert, S. R. (1993). The biological base for human values of nature. In Kellert, S. R. & Wilson, E. O. (Eds.), *The biophilia hypothesis* (pp. 43-69) Washington, DC: Island Press.

Kellert, S. R. (1996). *The value of the life*. Washington, DC: Island Press.

Lindemann-Matthies, P. (2002). The influence of an educational program on children's perception of biodiversity. *The Journal of Environmental Education, 33*, 22-31.

Lindemann-Matthies, P. (2005). 'Loveable' mammals and 'lifeless' plants: how children's interest in common local organisms can be enhanced through observation of nature. *International Journal of Science Education, 27*, 655-677.

Lindemann-Matthies, P., & Bose, E. (2008). How many species are there? Public understanding and awareness of biodiversity in Switzerland. *Human Ecology, 38*, 731-742.

Lucherini, M., & Merino, J. (2008). Perceptions of human-carnivore conflicts in the high Andes of Argentina. *Mountain Research and Development, 28*, 81-85.

MacDonald, I. A. W., Loope, L. L., Usher, M. B., & Hamann, O. (1989). Wildlife conservation and the invasion of nature reserves by introduced species: a global perspective. In Drake, J. A., Mooney, H. A., di Castri, F., Groves, R. H., Kruger, F. J., Rejmánek, M. & Williamson, M. (Eds.), *Biological invasions: a global perspective* (pp. 215-255). Chichester, UK: John Wiley.

Mares, M. A., Enders, F. A., Kingsolver, J. M., Neff, J. L., & Simpson., B. B. (1977). Prosopis as a niche component. In Simpson, B. B. (Ed.), *Mesquite. Its biology in two desert scrub ecosystems*. (pp. 123-149). Stroudsburg, PA: Dowden, Hutchinson & Ross, Inc.

Márquez, J. (1999). Las áreas protegidas de la provincia de San Juan. *Multequina, 8*, 1-10.

Marzocca, A. (1994). *Guia descriptiva de malezas del Cono Sur*. Buenos Aires: INTA.

Millennium Ecosystem Assessment (2003). *Ecosystem and human well-being: a framework for the assessment*. Washington, DC: Island Press.

Mooney, H. A., Mack, R. N., Mc Neely, J. A., Neville, L., Schei, P. J., & Waage, J. (2005). *Invasive alien species: a new synthesis*. Washington, DC: Island Press.

Morris, R., & Morris, D. (1965). *Men and snakes*. London: Hutchinson & Co.

373 Morris, R., & Morris, D. (1966). *Men and pandas*. London: Sphere Books Limited.

374 Novillo, A., & Ojeda, R. A. (2008). The exotic mammals of Argentina. *Biological Invasions*,
375 *10*, 1333-1344.

376 Ojeda, R. A., Campos, C. M., Gonnet, J. M., Borghi, C. E., & Roig, V. G. (1998). The MAB
377 reserve of Ñancuñán, Argentina: its role in understanding the monte desert biome. *Journal*
378 *of Arid Environments*, *39*, 299-313.

379 Pereyra, B. R. (2000). Clima de la provincial de San Juan. In Abraham, E. & Rodríguez
380 Martínez, F. (Eds.), *Argentina, recursos y problemas de la zona árida* (pp. 71-78).
381 Mendoza: Junta de Gobierno de Andalucía, Universidades y Centros de investigación de la
382 Región Andina.

383 Pilgrim, S. E., Cullen, C., Smith, D. J., & Pretty, J. (2007). Ecological knowledge in lost in
384 wealthier communities and countries. *Environmental Science & Technology*, *42*, 1004-1009.

385 Shepard, P. (1997). *The Others.* Washington, DC: Island Press.

386 Stokes, D. L. (2007). Things we like: human preferences among similar organisms and
387 implications for conservation. *Human Ecology*, *35*, 361-369.

388 Trombulak, S. C., Omland, K. S., Robinson, J. A., Lusk, J. J., Fleischner, T. L., & Domroese,
389 M. (2004). Principles of conservation biology: recommended guidelines for conservation
390 literacy from the Education Committee of the Society for Conservation Biology.
391 *Conservation Biology*, *18*, 1180-1190.

392 Tunnicliffe, S. D. (2001). Talking about plants- comments of primary school groups looking at
393 plant exhibits in a botanical garden. *Journal of Biological Education*, *36*, 27-34.

Vilá, M., & Weiner, J. (2004). Are invasive plant species better competitors than native plant species? - evidence from pair-wise experiments. *OIKOS*, *105*, 229-238.

Vitousek, P. M., D'Antonio, C. M., Loope, L. L., & Westbrooks, R. (1996). Biological invasions as global environmental change. *American Scientist*, *84*, 468-478.

Wandersee, J. H., & Schussler, E. E. (2001). Toward a theory of plant blindness. *Plant Science Bulletin*, *4*, 2-9.

Ward, P. I., Mosberger, N., Kistler, C., & Fischer, O. (1998). The relationship between popularity and body size in zoo animals. *Conservation Biology*, *12*, 1408-1411.

Wilson, E. O. (1984). *Biophilia: the human bond with other species*. Cambridge: Harvard University Press.

Appendix

Questions asked

- How old are you?
- Are you a girl or a boy?
- Indicate the most significant source of your knowledge about plants and animals (only one answer): teacher, family, friends, others.
- Write down the animal you like most.
- Write down the plant you like most.
- Write down the animal you dislike most.
- Write down the plant you dislike most.
- Write down the animal you perceive as most useful.

- Write down the plant you perceive as most useful.
- Write down five local animals of Valle Fértil and describe their uses.
- Write down five local plants of Valle Fértil and describe their uses.