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An analysis of reported cases of leishmaniasis in the southern Ecuadorian Amazon region, 1986–2012

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ABSTRACT

An analysis of reported cases of cutaneous leishmaniasis (CL) was performed using the data registered in the southern Ecuadorian Amazon region during 27 years from 1986 to 2012. The cases/subjects with both the suspected CL lesions and the amastigote-positive results were recruited for the analysis. The yearly occurrence of cases showed a markedly higher number during the six years, 1988 and 1993. After 1994 when the insecticide spraying campaign using helicopter in 1993–1994, the number dropped remarkably. Then, the yearly occurrence gradually fluctuated from 101 cases in 1996 to 11 in 2009, maintaining a low number of cases after the campaign. The monthly occurrence of cases showed a markedly high number during March and August, suggesting a correlation to the rainy season (months) in the areas. A statistical significance was found between the monthly average number of the CL case and the average precipitation ($p=0.01474$). It was suggested that the time of transmission of CL would depend on the rainy seasons at each endemic area of Ecuador, which has a diverse climatic feature depending on the geographic regions. Such information at given leishmaniasis-endemic areas of Ecuador would be important for the future planning of the disease control. Molecular analysis and characterization of clinical samples revealed the presence of *Leishmania* (*Viannia*) *braziliensis*.

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1. Introduction

Leishmaniasis is caused by a protozoan parasite of the genus *Leishmania*, and transmitted by a sand fly of the genera *Phlebotomus* and *Lutzomyia* in the Old and New World, respectively. A total of about 20 species of *Leishmania* parasites in the world are responsible for a wide range of clinical manifestations. Cutaneous leishmaniasis (CL) ranges from simple types to those producing destructive mucocutaneous leishmaniasis (MCL) and non-healing diffuse cutaneous leishmaniasis (DCL). Visceral leishmaniasis (VL) is the severe

chronic infection, which is often fatal if left untreated. These different types of the disease are endemic in many tropical and subtropical regions in the world with two million annual incidence and 350 million people at risk (Desjeux, 2001; Alvar et al., 2012).

In the New World, leishmaniasis are endemic in Central and South American countries, including southern parts of the US (Grimaldi et al., 1989). Control of the disease in the New World is complicated by the variety of different *Leishmania* species and their diverse clinical forms, and also complicated by unique epidemiological patterns of each *Leishmania* species. Furthermore, in many regions of the New World, two or more *Leishmania* species are often sympatric. In Ecuador, seven species of the genus *Leishmania*, *Leishmania* (*Viannia*) *braziliensis*, *Leishmania* (*Viannia*) *panamensis*, *Leishmania* (*Viannia*) *guyanensis*, *Leishmania* (*Viannia*) *naiffi*, *Leishmania mexicana*, *Leishmania amazonensis*, and *Leishmania major*-like are reported (Mimori et al., 1989; Armijos et al.,

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1990; Hashiguchi and Gomez, 1991; Hashiguchi et al., 1991; Furuya et al., 1997; Calvopiña et al., 2004; Kato et al., 2008, 2013; Gomez et al., 2014a,b). The CL is the most frequent clinical feature of the disease in the country, but MCL cases are also seen (Hashiguchi and Gomez, 1991; Calvopiña et al., 2004). The first case of CL in Ecuador was reported by Valenzuela in 1920 in Esmeralda's province, close to the border of Colombia, and MCL case was first described in 1924 by Heinert (Rodriguez, 1974). Since then, many clinical cases of CL and MCL have been reported in the country. Most of the clinical cases of leishmaniasis in Ecuador were reported from the Pacific coastal region (Heinert, 1924; Leon, 1951; Carrera, 1953; Rodriguez and Aviles, 1953; Rodriguez, 1974; Calero and Coronel, 1981; Hashiguchi et al., 1984; Mimori et al., 1989; Armijos et al., 1990; Hashiguchi and Gomez, 1991; Hashiguchi et al., 1991; Furuya et al., 1997; Calvopiña et al., 2004), with very few numbers from the Amazonian regions (Amunarriz, 1982; Hashiguchi and Gomez, 1991; Calvopiña et al., 2004; Kato et al., 2008, 2013) where communications and the medical care system are generally inadequate. Cases of CL have also been reported from the Andean region (Hashiguchi et al., 1991; Gomez et al., 2014a,b). Still, the lack of a well structured information system has not allowed the elaboration of a good and representative epidemiological feature of the disease, requiring more information at given endemic areas of the country.

In this study, we performed an analysis of leishmaniasis cases reported in the southern Ecuadorian Amazon region during 27 years from 1986 to 2012. The yearly and monthly occurrence of the CL cases was analyzed, in relation to the climate changes especially precipitation, insecticide spraying campaign and other factors, such as human life styles, deforestation and migration. Furthermore, to obtain information on the causative *Leishmania* species circulating in the areas, molecular analysis and characterization of clinical samples were made.

2. Materials and methods

2.1. Study sites

Zamora-Chinchipe province is composed of nine cantons/regions in the southeast of Ecuador, and Palanda and Chinchipe are located in the southernmost of the province. The present study sites (Fig. 1), canton Chinchipe (4°51'46" S latitude,

7907'58" W longitude; 1113–1200 m a.s.l., 1207 km², av. temp. 21–22 °C) with 9119 inhabitants in 2010 and canton Palanda (4°38'59" S latitude, 79°07'56" W longitude; 1020–1735 m a.s.l., 1986 km², av. temp. 20–22 °C) with 8089 inhabitants in 2010, belong to Zamora-Chinchipe province (815–2800 m a.s.l.; precipitation, 2000 mm/year; av. temp. 17–22 °C; relative humidity, >99%; humidity index, 92%; Plan de Desarrollo y Ordenamiento Territorial, Unidad de Gestion Territorial Zamora-Chinchipe, <http://www.zamora-chinchipe.gob.ec>) at the southern Ecuadorian Amazon region. Fig. 2 shows panoramic features of study sites, Palanda and Chinchipe (Ishimanchi), located in forested and mountainous areas. Inhabitants of the areas work mostly in agriculture at the field surrounded by primary or secondary forests, except those engaging in commercial activities in the urban areas of parish Zumba and Palanda. Population migration from rural areas to urban areas was found from the past to date and the construction of new roads has been progressed in the regions (see Fig. 2).

2.2. Subjects

The subjects recorded had come from different endemic foci within canton Chinchipe and Palanda, Zamora-Chinchipe province. All the subjects received differential diagnosis of leishmaniasis at the laboratories of outpatient facilities of the Zumba hospital (Chinchipe) and Palanda health center. One of the main activities of the laboratories of these medical/health institutions is to provide differential diagnosis of various parasitological, bacterial, viral and fungal infections in the areas. Thus, the subjects with suspected CL lesions came from almost all the endemic areas of the Canton Chinchipe and Palanda. Questionnaires were prepared to record the residence and occupation of the patients, the evolution and history of the disease, and information on the treatment and others. More than 95% of the study participants lived on farms located at dense forested and mountainous areas. In this study, only the clinical cases with both the suspected CL lesions and the amastigote (smear) positive results were recruited for the analysis, but those without demonstrating the parasites in the smears were excluded unless otherwise specified. Thus, a total of parasitologically confirmed 2323 CL cases registered at the laboratories between 1986 and 2012 were analyzed. Apart from these retrospective studies,

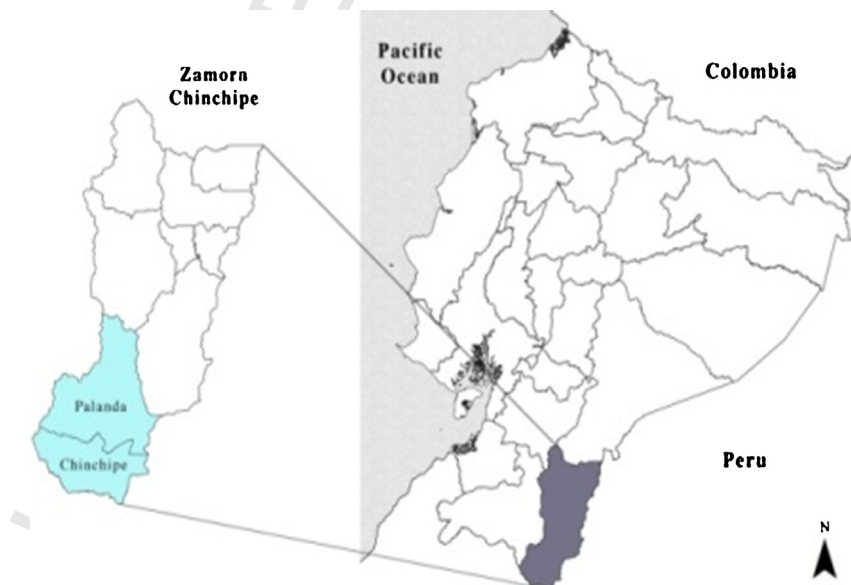


Fig. 1. Map of Ecuador, showing study sites, Canton Chinchipe and Canton Palanda, in Zamora-Chinchipe province (3°15'12" S latitude, 79°30'07" W longitude; <http://www.zamora-chinchipe.gob.ec>).

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