Blackfly outbreak predictive model

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Research focus area: Animal Health and Welfare

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Full Title of the project

Development of a predictive management model for Orange River blackfly outbreaks

Aims of the project

- To test and refine the recently developed pilot probabilistic blackfly outbreak model by inclusion of temperature and turbidity data, and using previous flows and monitoring data.
- To undertake climate change scenario analyses to assist future management planning.
- To provide an evaluation framework for monitoring data of blackfly larval densities, based on the outbreak model.

Executive summary

Blackfly outbreaks on the Orange River impact on the agricultural sector through loss in conception, stock mortalities and loss in body weight gain, with losses of over R333 million pa. The Blackfly Control Programme has been in place for some twenty years, using a combination of bacterial and organophosphate applications at river breeding sites. This should have resulted in as many years worth of monitoring data, which, in analysis with flow data, would have provided a useful long-term dataset. Given acknowledged challenges, this has not been the case to the degree hoped for, with periodic outbreaks of blackfly continuing to occur, and the monitoring dataset being patchy and seldom evaluated. New thinking is needed that builds on existing research to reduce the chances of repeated outbreaks.

The aims of this study were threefold: to test and refine an existing Bayesian network predictive model of blackfly outbreaks; to undertake climate change scenario analyses to assist with future planning; and to provide an evaluation framework for blackfly monitoring data.

Fourteen sites between Douglas and Blouputs were monitored over four surveys: November 2015; March 2016; July 2016 and December 2016. Data collected were blackfly samples (by species, density and relative abundances), hydraulic data (current velocities associated with multiple sample points per site), and water quality data (spot measurements of pH, conductivity, turbidity). Hourly air temperature data has been collected for 13 sites using Hobo TidBit data loggers, for 4 November 2015-5 December 2016. Water quality was fairly consistent between sites, but showed seasonal variation. Conductivity and pH had little impact on blackfly species patterns, with the exception of very high (> 1000µS.cm-1) conductivities in the irrigation return flow channels. Diatom data do, however, suggest that conductivities in the main Orange River have been increasing. Turbidity was a key driver in triggering ecosystem switching between dominance of pest blackfly species, and other blackfly species co-occurring with benthic algae.

Data confirm that the Orange River system switches between two states, viz. a high turbidity state favouring pest blackfly, and a clearer state favouring algal growth and where blackfly numbers are lower. Flow volumes and water temperatures affect turbidity levels, efficacy of larvicides, and availability of habitat for various ecosystem components (benthic algae, blackfly species). Thresholds were successfully identified from the abiotic-biotic relationships, which were incorporated into a Bayesian network model to predict the probability of blackfly outbreaks.

A predictive management framework was successfully constructed. An evaluation framework where ongoing monitoring by the Department of Agriculture, Forestry and Fisheries, and stakeholder involvement has been integrated through the development of a mobile phone App with an associated website. These are available through the Google Play App store (search for “Muggies”) and at www.muggies.org respectively. These also include links to two YouTube videos explaining how to download the App and to upload data, with explanations of the scoring systems. All data uploaded makes use of Google Pins, so that the data are geo-referenced. Model predictions are available to users.

Additional Comments

A follow up article in Landbouweekblad has been confirmed with Landbouweekblad staff. Both MSc studies are due to be submitted in the next 1-3 months respectively. Two scientific papers from this research are currently being prepared for submission and review