RIU

Catch Brown Locusts before they hatch

Validated RNRRS Output.

Forecasters in southern Africa can now predict swarms of locusts cost-effectively and accurately. Plagues of the Brown Locust are extremely destructive in Botswana, Namibia and South Africa. They happen in at least seven out of ten years, often coinciding with droughts—a double whammy for poor farmers. Previously, warnings based on field surveys often came too late for farmers to take action. Forecasters in South Africa successfully used a new computer model—based on rainfall, vegetation, historical and satellite data—to show where locusts were likely to hatch out. They then warned farmers to prepare for outbreaks. Now, the governments of South Africa, Namibia and Botswana intend to use this system to strengthen control of locust and other migrating pests.

Project Ref: **CPP70:**
Topic: **1. Improving Farmers Livelihoods: Better Crops, Systems & Pest Management**
Lead Organisation: **Natural Resources Institute (NRI), UK**
Source: **Crop Protection Programme**

Document Contents:

Description

CPP70

A. Description of the research output(s)

Research into Use
NR International
Park House
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UK

Geographical regions included:

Botswana, Namibia, South Africa,

Target Audiences for this content:

Crop farmers,

1. Working title of output or cluster of outputs.
In addition, you are free to suggest a shorter more imaginative working title/acronym of 20 words or less.

Title: Components of an improved Brown Locust forecasting system for southern Africa

Working Title: Forecasting to Avert Brown Locust Emergencies (FABLE)

2. Name of relevant RNRRS Programme(s) commissioning supporting research and also indicate other funding sources, if applicable.

Crop Protection Programme

3. Provide relevant R numbers (and/or programme development/dissemination reference numbers covering supporting research) along with the institutional partners (with individual contact persons (if appropriate)) involved in the project activities. As with the question above, this is primarily to allow for the legacy of the RNRRS to be acknowledged during the RIUP activities.

Project R7779 (Forecasting outbreaks of the Brown Locust in southern Africa)

Lead Institute:

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Main partner institutions:

South Africa
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Contact person Dr M Molopy email: malopy@arc.agric.za

Botswana
Ministry of Agriculture, Plant Protection Division
Contact person: Mr M. Modise. Email: molmodise@yahoo.co.uk; MolModise@gov.bw.

Namibia
The Ministry of Agriculture Water and Development, Windhoek
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Associated projects:

R7890 2001-2003 *Establishment of an information core for southern African migrant pests (ICOSAMP)*
R8315 2003-2005 *Establishment of satellite ICOSAMP systems and improved migrant pest reporting network*

Associated Programme Development / dissemination
1999-2000 *Migrant pest workshop (NRInt. Refs. ZA0274 & ZA0336)*

*4. Describe the RNRRS output or cluster of outputs being proposed and when was it produced? **(max. 400 words)**. This requires a clear and concise description of the output(s) and the problem the output(s) aimed to address. Please incorporate and highlight (in bold) key words that would/could be used to select your output when held in a database.*

The **Brown Locust** (*Locustana pardalina*) is a destructive **migrant pest** endemic to the **semi-arid** regions of **Botswana, Namibia and South Africa**. During the last 53 years there have only been 7 seasons in which no control was required. More than US$2.4 million was spent on controlling the Brown Locust plague in 1996 alone.

Since Brown Locust outbreaks are often associated with major climatic fluctuations such as droughts, they pose a significant additional threat to resource-poor farmers who may already be vulnerable to production shocks and have no means of protecting their crops.

The main outputs of the project were delivered between 2000 and 2003:

§ The spatial and temporal patterns of Brown Locust population fluctuations were determined from analyses of historical records and existing data. They highlight the fact that successful **control** of the Brown Locust depends on having a **management system** that can take account of seasonal variations in the distribution and numbers of locusts in the outbreak area.

- The seasonal changes in vegetation conditions were characterised. The preliminary findings clearly indicate the potential for gauging vegetation growth by visually interpreting **SPOT-VEGETATION satellite images** in conjunction with the coarser resolution, but more frequently produced, **NDVI** data, to predict the possible seriousness and location of outbreaks.
- The seasonal changes in key **weather variables** were also identified. The work quantified the threshold rainfall amounts and the proportion of the **outbreak** area needed to register the threshold values in order to provide a long-term prediction of outbreak size.
- Case studies of historic Brown Locust **population developments** were produced (based on archived reports).
- Outbreak localities and timings were also defined via a synthesis of other analyses and data. In the absence of field surveys, the results suggest that early reporting of the possible start of **hatching**, based on environmental conditions could be used to initiate **warnings** of possible locust population developments.

All of these outputs refine the understanding of the relationships between environmental factors and locust population developments. They are crucial datasets for an improved Brown Locust **forecasting system** and will contribute to the development of a more cost-effective and **environmentally** sound **preventive control** strategy whereby locust outbreak areas are located before and during the breeding season in a more timely and accurate manner.

5. What is the type of output(s) being described here?
Please tick one or more of the following options.

Product	***Technology***	***Service***	***Process or Methodology***	***Policy***	***Other Please specify***
	X	*X*			Datasets

6. What is the main commodity (ies) upon which the output(s) focussed? Could this output be applied to other commodities, if so, please comment

There is a wide range of commodities that would be better protected by improved Brown Locust forecasting. These include barley, oats, wheat, maize, millet, sorghum, legume crops and vegetables. Feeding damage to sheep pasture is also often severe.

7. What production system(s) does/could the output(s) focus upon?
Please tick one or more of the following options. Leave blank if not applicable

Semi-Arid	***High potential***	***Hillsides***	***Forest-Agriculture***	***Peri-urban***	***Land water***	***Tropical moist forest***	***Cross-cutting***
X	*X*						

8. What farming system(s) does the output(s) focus upon?
Please tick one or more of the following options (see Annex B for definitions).
Leave blank if not applicable

Smallholder rainfed humid	***Irrigated***	***Wetland rice based***	***Smallholder rainfed highland***	***Smallholder rainfed dry/cold***	***Dualistic***	***Coastal artisanal fishing***
	X			*X*	*X*	

*9. How could value be added to the output or additional constraints faced by poor people addressed by clustering this output with research outputs from other sources (RNRRS and non RNRRS)? (**max. 300 words**).*
Please specify what other outputs your output(s) could be clustered. At this point you should make reference to the circulated list of RNRRS outputs for which proformas are currently being prepared.

Value could be added to the output by clustering it with those of other migrant pest projects, in particular those dealing with the forecasting of armyworm and quelea birds. A possible 'migrant pest' cluster could include Quelea (R8426, R7967, R6823, R8314), Community-based Armyworm Forecasting (CBAF, R8407/R7966/R6762), Novel control of armyworm (R8408), Brown locust (R7779), ICOSAMP (R8315, R7890), Armoured Bush Cricket (ABC; R8253, R7428) and Larger Grain Borer *Prostephanus truncatus* (LGB; R7486,R6684). ABC and LGB are not strictly migrants but their control is often managed by the same organisations.

The vision of ICOSAMP staff is that these outputs will contribute to the development of BLISS (Brown Locust Information Support System) – a forecasting system for southern Africa.

Validation

B. Validation of the research output(s)

*10. **How** were the output(s) validated and **who** validated them?*

*Please provide brief description of method(s) used and consider application, replication, adaptation and/or adoption in the context of any partner organisation and user groups involved. In addressing the "who" component detail which group(s) did the validation e.g. end users, intermediary organisation, government department, aid organisation, private company etc... This section should also be used to detail, if applicable, to which social group, gender, income category the validation was applied and any increases in productivity observed during validation **(max. 500 words)**.*

Outputs were validated in a variety of ways:

§ The outputs have been sufficiently convincing that the immediate stakeholders of the system - that is the forecasters working for the Directorate of Land and Agricultural Resource Management (DLARM) in South Africa – are already having discussions with ARC-PPRI project researchers in Pretoria on changing the Brown Locust control strategy to one in which only large hopper bands and swarms are controlled, using aircraft.

§ The accuracy of the forecasts arising out of these outputs has been validated by ARC staff against historical data and has proved to be robust.

§ The South African Government values the system sufficiently to have funded the operation of BLISS for a short period in 2006 to produce forecasts.

§ The outputs have been used in the early version of BLISS (Brown Locust Information Support System for Southern Africa) and several forecast scenarios based on different rainfall patterns have been constructed. So far the model predictions are tallying well with manually produced forecasts, and, more importantly, with locust population dynamics on the ground. The Brown Locust plague that the model predicted is developing rapidly at the time of writing (November 2006).

*11. **Where and when** have the output(s) been validated?*
*Please indicate the places(s) and country(ies), any particular social group targeted and also indicate in which production system and farming system, using the options provided in questions 7 and 8 respectively, above **(max 300 words)**.*

The outputs have been validated in South Africa:

§ In 2003, evidenced by changes in locust control strategy towards a preference for aerial control

§ In 2003 by entering historical input parameters into the model and comparing its predictions with historical locust populations and movements

§ In 2006, with additional funding from the Government of South Africa, in the form of credible and accurate forecasts of locust population patterns and dynamics.

The social group targeted is the forecasters working for the Directorate of Land and Agricultural Resource Management (DLARM) in South Africa and the ARC-PPRI project researchers. However, they are proxy beneficiaries, since the final beneficiaries of better forecasts will be the farmers and pastoralists operating Irrigated and Rain-fed / dry farming systems in Semi-Arid and High Potential production systems.

Current Situation

C. Current situation

12. ***How and by whom*** *are the outputs currently being used? Please give a brief description* ***(max. 250 words)****.*

The project outputs currently reside in the early version of BLISS, and this has been used in 2006 by the forecasters in DLARM to forecast Brown Locust population levels (See Annex 3 for pictorial representation of recent forecast).

13. ***Where*** *are the outputs currently being used? As with Question 11 please indicate place(s) and countries where the outputs are being used* ***(max. 250 words).***

BLISS currently only exists in South Africa. However, there is currently no further funding to continue its development or use.

14. What is the scale of current use? Indicating how quickly use was established and whether usage is still spreading ***(max 250 words).***

There is currently minimal use due to funding constraints. Usage is likely to spread to Namibia and Botswana if funding becomes available.

15. In your experience what programmes, platforms, policy, institutional structures exist that have assisted with the promotion and/or adoption of the output(s) proposed here and in terms of capacity strengthening what do you see as the key facts of success? ***(max 350 words).***

Although there are current funding constraints to further development, the South African government has recently established a migratory pests risk management division within the Department of Agriculture. This initiative indicates an increasing commitment by the Government of South Africa to migratory pest management, and strengthens the prospect that BLISS (and the project outputs) will be established and used there in the medium-term future.

The Governments of Namibia and Botswana are likewise increasingly concerned with the economic and developmental impact of Brown Locust upsurges and plagues, and have stated their intention to install and operate BLISS in each country. The rapidly developing Brown Locust plague provides a timely reminder of the economic and social damage that this migrant pest can cause.

Environmental Impact

H. Environmental impact

24. What are the direct and indirect environmental benefits related to the output(s) and their outcome(s)? ***(max 300 words)***

This could include direct benefits from the application of the technology or policy action with local governments or multinational agencies to create environmentally sound policies or programmes. Any supporting and appropriate evidence can be provided in the form of an annex.

The outputs are essential building blocks for the BLISS system that will be used to improve the forecasting of Brown Locust populations in South Africa, Namibia and Botswana. Environmental benefits arising from better forecasts include:

- Reduced quantities of insecticides used due to earlier detection of locust outbreaks, before successive breeding has multiplied numbers.
- Reduced quantities of insecticides used due to earlier detection allowing more time available to treat younger, less mobile, individual hopper band targets, rather than having to spray large blocks of highly mobile later instars and swarms.
- More likely adoption of green muscle (*Metarhizium anisopliae*) and other biological agents instead of conventional insecticides. This is due to the fact that under normal circumstances of “surprise” plagues, there is insufficient lead time to bulk up biological products for control operations. But with earlier warnings, and the associated smaller scale of control operations required, it is more feasible to use biological control agents.

25. Are there any adverse environmental impacts related to the output(s) and their outcome(s)? ***(max 100 words)***

All insecticide applications have the potential to cause adverse environmental impacts, but in this case, the areas needing to be treated, and the duration of the plagues are likely to be markedly reduced as a result of better forecasts, so the direct impacts from these outputs and outcomes are all expected to be positive.

It is possible that cropped areas might increase if the timeliness and reliability of control was improved, but the increased yields, coupled with the fact that there is no shortage of available un-cropped land in most affected regions, mean that any potential net negative impact is likely to be negligible.

26. Do the outputs increase the capacity of poor people to cope with the effects of climate change, reduce the risks of natural disasters and increase their resilience? ***(max 200 words)***

The better understanding of changing rainfall patterns, and the better prediction of the associated trends in Brown Locust populations will result in an improved ability to cope with the effects of climate change. The improved monitoring and prediction of low rainfall periods allows the Governments more time to activate mitigation measures.

Annex

References

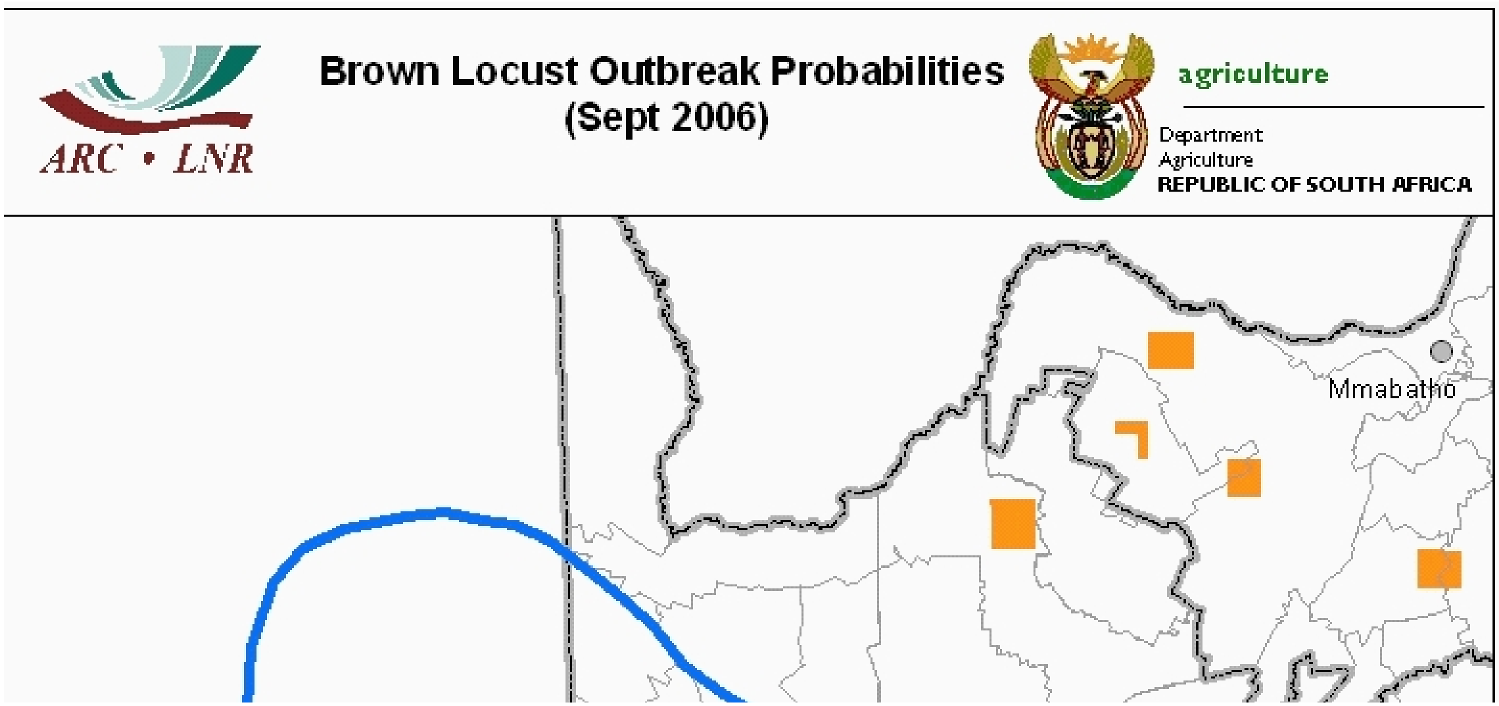
CILLIERS, J., VAN SOMEREN-GREVE, J. & LEA, A. (1964) A case of converging swarms of the Brown Locust (*Locustana pardalina* (Walker)) and implications for control strategy. S. Afr. J. agric. Sci. 7: 867-874.

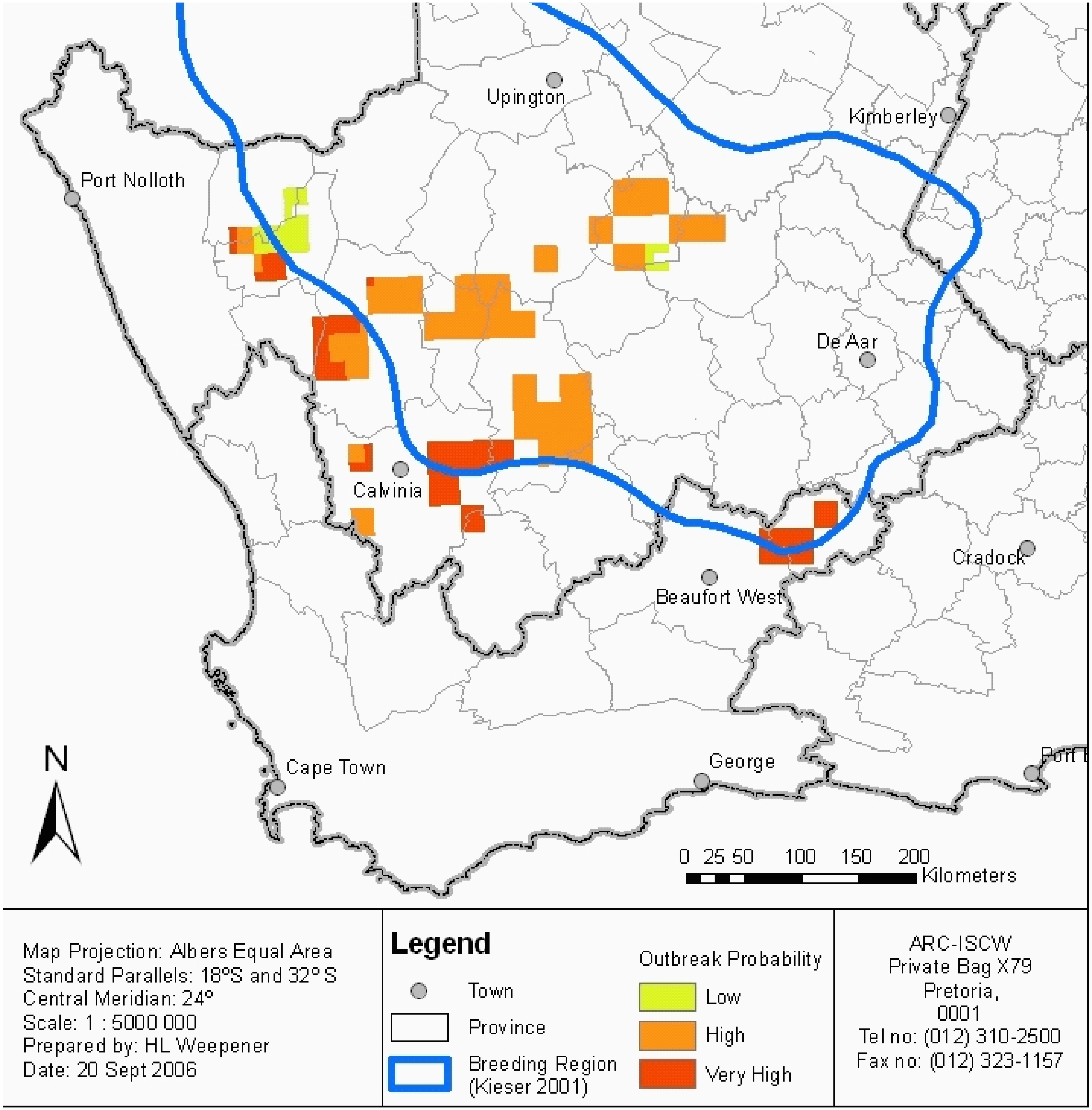
COPR (1982) *The locust and grasshopper agricultural manual*. Centre for Overseas Pest Research, London.

KIESER, M.E., THACKRAH, A. and ROSENBERG, J. 2002. Changes in the outbreak region of the brown locust in southern Africa. *Grootfontein Agric*. 4: 20-23.

TODD, M. C., WASHINGTON, R., CHEKE, R. A. & KNIVETON, D. (2002) Brown locust outbreaks and climate variability in southern Africa. *Journal of Applied Ecology* 39: 31-42.

Annex 3. Brown Locust Outbreak Probabilities

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Kimberley
Port Nolloth
De Aar
Calvinia
Cradock
Beaufort West
N
Cape Town
George
0 25 50 100 150 200
Kilometers
Map Projection: Albers Equal Area
Standard Parallels: 18°S and 32° S
Central Meridian: 24°
Scale: 1 : 5000 000
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Legend
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Breeding Region (Kieser 2001)
Outbreak Probability
Low
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