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REGULAR ARTICLES

Health impact evaluation of alternative management systems in vicuña (*Vicugna vicugna mensalis*) populations in Peru

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Abstract To determine the impact of farming over vicuña population in Peru, serum samples were collected from 207 vicuñas (126 captive vicuñas and 81 free-ranging vicuñas) and 614 domestic South American camelids (571 alpacas and 43 llamas), in ten Andean communities at the Salinas y Aguada Blanca reserve, province of Arequipa, southern Peru. Samples were tested for the presence of leptospirosis, foot and mouth disease (FMD), bovine viral diarrhea (BVD), bovine herpesvirus type 1 (BHV-1), brucellosis, bluetongue disease (BT), paratuberculosis, and neosporosis. Serological results showed that 1.9 % (4/207) of vicuñas, 18.6 % (106/571) of alpacas, and 23.3 % (10/43) of llamas were positive to one or more *Leptospira* serovars. One percent of vicuñas (2/207) and 2.4 % of domestic camelids (15/614) had *Neospora caninum* antibodies tested by ELISA, but only two vicuñas and two alpacas were confirmed by Western blot. Epidemiological evaluation found an association of leptospirosis to sex and age ($p<0.001$), with female subjects older than 2.5 years at higher risk of infection. Interestingly, antibodies against *Leptospira* serovars were only found in captive vicuñas. This is the first study where health status of free-ranging and captive vicuñas has been compared. Results indicate minimal to nil presence of FMD, BVD, BHV-1, brucellosis, BT, paratuberculosis, and neosporosis allied to health disorders in our sample. The detection of seropositive animals against *Leptospira*, however, unveils the likely significance of leptospirosis in wild and domestic South American camelids, the impact of mixed husbandry over vicuña population and the risk to human health.

Keywords Free-ranging · Captive · Domestic camelids · Leptospirosis · Arequipa

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Introduction

The wild South American camelids, vicuña (*Vicugna vicugna*) and guanaco (*Lama guanicoe*), and their domestic forms, the alpaca (*Vicugna pacos*) and llama (*Lama glama*), are native species inhabiting the Andean plateau of South America many millennia ago (Wheeler 2012). Today, camelids rearing in Peru and Bolivia provide fiber, meat, and fuel to impoverished Andean herders, who hold most of these livestock (Wheeler and Hoces 1997).

Current vicuña distribution is limited to areas of extreme elevation in the Andes (Wheeler 2012), and for several decades, vicuña has been in danger due to the economic value of their fiber (Appendix II of Convention on International Trade in Endangered Species (CITES)), but protection laws from involved countries in the last 20 years have succeeded on recovering the population (Cox 2003). Several management systems

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