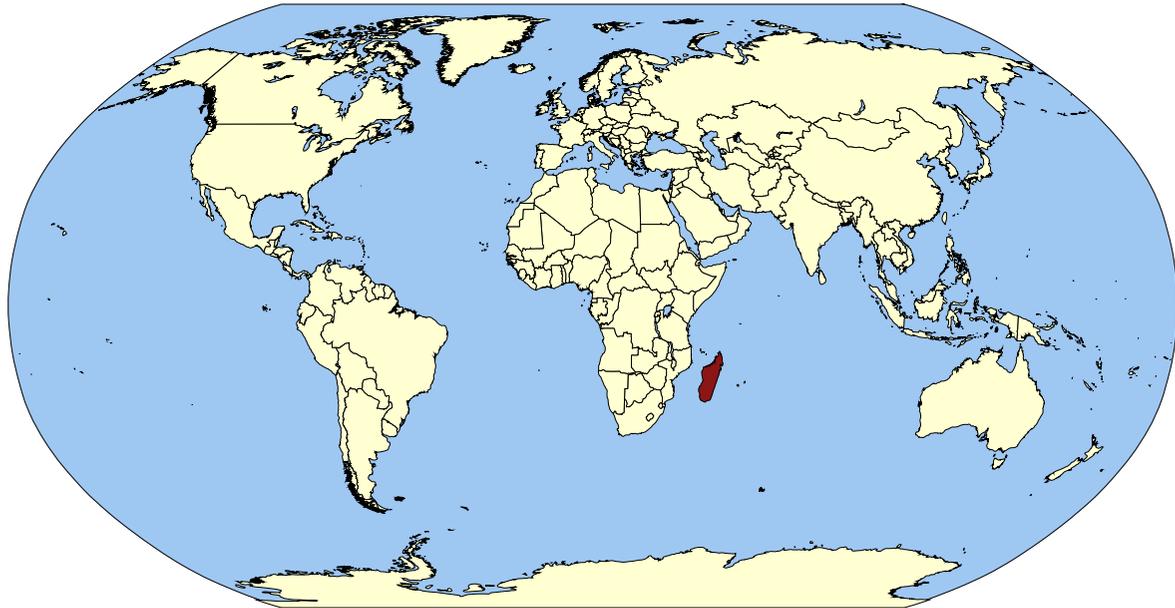


Madagascar



Schistosomiasis in Madagascar -- in Context

Madagascar has the fifth highest rate of schistosomiasis in the world [1]. First reported in the early part of the 20th century, *Schistosoma haematobium* and *S. mansoni* infections have long been considered major public health problems in Madagascar [3]. Prevalence rates have remained high, and political instability has likely been a reason for fluctuating treatment and control. Madagascar gained independence from France in 1960, but it wasn't until more than 30 years later, in 1992, that Madagascar became a constitutional democracy [15]. In early 2009, as a result of protests over increasing restrictions on freedom of the press, President Ravalomanana handed over power to the military in a coup d'état. The 2009 political crisis hurt economic development, with investment decreasing and tourism dropping more than 50% in 2010. Presidential and parliamentary elections in 2013 restored constitutional governance. Over the long history of instability in Madagascar, schistosomiasis infection rates climbed steadily [7]

Schistosomiasis in Madagascar [20]

6.6 million total people and 2.8 million children require treatment

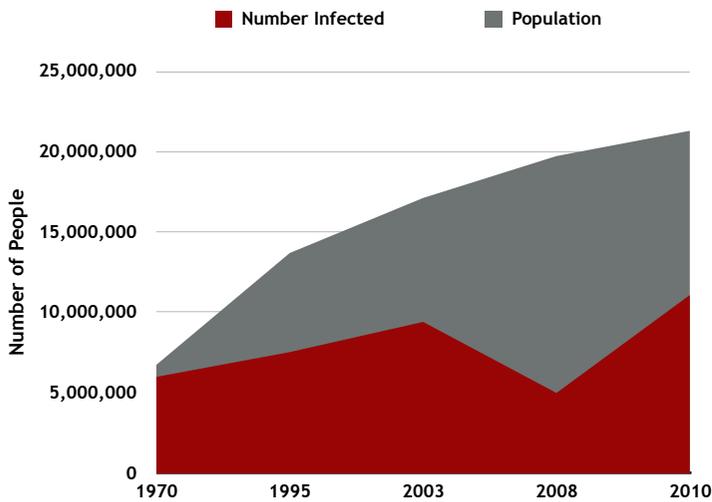
28% of the population requires preventative chemotherapy for schistosomiasis

Madagascar's schistosomiasis treatment programs treat 75% of its targeted population, but only 15% of the total population in need



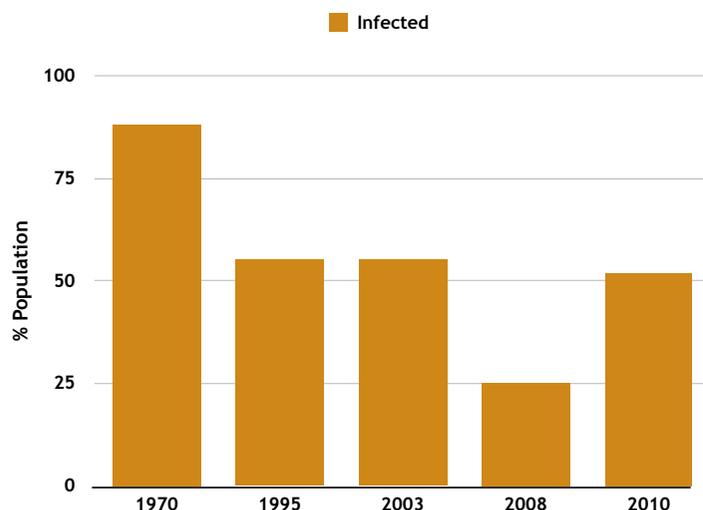
Overview of Madagascar [15]

- » Population in 2015: 23,812,681
- » Official Languages: French & Malagasy
- » Capital: Antananarivo
- » Republic
- » Percentage of Population with Access to Improved Drinking Water in 2012: 49.6%
- » Percentage of Population with Access to Improved Sanitation in 2012: 13.9%



Schistosomiasis Rates in Madagascar

As seen in the graph above, the number of people infected and at risk for schistosomiasis on Madagascar has steadily grown with the population. Estimates range from 6 million people infected in 1970, to 7.5 million in 1995 and 11 million in 2011 [18,6]. Prevalence has shown a similar expanding trend, as seen in the graph below: in 1968, 17% of Madagascar's population was infected with *S. haematobium* and 28% with *S. mansoni* [8]. whereas the prevalence increased to 55% in 2003 and 52.1% in 2010 [1]. Schistosomiasis has remained widespread across the country. In 1968, *S. haematobium* was found in 120 of the 455 districts surveyed, and *S. mansoni* in 201 of the 438 districts [11]. A recent reassessment in 2008 by the WHO showed that 95 out of 111 districts surveyed remain infected [8].



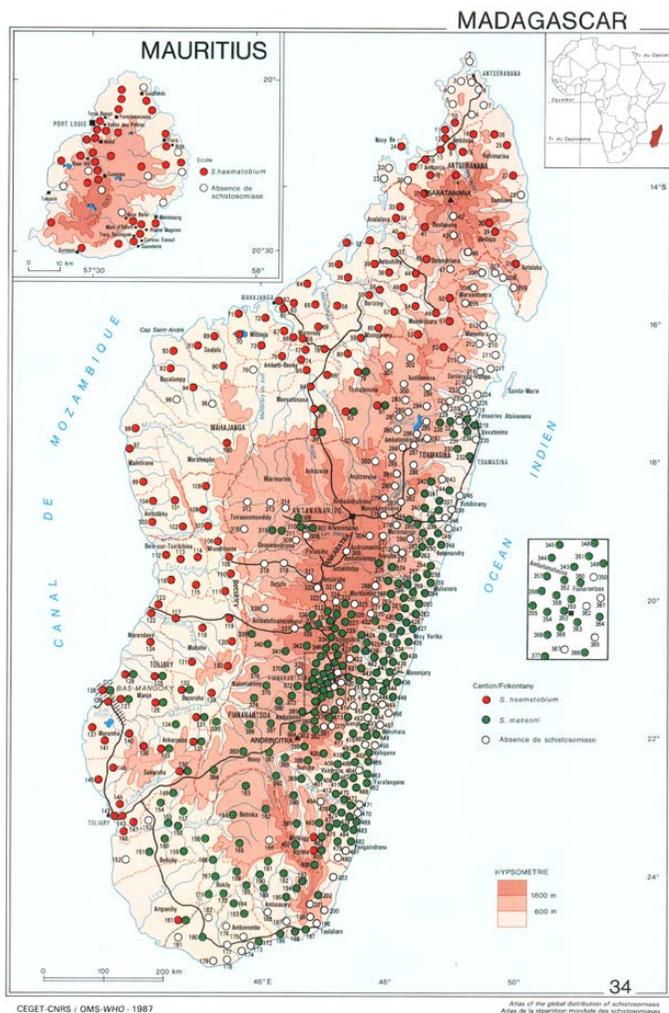
Development Projects in Madagascar

The high schistosomiasis transmission rates in Madagascar may be influenced by the fact that agriculture, fishing and forestry account for one quarter of the country's GDP and employ approximately 80% of the population [15]. Madagascar has the second largest extent of irrigated area in Sub Saharan Africa, with rice crops representing the dominant sector of irrigation allocation [12,13]. In the 1960s, large-scale irrigation schemes on Lake Alaotra, Marovoay, and the Mangoky Delta, helped increase the amount of cultivated land [14]. But, run-off from heavy rains combined with poor drainage in fields created large amounts of stagnant water - the perfect environment for snail populations transmitting schistosomiasis [7].

Schistosomiasis Distribution in Madagascar

A considerable amount of information on the schistosome species' distributions has been available since the 1950's. Mobile health teams and medical districts collaborated with the Directorate General of Health and the Pasteur Institute of Madagascar to conduct parasitological surveys. As seen on the map on the next page, *S. mansoni* rarely overlaps with *S. haematobium*. A report in 1978 confirmed the geographically separated distribution of the two species -- where *S. haematobium* mainly occurred in the northwest and west coast, *S. mansoni* could be found in the east coast and central/southern region [3]. Co-infection with both forms of the disease can occur in certain irrigated areas, especially in the Lower Mangoky development area.

Recent reports note that schistosomiasis is expanding from rural to urban locations, and in this fashion is moving inward towards the central highlands of Madagascar [7]. The spread of intestinal schistosomiasis especially shows cause for alarm [16]. A report from 1998 linked the spread of *S. mansoni* into the central highlands of Madagascar to increased human migration, development projects, and urbanization in that area [17]. Thus, schistosomiasis rates may follow the increases in Madagascar's development. Meanwhile, the disease distribution of *S. haematobium* most strongly correlates to the expansion of suitable snail host distribution.



Schistosomiasis Distribution

Areas with red dots indicate districts affected by *S. haematobium*. Areas with green dots indicate districts affected by *S. mansoni*. As the map shows, the two species are geographically separated.

Control Measures, Praziquantel, and Program Coverage

Beginning in the early 1970s and 1980s, Madagascar began to sponsor pilot schistosomiasis control initiatives. These initiatives employed molluscicides in combination with other methods, including environmental modification, health education, and chemotherapy [4].

Starting in 1983, Madagascar was one of 24 countries that established a national schistosomiasis control program [5]. In the early 1980s, the German Agency for Technical Cooperation (GTZ) participated in some of the first large-scale applications of praziquantel in a number of countries, including Madagascar [5,6]. The German Pharma Fund also carried out a project in collaboration with the WHO to donate praziquantel in Pemba Madagascar for schistosomiasis control in the 1990s.

Although schistosomiasis control efforts seem to have started early in Madagascar, coverage rates have been low: from 1999 to 2006, only 110,000 school children in total were treated out of an infected population in the millions [8]. Similarly, in 2013, over 6 million people were reported infected of which 1 million were treated, representing a c. 15% coverage rate [20]. In addition to the large number of individuals infected and low coverage rates for treatment, there is little health education on the disease, which is often mistaken for a sexually transmitted infection [7].

Recent Control Measures

In 2006, the government of Madagascar initiated the Madagascar Action Plan 2007-2012 in order to help the country reach the Millennium Development Goals (MDGs) [9]. The plan aims to reduce prevalence of schistosomiasis infection from 50% to less than 20%. In 2008 Merck donated 3.4 million Praziquantel tablets to the project, resulting in the treatment of more than a million school-aged children in that year. However, this effort has not been sustained and major public health initiatives in the country are more focused on diseases such as HIV/AIDS, tuberculosis, leprosy, and the black plague [7]. In 2012, USAID started a program for latrine education, which may be helpful in curbing the disease. As of October 2013, the Schistosomiasis Control Initiative started exploratory project preparations in Madagascar [10].

Overall, access to improved water supplies and to a lesser extent, access to improved sanitation facilities have increased only slightly in both rural and urban areas of Madagascar. At the national level, access to improved water sources increased from 31% in 1990 to 41% in 2008. In 1990, 8% of people had access to improved sanitation, and 11% by 2008 [2]. Madagascar is unlikely to reach water supply and sanitation (WSS) targets of the Millennium Development Goals, and this lack of access to improved water and sanitation may contribute to the schistosomiasis prevalence over the decades.

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Madagascar is in great need of an intervention or revamping of its schistosomiasis control programs. The disease widely affects Madagascar, infecting millions each year. The results of early control programs are hopeful, but modern control needs to be well-executed and constantly applied in order to step closer to schistosomiasis elimination