Sand Fly Vectorial Ecology in the State of São Paulo

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Ecological aspect of sand fly distribution in the State of São Paulo, Brazil are described. The main man-biting species are Lutzomyia whitmani, Lu.pessoai, Lu.intermedia, Lu.migonei and Lu.fischeri. Their primary habitat is the forest but latter three of the above species are also encountered in domiciliary environment. Sylvatic species such as Lu.flaviscutellata bite man only rarely and Psychodopygus ayrozai seems to be more anthropophilic. The survival of sand flies in the residual forest and in cultivated areas where man has nearly destroyed the forest almost completely is analyzed. Over the last ten years the incidence of human American cutaneous leishmaniasis (ACL) has been increasing: human cases occurring within several municipalities in which there is overlapping with the distribution of domiciliary Lu.intermedia. New ACL microfoci are appearing in the State of São Paulo and these call for further study.

Key words: American cutaneous leishmaniasis - sand fly - ecology - *Lutzomyia*

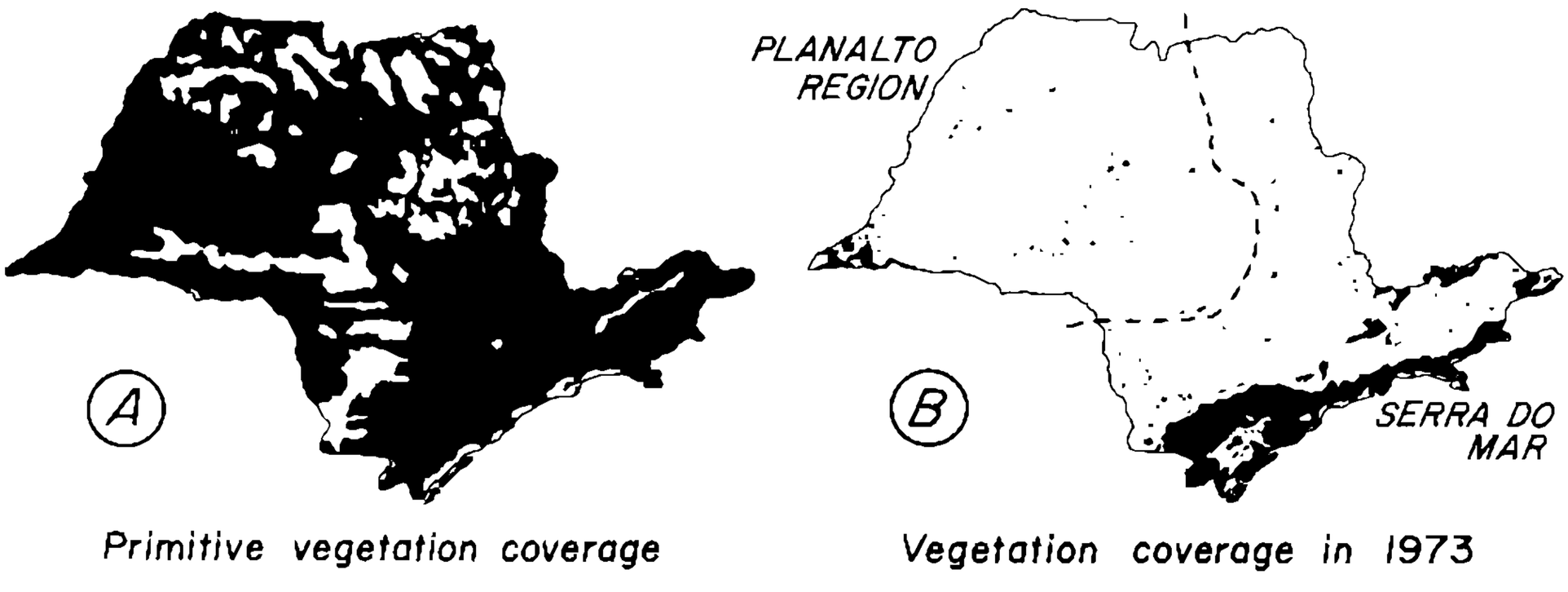
In South America there are two biomes which are of great importance in the epidemiology of American cutaneous leishmaniasis (ACL) and they lie within Brazil (Forattini 1980, Gomes 1986). One is the Amazonian Forest and the other is the Atlantic Forest which originally covered 81.8% of the State of São Paulo (São Paulo), (Fig. 1A). Due to physiographic and climatic variations two principal kinds of vegetation are found in the latter area: semideciduous forest in the Planalto region, and the coastal rainforest on the Serra do Mar (Fig. 1B).

The change from natural forest to cultivated areas has affected the number and diversity of sand fly species and their strategic survival. Their habitat and habits have changed in accordance with man's devastation of the natural environment. Figure 1C shows the currents areas of cattle-raising and agricultural activities in São Paulo State. This development has had a drastic influence on the autochthonous sand fly fauna.

The São Paulo sand fly fauna includes 60 different species (Barretto 1943, Gomes et al. 1989 a, b, Galati 1990), but the present level of human devastation may perhaps have reduced that number. Some of the species are more common in the Planalto region while others are more abundant in the coastal region. *Lutzomyia whitmani*, and *Lu.pessoai*, for example, are found in the former and *Lu.flaviscutellata* and *Psychodopygus ayrozai* in the latter area; species such as *Lu.intermedia*, *Lu.migonei* and *Lu.fischeri* are found in both regions.

Barretto (1943) and Pessoa and Barretto (1948) showed that *Lu.whitmani*, *Lu.pessoai*, *Lu.migonei* and *Lu.fischeri* were the predominant man-biting sand flies in the Planalto region with *Lu.whitmani* accounting for greatest numbers of caught. This sand fly frequently bites man inside dwellings and in the proximities of the forest. The presence of some sand fly species in man-made environment led Barretto (1943) to accentuate the different domiciliary adaptation levels among sand flies species.

As the natural vegetation continued to be destroyed enzootic foci of ACL were reduced to isolated refuges in the residual forest (Fig. 1B). Forattini (1954, 1960) showed that the dominance of *Lu.whitmani* and *Lu.intermedia* alternated in his catches. The latter species tended to overcome the adverse conditions of the open environment by adapting to cultivated land. On the other hand, *Lu.whitmani* and *Lu.pessoai* remained inside the forest. Forattini et al. (1972a,b, 1973, 1976) demonstrated the activity of an enzootic focus of *L.braziliensis* s.l. by isolating the parasite from *Akodon* and *Oryzomys* rodents and from *Lu.intermedia* and *Lu.pessoai*. *Lutzomyia intermedia* was the most numerous sand fly found in Luis Antonio county, although other sand flies were found in smaller numbers. Gomes et al. (1989b) studied the specific composition and the activity of sand flies in four different forests in the northeast-central region of São Paulo. They found that the original forest was the favored habitat of *Lu.whitmani* and *Lu.pessoai* species that now may possibly play a secondary role in the human transmission of ACL. However, *Lu.intermedia* predominates in all places where there has been human modification, including human dewellings. In the Planalto region, the activity of sand flies is frequently noc-



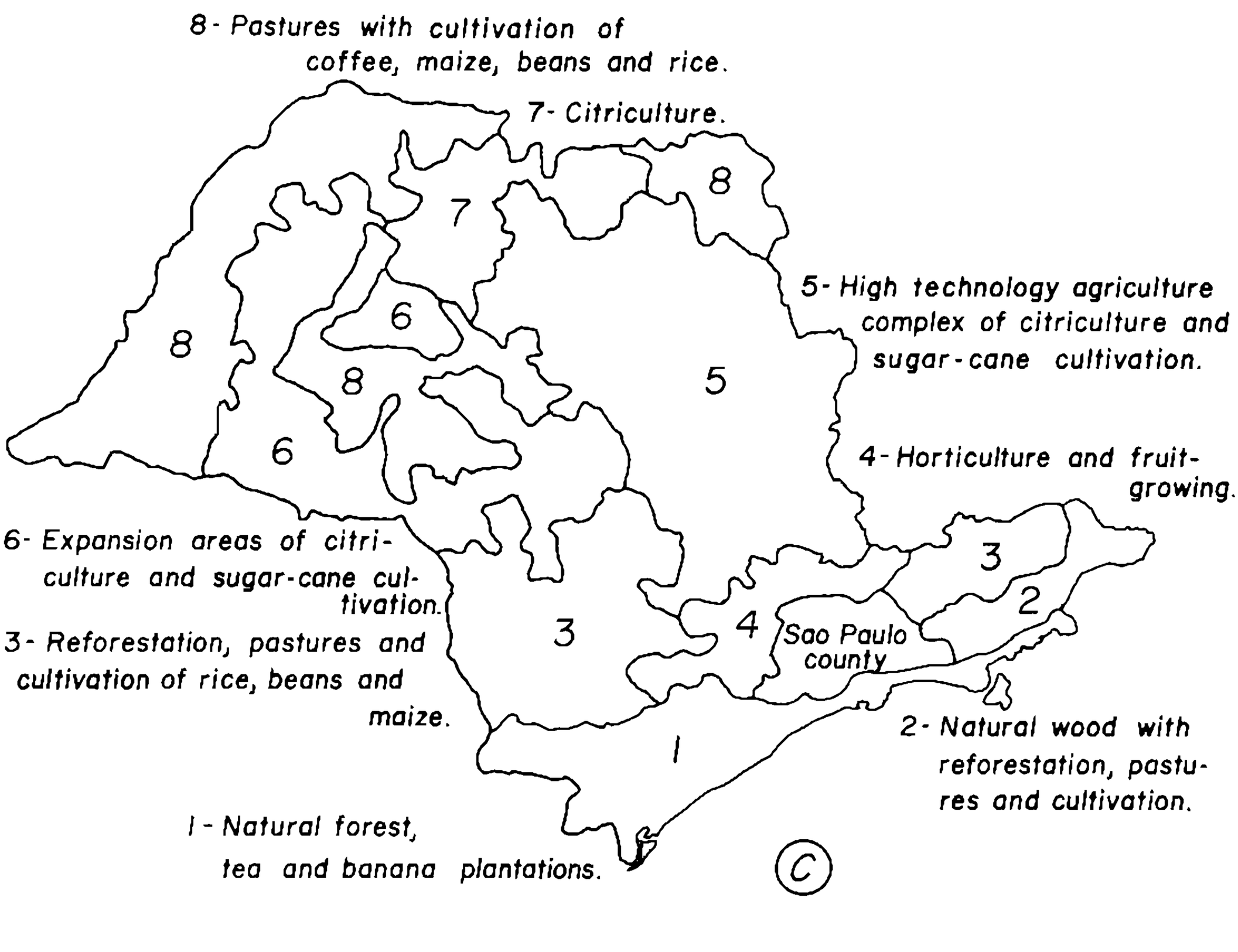


Fig. 1: past and present land use of the State of São Paulo. A - Primitive vegetation coverage. B - Vegetation coverage in 1973. C - Man made landscape.

turnal, except for *Lu.firmatoi* which attacks man during the day. On the other hand, the seasonal activity is almost completely limited to the warm and rainy months. Finally, during investigation of a recent outbreak of ACL in the northeastern region of São Paulo the sand fly catches showed the presence of the important man-biting species *Lu.whitmani*, *Lu.intermedia*, *Lu.migonei*, *Lu.fischeri*, *Lu.firmatoi* and *Lu.longipalpis* (Pignatti, personal communication).

The Ribeira Valley region is separated from the Planalto region by the Serra de Paranapiacaba. Man's devastation of the natural vegetation began in the last century and now the

original forest accounts only 3.0% of the vegetation coverage. The foothills and valleys are used for banana and tea plantations and pasture. Dwellings are scattered, and most of them are far from the forest.

The habits of sand flies have been studied most intensively in the Ribeira Valley. Ecological study has suggested that *Lu.intermedia* is a major vector of ACL and that this human disease is contracted in both peridomiciliar and domiciliar environments. Aside from the fact that *Lu. migonei* and *Lu. fischeri* are also anthropophilic and share the same habitats, their contact with man is less than that of *Lu.intermedia*. This sand fly is an endophilic species and is active throughout the year. Gomes et al. (1989a) showed that *P. ayrozai* attacks man in the forest and that *Lu. flaviscutellata* rarely attacks him in this habitat. *L utzomyia intermedia, Lu. migonei* and *Lu. fischeri* were found in the primary forest but in much smaller numbers. Thus they do not appear to play an important sylvatic role in the epidemiology of ACL. Gomes et al. (1980) observed that *Lu. intermedia* has adapted to the forest edge of woodlands, far from the primary forest. Presently, the natural infection of sand flies in the forest and extra-forest habitats has been studied but, so far only one female of *Lu.intermedia* has been found with flagelates and it seems to be *Leishmania*. On the other hand it has been verified that *Lu.migonei* is not endophilic and that *Lu. fischeri* has rarely been caught in houses, and that *Lu. intermedia* is the dominant sand fly in this region. The sand flies of the Planalto region and in the Ribeira Valley exercise nocturnal activity and are generally caught between 19:00 hr to 24:00 hr. The sylvatic sand flies are clearly most active in the warm months. Gomes et al. (1989c, 1990) demonstrated the presence of *L.(V.) braziliensis* in the forest but did not isolate it from the sylvatic rodents in the same area.

The ecology and epidemiology of ACL in São Paulo deserve further research in an attempt to discover the transmission cycle of *L.braziliensis*. The current view is that man's devastation creates artificial barriers and that the survival of *L.braziliensis* depends on new interrelations with *Lu.intermedia* and reservoirs are still unknown. This may help answer the question as to why the epidemiology has changed over the last three decades. After several years of sporadic human cases, and since 1980, these has been a remarkable increase in the incidence in microfoci throughout São Paulo (Gomes 1992). Figure 2 shows the patchy distribution of human cases from 1987 to 1992. These data suggest that changes in the habits of the vector or a co-evolution vector/*Leishmania*/reservoir have occurred. Even so, *Leishmania* continues to survive within small wooded areas, although primitive foci are now rare and *Lu.whitmani* seems to be losing epidemiological importance. In the Ribeira Valley region the primary forest is extensive and the natural enzootic cycle does not involve man because the sand flies are zoophilic. An alternative suggestion is that the sylvatic mammal reservoir travels into peridomiciliar environments, banana plantations and residual woods where *Lu.intermedia* is also present. Therefore there may be a secondary enzootic cycle in which *Lu.intermedia* transmits *Leishmania* within human dwellings. In some way however, ACL still maintains its relationship with the environment which, in the State of São Paulo, contains both natural and monocultural vegetation.

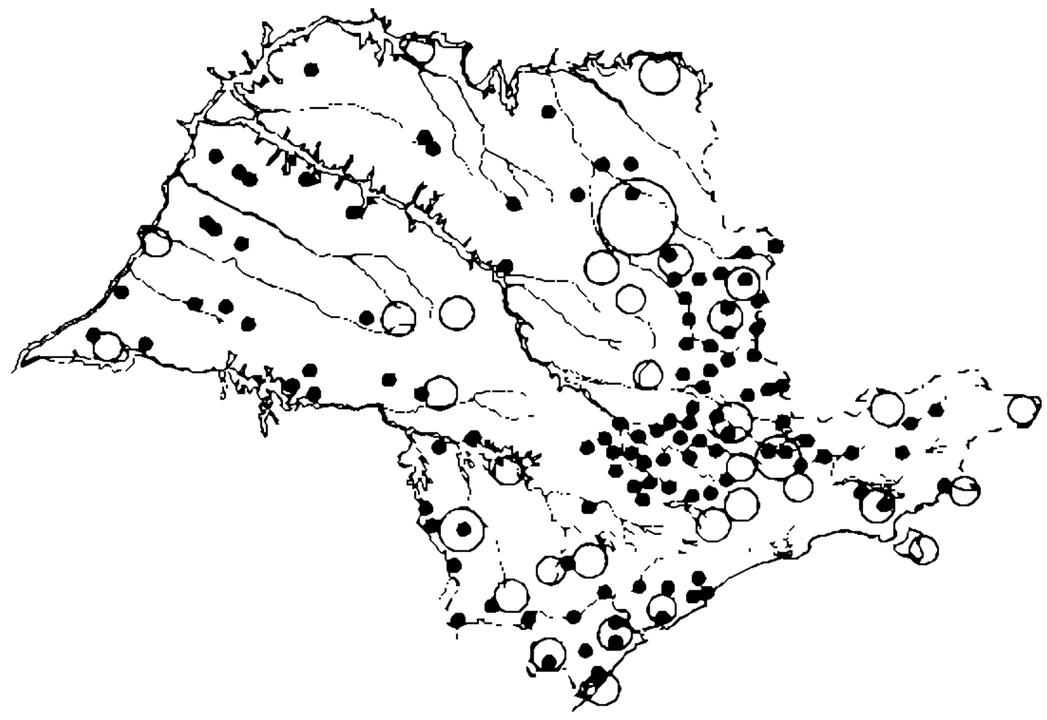


Fig. 2: the overlapping human cases and primary and modified woodlands in the State of São Paulo. ● - Human cases of ACL. ○ Primary and modified woodlands.

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