

# Towards the management of the invasive plant *Parthenium hysterophorus* (Asteraceae) in eastern and southern Africa: determining its distribution

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## Introduction

*Parthenium hysterophorus* L. (Asteraceae), an annual herb with prolific seed production, is native to the Americas. *Parthenium* is a major weed globally, having invaded Australia, large parts of Asia, several Pacific islands, and southern and eastern Africa. *Parthenium* causes severe economic losses to agricultural production by invading land used for cropping and livestock grazing. This weed also impacts on biodiversity conservation, and invades disturbed land, wasteland, roadsides and water courses. *Parthenium* impacts on human and animal health by causing severe allergic respiratory reactions and contact dermatitis, and taints the meat and milk of animals. On the African continent, where *parthenium* is known to occur in Ethiopia, Somalia, Kenya, Madagascar, Mozambique, South Africa, Swaziland and Zimbabwe, there have been no concerted efforts to control this weed until recently. Little was documented on the distribution of *P. hysterophorus* infestations in Africa prior to the inception of the USAID IPM CRSP *parthenium* project. It was deemed critical to determine the distribution of the weed in parts of eastern and southern Africa to prioritise areas for control efforts (biological, mechanical, chemical, and cultural).



Fig. 1 *Parthenium hysterophorus*

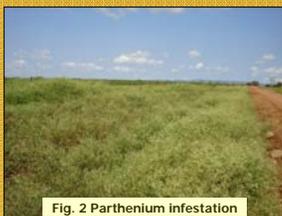


Fig. 2 *Parthenium* infestation

## Materials and Methods

- Potential distribution:** CLIMEX ver. 2.0 software and parameters derived from the literature (by Queensland Department of Natural Resources and Mines) were used in this study to develop a predictive model and generate maps depicting the most climatically favourable areas in Africa for the growth of *Parthenium hysterophorus*.
- Baseline data:** Known locality records for *parthenium* in eastern and southern Africa were obtained from herbarium records and databases.
- Surveys (distribution and abundance):** Using the CLIMEX predictions and *parthenium* records, a strategy was formulated to survey ecologically suitable areas surrounding known localities, at quarter degree square scale (QDS) (25 km x 25 km), to determine the distribution of *parthenium* in South Africa, Swaziland, Botswana, Uganda and Ethiopia. In 2006, two-week road surveys were conducted towards the end of the summer growth season to assess the distribution and abundance of *parthenium*. Surveys determined whether *parthenium* occurred in quarter degree squares immediately surrounding known localities and/or ecologically suitable areas. In 2007, quarter degree squares adjacent to the 2006 localities and beyond were examined. The abundance of infestations was rated as low (1 plant/m<sup>2</sup>), medium (2 plants/m<sup>2</sup>) or high (>2 plants/m<sup>2</sup>).
- CLIMEX validation:** Distribution records were overlaid on the CLIMEX predictive maps to assess the validity of predictions.

## Results and discussion

### Potential distribution

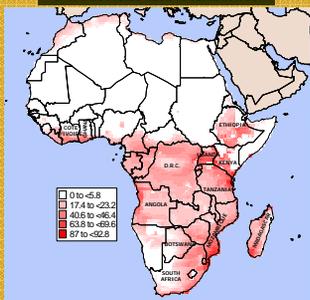


Fig. 3 CLIMEX prediction of ecologically suitable areas in Africa for *P. hysterophorus* invasion. Higher value (dark red) Ecoclimatic Indices indicate the most favourable areas for *parthenium* growth.

- CLIMEX model predictions indicated that large parts of Central, Western, Eastern and Southern Africa are ecologically suitable for the growth of *parthenium* (Fig. 3).

- Limited baseline distribution records of *parthenium* were available in herbarium records and databases (Fig. 4 (a) and (b)).

### Baseline data

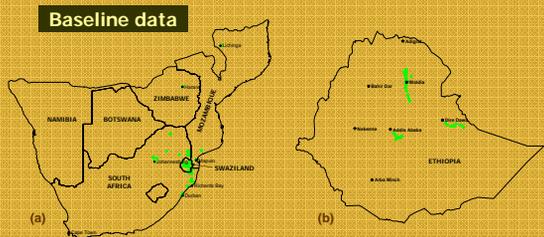


Fig. 4 Baseline *P. hysterophorus* distribution records from herbaria and databases in (a) southern Africa, and (b) Ethiopia.

### Surveys: distribution

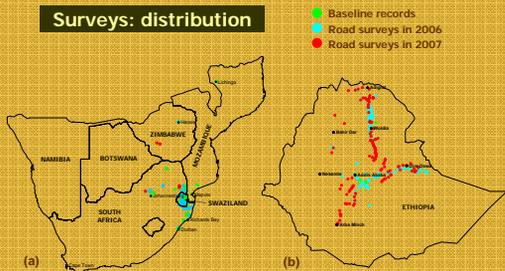


Fig. 5 *P. hysterophorus* distribution from baseline data, and road surveys in 2006 and 2007 in (a) southern Africa, and (b) Ethiopia.

- Surveys in selected countries indicated that *parthenium* was more widely distributed than previously recorded, with a 41-81% increase in distribution records following surveys (Fig. 5 (a) and (b)).

- Increased records do not necessarily reflect increased spread but could rather be attributed to sampling effort.

- Parthenium* was present throughout Swaziland, parts of eastern South Africa, and widespread in Ethiopia.

- Second year surveys in South Africa and Swaziland yielded only an additional 4 QDS, likely indicating that the current extent of *parthenium* there had been determined.

- Surveys in Botswana and Uganda yielded no *parthenium*.

### Surveys: abundance

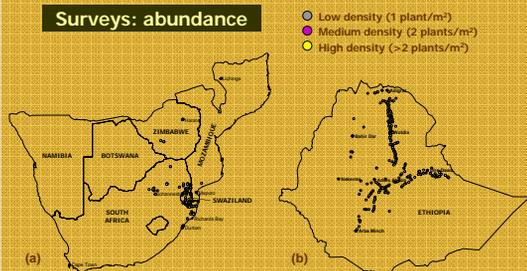


Fig. 6 Abundance of *P. hysterophorus* at localities determined from road surveys during 2006 and 2007 in (a) southern Africa, and (b) Ethiopia.

- High density infestations of *parthenium* were present throughout most of its distribution in southern Africa and Ethiopia (Fig. 6 (a) and (b)).

### CLIMEX validation

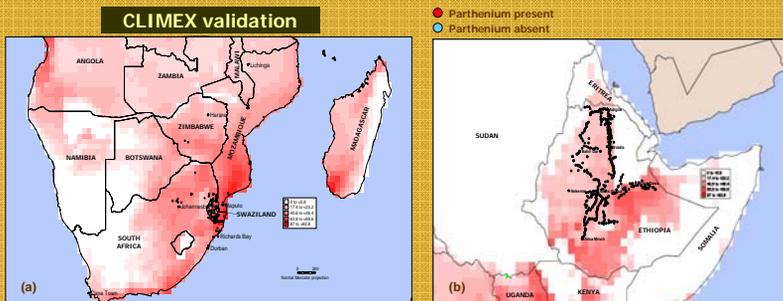


Fig. 7 Updated distribution of *P. hysterophorus* overlaid on CLIMEX model predictions of ecologically suitable areas for the weed in (a) southern Africa, and (b) Ethiopia.

- Observed distributions of *parthenium* matched CLIMEX predictions of suitable areas (Fig. 7 (a) and (b)).
- Several ecologically suitable areas could not be incorporated in these surveys for logistical reasons; they should be closely monitored for invasion by *P. hysterophorus*.

## Conclusion

- The benefits of this species-specific distribution survey were: (i) increased knowledge of the current distribution of *parthenium*, and indication that this weed occurs more widely than previously recorded, (ii) locality information of the extent and severity of *parthenium* infestations for the selection of suitable sites for the implementation of control strategies, and (iii) development of a baseline to monitor future spread and abundance of *parthenium*, both with regard to presence of the plant and in the long-term, as a broad measure of the efficacy of control methods implemented.

- Because of the vast distances to be covered, and limited road access and political instability in parts, not all ecologically suitable areas could be visited during the surveys. Other areas of Ethiopia as well as other countries that are highly suitable for invasion by *parthenium* e.g. Tanzania, Mozambique and Madagascar, should be monitored.

- Outcomes of this study included the realization of *parthenium* as a problem of national significance in e.g. Ethiopia and Swaziland, and a potential widespread problem on the resource-limited African continent.

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