Current epidemiological status of schistosomiasis in the state of Pernambuco, Brazil

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Uncontrolled peripheral urbanisation coupled with environmental degradation has affected the status of schistosomiasis in Pernambuco (PE), Brazil. This endemic disease continues to perpetuate its transmission in rural areas and has also become a cause for concern in coastal towns of the state. The lack of basic infrastructure (sanitation and health programmes) to support the new urban areas leads to faecal contamination of natural aquatic environments, resulting in consequent infection of vector snails and the emergence of new sources of schistosomiasis transmission. In the present paper, we discuss the current epidemiological status of schistosomiasis in PE. We have consolidated and analysed information from parasitological, malacological and morbidity surveys undertaken by the group of researchers at the Laboratory of Schistosomiasis, Centro de Pesquisas Aggeu Magalhães-Fiocruz. The results of our analysis show: (i) the maintenance of the levels of schistosomiasis in the rural Zona da Mata, PE, (ii) the record of the human cases of schistosomiasis and the foci of infected snails detected along the coast of PE through 2007, (iii) the high record of the severe clinical form of schistosomiasis in the metropolitan region of Recife (RMR) and (iv) new breeding sites of schistosomiasis vector snails that were identified in a 2008 survey covering the RMR and the coastal localities of PE.

Key words: schistosomiasis - epidemiological monitoring - endemic diseases

In the state of Pernambuco (PE), uncontrolled development of peripheral urban areas together with environmental degradation has led to new health hazards for the human population. Among these is schistosomiasis, which was previously considered to be a rural endemic disease. The agricultural industry, comprised of large landholdings of sugarcane monoculture, which is socially and economically excluding by nature, has invested little in healthcare for rural workers. Opportunities for employment on the land have been decreasing and this has led to the migration of large proportions of the rural populations to urban centres. This has resulted in the appearance of schistosomiasis in the coastal regions where it has reproduced the transmission model found in rural areas and has demonstrated a concerning tendency towards endemisation.

On the periphery of coastal urban areas, the lack of basic infrastructure (sanitation and health services) to support new urban development has resulted in faecal contamination of natural aquatic environments. Consequently, vector molluscs have become infected and new foci of schistosomiasis transmission have arisen. Environmental, climatic and human-engendered disturbances have put populations at risk that have never been previously exposed to this disease. The heavy rains that occur on the coast of PE between the months of May and August cause breeding sites to overflow, thereby carrying infected molluscs into streets and backyards. Healthy individuals become exposed through this rout and outbreaks of acute cases of schistosomiasis now occur even among middle and upper-class individuals (Barbosa et al. 1998, 2000, 2001a, b, 2004, Silva et al. 2006, Araújo et al. 2007, Souza 2008, Souza et al. 2008).

The Schistosomiasis Laboratory of the Centro de Pesquisas Aggeu Magalhães-Fiocruz (CpqAM-Fiocruz) has 20 years of experience researching schistosomiasis epidemiology and control and, in partnership with researchers from other institutions, has accumulated an important collection of published papers on the occurrence of this endemic disease in PE. Recently, the researchers and collaborators at this laboratory created a research group that has been registered as the XisCanoé Program at the website http://200.17.137.109:8081/xiscanoe. The purpose of this program is to assemble knowledge in order to understand and analyse structures and processes related to schistosomiasis transmission on the coast of PE. The program brings together postgraduate students from different fields and provides training to enable a holistic view of the biological, socioeconomic and cultural determinants of Manson's schistosomiasis.

The aim of this paper was to compile the information resulting from various epidemiological surveys and a recent scientific expedition conducted by the researchers of the Schistosomiasis Laboratory of CpqAM-Fiocruz

Financial support: SVS/MS
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Received 22 January 2009
Accepted 4 September 2009

in order to assess the current epidemiological status of schistosomiasis in PE. The results of those investigations have allowed us to (i) determine the prevalence among humans in the endemic area (Zona da Mata), (ii) record the human cases and the foci of infected molluscs occurring in coastal areas from 1998-2007, (iii) survey the occurrence of severe clinical forms of the disease and (iv) identify new breeding sites and foci of vector snails in the metropolitan region of Recife (RMR) and coastal area through a recent malacological survey.

MATERIALS AND METHODS

The epidemiological surveys analysed in the present study were coordinated by researchers who form part of the Schistosomiasis Laboratory of CpqAM-Fiocruz and resulted from several research projects that were implemented between 1998-2008. In addition, a scientific expedition was undertaken in 2008 to update the records regarding foci of vector molluscs for schistosomiasis along the entire coastline of PE. The methodological procedures are described as follows:

The prevalence of schistosomiasis in the endemic area of PE was updated by means of a coproscopic survey carried out in 2005 on representative samples from schoolchildren aged 9-12 years. The 46 municipalities that make up the Zona da Mata of PE [(ZMP); "forest zone"], the endemic area for schistosomiasis in PE, were included in this survey (Barbosa et al. 2006) (Fig. 1). The tests were performed using the Kato-Katz method (Katz et al. 1972) with one sample from each individual.

Epidemiological studies that have been conducted since 1998 were used to investigate human cases of the acute and/or chronic clinical forms of schistosomiasis in beach localities where tourism and leisure activities are prevalent. Human cases and foci of vector molluscs were identified through active searches of sampled or census-based coproscopic or malacological surveys of coastal localities. The choices of areas to be investigated were made based on the index of human cases referred to CpqAM-Fiocruz by local health services and on active random searches for snails that were positive for *Schistosoma mansoni* in litoral areas (Barbosa et al. 1998, 2000, 2001a, b, Araújo et al. 2007, Souza et al. 2008).

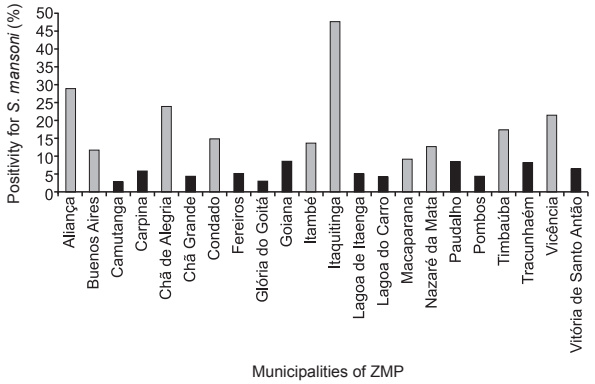

Fig. 1: positivity for *Schistosoma mansoni* among schoolchildren in the municipalities of the Zona da Mata of Pernambuco (ZMP), September 2005.

The severe clinical forms of schistosomiasis were surveyed by means of a case series study on schistosomotic myeloradiculopathy cases that were found by searching and reviewing the medical records of Hospital das Clínicas, Hospital da Restauração and Instituto Materno Infantil de Pernambuco, between 1994-2006 (Araújo et al. 2006, Cunha et al. 2007, Lobo et al. 2007).

Updated observations of the schistosomiasis breeding sites and foci on the coastline of PE were made between September 15-20th 2008 through a scientific expedition formed by 11 researchers from CpqAM-Fiocruz who are specialists in malacology and epidemiology (Barbosa et al. 2008). They carried out a malacological survey covering the RMR and coastal localities of the state with the objective of updating and mapping the presence of new foci of the schistosomiasis vector snails. This scientific expedition covered a distance of 780 km along the northern and southern coastlines of PE in a zone parallel to the coast and at a distance of 2 km from the sea. The expedition investigated all water bodies in urbanised areas and other areas of epidemiological importance (i.e., areas with easy access and human contact). Snails were collected systematically by sweeping these areas for 30 min-2 h, depending on the extent and accessibility of the breeding site. Subsequent examination using the light exposure test in the laboratory determined whether the specimens were positive for *S. mansoni* (Standen 1952). The batches of molluscs that remained negative were subjected to a molecular diagnostic test (PCR-single tube) to identify the DNA of the parasite (Abath et al. 2002). The breeding sites were georeferenced and the index of relative abundance was estimated as the number of molluscs collected per unit of time and effort. This analysis, together with mollusc infection rates, was used to generate a map of the disease in PE coast areas.

RESULTS

The survey carried out in 2005 to update the prevalence data in rural zones of PE covered 271 schools that had been randomly selected in 179 localities in the 43 municipalities that make up the rural region of the ZMP (Fig. 2). In this survey, 11,234 schoolchildren ranging in age from 9-12 years were examined and 1,625 individuals presented parasitism with *S. mansoni*. The mean rate of positive findings was 14.4%. The geometric mean parasite burden among the population sampled was 67.9 eggs per gram of faeces. These indicators attest to the significant morbidity caused by schistosomiasis, especially considering the severity of the infection that had already become established in this young population.

Human cases of the acute and/or chronic clinical forms of schistosomiasis and foci of vector molluscs have been recorded through epidemiological studies conducted at beach locations where tourism and leisure activities are prevalent. Thirty-three acute cases were identified at Praia do Forte on Itamaracá Island (1998) and 442 acute cases were identified at Praia Porto de Galinhas in Ipojuca (2000). The clinical form of the disease could not be differentiated at the other coastal localities investigated because there has not been any clinical

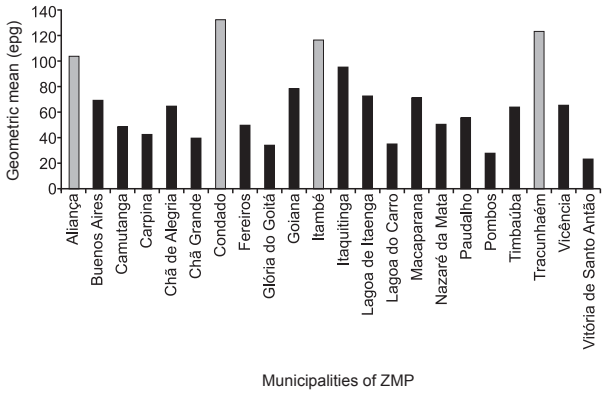

Fig. 2: intensity of infection by *Schistosoma mansoni* among schoolchildren in the municipalities of the Zona da Mata of Pernambuco (ZMP), September 2005. epg: eggs per gram.

Fig. 3: foci of schistosomiasis and vector molluscs identified on the coast of Pernambuco, Brazil, between 2000-2007.

investigation of the 539 positive human cases detected in Lagoa das Garças (RMR) in 2003, the 231 cases detected in Praia Carne de Vaca (Goiana) in 2006 and the 12 cases detected in Praia Ponta de Pedras (Goiana) in 2007. In the latter two localities, no previous record of the disease was found.

At coastal localities where no parasitological surveys were performed, such as Enseada dos Golfinhos (Itamaracá), Janga and Pau Amarelo (Paulista), non-systematic malacological investigations were conducted during the rainy season and immediately afterwards (March-September) to collect, identify and investigate the infectiveness of the snails that are the intermediate hosts for *S. mansoni*. All of the snails collected between 2000-2007 were of the species *Biomphalaria glabrata*. Between 2000-2002 in Porto de Galinhas, 2,214 snails were collected. Of these, 16.1% eliminated cercariae of *S. mansoni*. In the Sotave settlement (RMR), 1,212 *B. glabrata* snails were collected in 2003 and the infection rate was 12.9%. The specimens of *B. glabrata* from Porto de Galinhas and Sotave were exposed individually to light in laboratory tests. A mean of 750 cercariae were eliminated after 20 min of exposure, with 1 mL pipetted from the 50 mL that was homogenised in each vessel. The results demonstrate the infective power of *B. glabrata* collected at the two localities. Between 2003-2005 in Janga and Pau Amarelo (Paulista), 445 molluscs were caught. Of these, 3.4% and 20%, respectively, were found to be infected. The localities that were determined to be transmission sites of schistosomiasis between 2000-2007 are detailed in Fig. 3.

The occurrence and persistence of severe clinical forms of schistosomiasis in PE are evident in the survey of cases of schistosomotic myeloradiculopathy that was carried out by investigating 11,145 medical files referred by PE hospitals over the last 13 years (Araújo et al. 2006, Cunha et al. 2007, Lobo et al. 2007). It was found that 529 medical files involved cases of myelopathy. Of these, 139 were cases of schistosomotic myeloradiculopathy (26.3%). There were greater percentages of cases among young individuals, those with the hepatointestinal clinical form and those from the RMR (Tables I, II)

TABLE I

Distribution of cases of schistosomotic myeloradiculopathy at three hospitals in Recife, Pernambuco (1994-2006), according to age group and sex

Age group (years)	Men		Women		Total	
	n	%	n	%	n	%
< 20	30	32.6	22	46.8	52	37.4
20-40	39	42.4	16	34	55	39.6
40-60	20	21.7	7	15	27	19.4
≥ 60	3	3.3	2	4.2	5	3.6
Total	92	100	47	100	139	100

The scientific expedition, which provided a systematic and detailed investigation of the entire coastline of PE and the RMR, served to update previous records of the occurrences of breeding sites and foci of *Biomphalaria*. The expedition also recorded the introduction of new breeding sites and foci in these two regions, both in beach localities and in peripheral districts of the RMR (Fig. 4). Investigations were conducted in 11 municipalities and the 97 points investigated were georeferenced. In localities where *B. glabrata* that have been collected for several years, including Praia do Forte (Itamaracá), Janga, Pau Amarelo (Paulista), the presence of *Biomphalaria straminea* was detected for the first time. The *B. straminea* breeding site at Praia do Forte is situated 20 m from the sea. In Praia Mangue Seco (Igarassú) several specimens of *B. straminea* were collected 30 m from the sea. In Apipucos lake (RMR), specimens infected with *B. straminea* were diagnosed using the nested PCR technique to detect the DNA of *S. mansoni*.

TABLE II

Distribution of cases of schistosomotic myeloradiculopathy at three hospitals in Recife, Pernambuco (1994-2006), according to the systemic clinical forms of schistosomiasis (Araújo 2008)

Clinical forms	HR	HC	IMIP	Total	%
Acute	-	3	-	3	2.2
Intestinal	-	5	-	5	3.6
Hepatosplenic	-	2	-	2	1.4
Hepatointestinal	-	6	-	6	4.3
Not available	100	13	10	123	88.5
Total	100	29	10	139	100

HC: Hospital das Clínicas; HR: Hospital da Restauração; IMIP: Instituto Materno Infantil de Pernambuco.

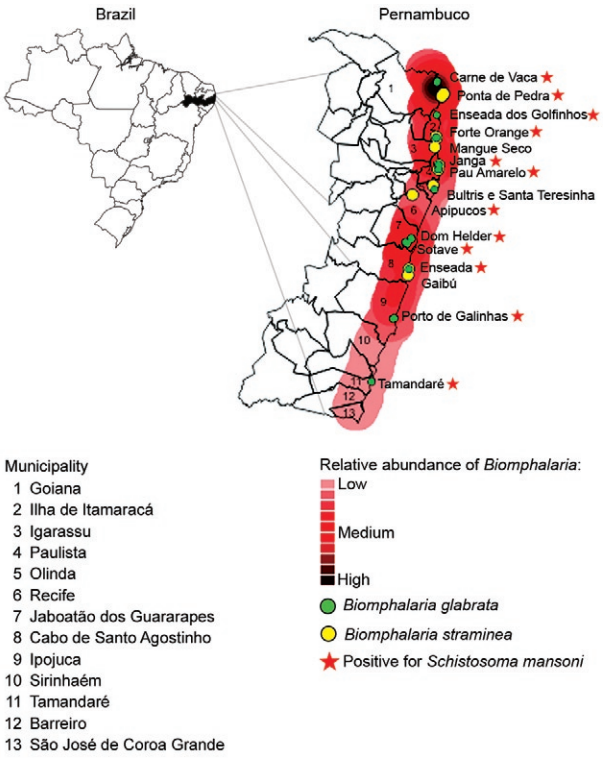

Fig. 4: updated map of breeding sites and foci of schistosomiasis on the coast of Pernambuco and the metropolitan region of Recife resulting from the scientific expedition of September 2008 (Barbosa et al. 2008).

DISCUSSION

Due to the tradition of research on schistosomiasis in PE, there is an important and up-to-date body of knowledge relating to the epidemiology, control, malacology, clinical characteristics, therapy, sociocultural relationships and behavioural traits of Manson's schistosomiasis. Previous and current studies provide insight regarding the current epidemiological status of this endemic disease in this state. The investigations that have been conducted in various areas of the state have made it possible to identify and record sites that present a potential biological and environmental risk of schistosomiasis transmission and to identify concentrated areas of epidemiological vulnerability.

Along the coastal strip of the state and in the peripheral areas of the RMR, the environment is clearly being altered by the spatial occupation patterns and the destruction of natural resources. In particular, landfill in mangrove swamps and the use of sandbank areas for construction, small hotels and residential complexes of vacation homes for the middle and upper classes are affecting the environment. These patterns of land use and occupation are creating conditions that may be favourable for the establishment and proliferation of colonies of the vector snails that transmit schistosomiasis (Barbosa et al. 2000, 2001b, 2004).

The coast of PE, with its beautiful beaches and natural resources, stimulates internal and external tourism. At the same time, it is the target of unrestrained real estate speculation. The demand for unskilled labour (in civil construction, domestic services, craftwork sales and bars and restaurants) is attracting enormous numbers of individuals from unemployed rural populations. These people migrate to invaded areas on the urban periphery of the seashore in the RMR. Since not even minimal levels of sanitation infrastructure or access to healthcare and information are available to these populations, they end up contaminating the environment with faecal material that often contains eggs of *S. mansoni*.

A recent study of the Praia Porto de Galinhas carried out by environmental analysts revealed that "[...] uncontrolled urban development has caused Porto de Galinhas to lose its characteristics. Severe environmental impacts can be seen in the form of devastation and indiscriminate landfill in mangrove swamp areas […] and in the form of sewage discharge into the rivers that cross the municipality; construction on the scrub vegetation along the shoreline; destruction of the coconut groves to keep up with the frenetic pace of the real estate sector and, finally, in the form of the increasing density of development in the central areas of Porto de Galinhas, which lack potable water and a basic sanitation network" (Barros 2002).

The recent map of the distribution of schistosomiasis foci in the RMR and along the coastline of PE shows the geographical expansion and spatial distribution of the mollusc's breeding sites and schistosomiasis foci in these areas. This gives rise to specific situations of risk for the resident population or for individuals who frequent these localities and it requires new forms of prevention and provision of care from the health services. Furthermore, the snails collected in these coastal localities were highly infected. This not only attests to the biological quality of the principal vector on the coast (*B. glabrata*), but also proves that active disease transmission is occurring in these places.

With regard to control measures for this endemic disease, the municipal healthcare services have had difficulty in meeting the standards for decentralised control defined by the Unified National Health System. This is

perhaps because of the occurrence of many other health problems, but it is also due to lack of defined priorities and lack of planning. Evaluation of the information system used by the schistosomiasis control programme, the Sistema de Informação do Programa de Controle da Esquistossomose (SISPCE), has revealed problems such as poor reliability of the prevalence estimates for *S. mansoni* (Pieri & Favre 2007). The percentage of the population studied was very low, which prevented determination of the prevalence and severity of schistosomiasis infection for the whole municipality. Recent studies have shown the inadequacy of the programme's actions with respect to schistosomiasis control in the RMR. It has been determined that 80% of the municipalities do not meet the standards recommended by the Ministry of Health for controlling the disease. There is no symmetry between the actions of different municipalities, suggesting that each municipality in the RMR has a different understanding regarding the SISPCE. The lack of connectivity and continuity among the control actions may contribute heavily to maintenance of transmission, since one activity depends on another for the control to be effective (Quinino et al. 2009).

In some municipalities of PE, the municipal teams responsible for controlling endemic diseases demonstrate a lack of readiness regarding their knowledge of the epidemiological situation, their skills for parasitological and malacological diagnosis and their planning for control actions. Special attention has been given to the coastal municipalities with localities in which schistosomiasis is still not perceived as a serious health hazard for the population. In this respect, the Schistosomiasis Reference Service of CpqAM-Fiocruz has been providing training for the municipal and state health services regarding techniques for parasitological and malacological diagnosis and has been holding workshops to develop projects aimed at controlling the disease. So far, 37 courses and training sessions have been held with the objectives of capacitating healthcare professionals, strengthening the experience of the municipal administration with the use of modern parasitological techniques and epidemiological tools that enable precise diagnosis and in planning actions to minimise situations of risk. For the municipalities of Itamaracá and Goiana, applications were constructed (Supplementary data) using the Geographical Information System. This is a valuable instrument for locating and characterising foci of schistosomiasis vectors and it allows managers to plan interventions according to whether the risk of schistosomiasis transmission is moderate or severe. However, much of the knowledge passed on through these training sessions has been ineffective because of rotation within the municipal teams and the particular criteria established by each municipality according to the availability of resources and equipment.

The studies outlined here illustrate the epidemiological complexity of schistosomiasis in PE and indicate the need for new studies to develop low-cost products with negligible environmental impact to facilitate control over vector molluscs (Favre et al. 2006). In addition, there is need to be new intervention strategies that allow greater diagnostic and treatment coverage for the communities affected, which could be used as alternative tools for integrated control over schistosomiasis. Such control cannot be viewed outside of the social and economic context of the communities affected and it will only be achieved through social changes that involve improvements in the living conditions of the least favoured populations.

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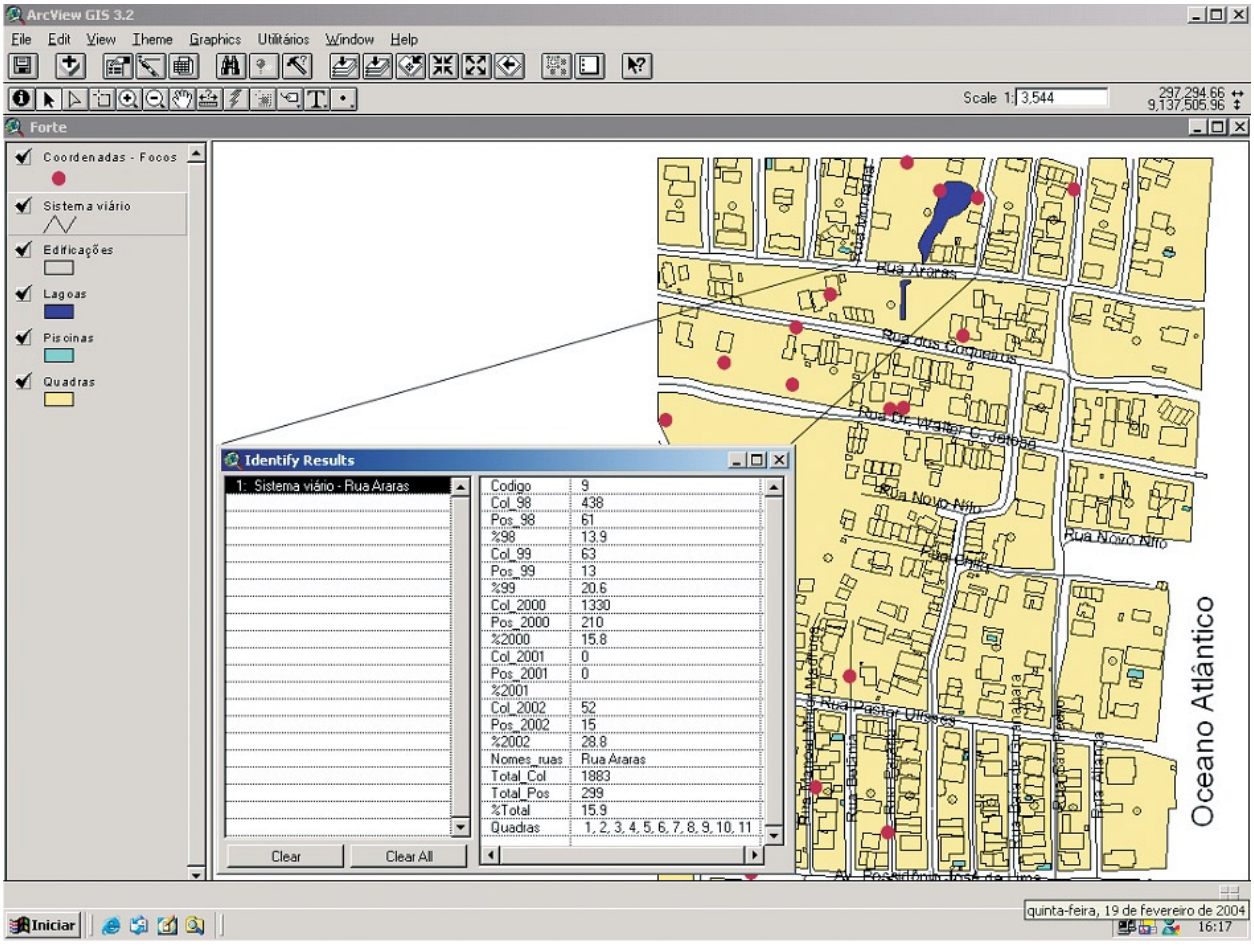
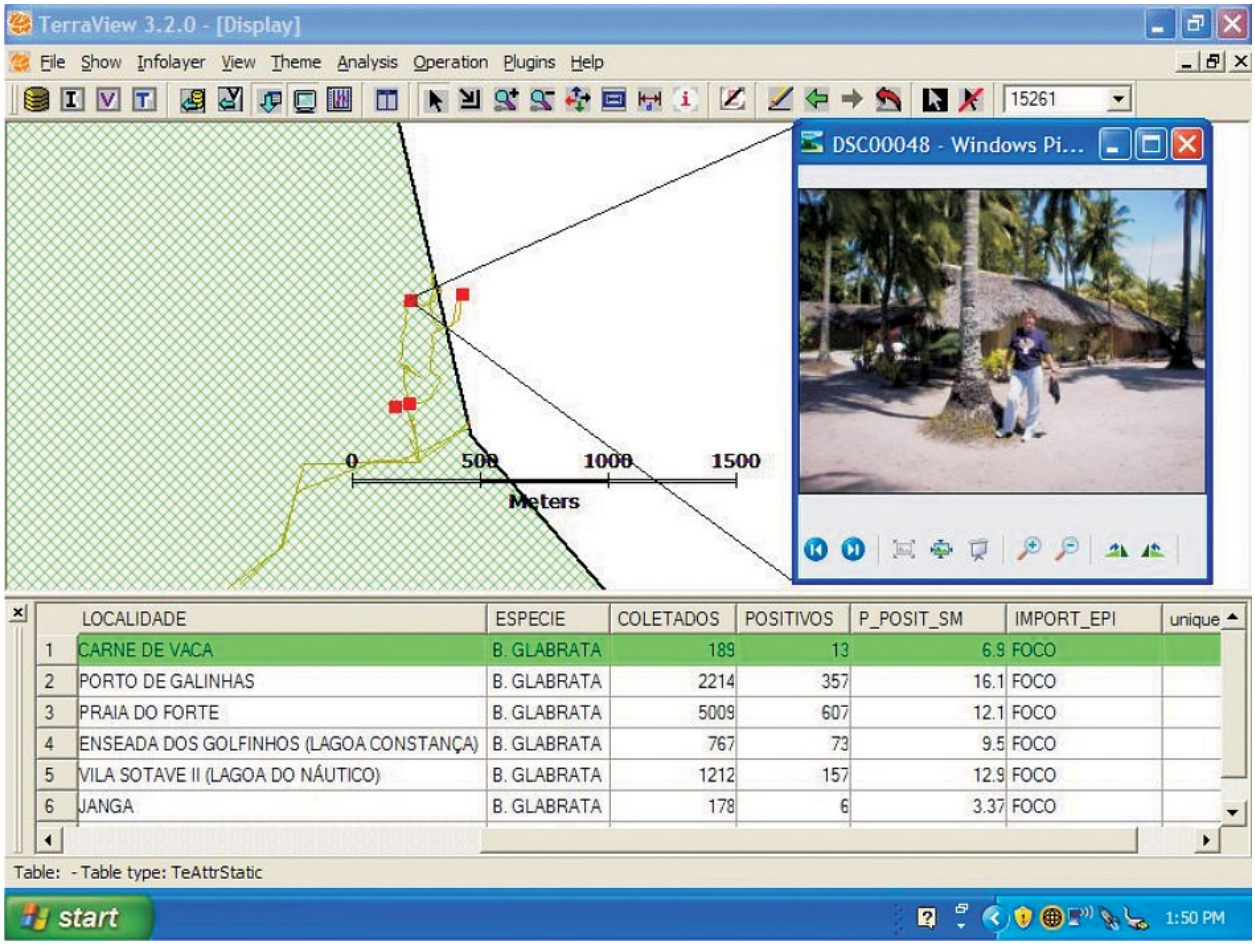


Fig. 5: application for monitoring the foci of schistosomiasis vectors at Forte beach, Itamaracá, Pernambuco, Brazil (KC Araújo, unpublished observations).



	LOCALIDADE	ESPECIE	COLETADOS	POSITIVOS	P_POSIT_SM	IMPORT_EPI	unique
1	CARNE DE VACA	B. GLABRATA	189	13	6.9	FOCO	
2	PORTO DE GALINHAS	B. GLABRATA	2214	357	16.1	FOCO	
3	PRAIA DO FORTE	B. GLABRATA	5009	607	12.1	FOCO	
4	ENSEADA DOS GOLFINHOS (LAGOA CONSTANÇA)	B. GLABRATA	767	73	9.5	FOCO	
5	VILA SOTAVE II (LAGOA DO NÁUTICO)	B. GLABRATA	1212	157	12.9	FOCO	
6	JANGA	B. GLABRATA	178	6	3.37	FOCO	

Fig. 6: application for monitoring the foci of schistosomiasis vectors at Carne de Vaca, Goiana, Pernambuco, Brazil (KC Araújo, unpublished observations).