

HEALTHWAY

**Biological control of bush flies: vectors of
trachoma and enteric disease
Project No. 2257**

Final Report

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FINAL REPORT ON HEALTH PROMOTION PROJECTS

PART A

1. OBJECTIVES AND TARGET GROUPS

Part 1 (1993/1994)

- To determine *Musca vetustissima* as a vector of *Chlamydia trachomatis*, *Salmonella spp.*, *Shigella spp.* and *Escherichia coli*.
- To establish whether *M. vetustissima* frequents eyes of humans and in doing so transmits trachoma.
- To determine the presence of dung beetles amongst Aboriginal communities in the Kimberley's, mid-west Gascoyne and Eastern Goldfields.
- To monitor *M. vetustissima* fly abundance amongst Aboriginal communities in the Kimberley's, mid-west Gascoyne and Eastern Goldfields.
- To survey the prevalence of faeces in Aboriginal communities in the Kimberley's, mid-west Gascoyne and Eastern Goldfields.

Part 2 (1994/1996)

- To release and monitor dung beetles in 2 Aboriginal communities selected from the Kimberley's, mid-west Gascoyne and Eastern Goldfields.
- To monitor *M. vetustissima* activity in both experimental (1 community) and control (1 community) communities in the Kimberley's, mid-west Gascoyne and Eastern Goldfields.
- To correlate number of *M. vetustissima* and dung beetles in experimental and control communities with the incidence of *C. trachomatis*, *Salmonella spp.* and *Shigella spp.*.

Six Aboriginal communities, 2 from each of the Kimberley's, mid-west Gascoyne and Eastern Goldfields were to be involved in the project. Permission to conduct these experiments was sought from Community Elders and Coordinators and the ethical implications were discussed with the WA Health Department.

2. STRATEGIES

The project did not commence until June 1994

- Flies were trapped in 6 aboriginal communities. Three communities are located in the west Kimberley (Nookenhah, Looma, Bayulu), one in the east Kimberley (Yiyili) and one in the mid north Kimberley (Gibb River). Flies were trapped in only one community in the Goldfields area (Coonana). Other communities were approached in the Norseman area and mid-west Gascoyne area however these communities were either not interested or could not assist with the trapping.

- A Technical Officer (TO) was employed in July 1994 and commenced duties in the Derby Office of Agriculture WA in October 1994. The TO trapped flies and dung beetles every 14 days at each site (Looma, Bayulu and Yiyili). Both Flies and dung beetles were trapped at Nookenhah and Gibb River Station for only 1 year. As the bush fly population increases during the wet, Nookenhah becomes isolated and trapping was spasmodic. At Gibb River Station the Catholic Nuns did not want to continue after the first year.
- A School Teacher at Coonana and a Catholic Nun at Gibb River Station were employed to trap flies and dung beetles every 14 days. This proved to be less expensive than to employ an Agriculture WA TO from the various regions to conduct these trapping surveys. We supplied the School Teacher and Nun with equipment and trained them in all the necessary skills to survey flies and dung beetles. Equipment included a microscope, dissecting kit, fly and dung beetle identification kits, freezer, consumables and fly and dung beetle traps.
- Community Health and Environmental Health were extremely helpful in supplying accommodation for the TO at Derby. Many of the logistics involved with organising this project in both the Kimberley and Goldfields were also facilitated by the Health Department of WA.
- Following the trapping and collection of flies, they were sexed and aged. A sample of these flies were placed in the freezer for enzyme immunoassay analysis of *C. trachomatis* and culture of *Salmonella spp.*, *Shigella spp.* and *E. coli*. A further sample was placed in alcohol for PCR (Polymerase Chain Reaction) analysis of *C. trachomatis*. All samples were air freighted to Perth.
- An Honours student at Murdoch University completed a project on using PCR to detect both *C. trachomatis* and *Giardia duodenalis* in flies. The objectives of this study were as follows
 - a) optimising a PCR system for the detection of *C. trachomatis* and *G. duodenalis* DNA in bush fly samples in the laboratory.
 - b) determine if *C. trachomatis* and *G. duodenalis* are carried internally or externally by the bush fly
 - c) determine how long *C. trachomatis* and *G. duodenalis* can stay viable and infectious on or in the bush fly.
- The PCR work was continued at the State Agricultural Biotechnology Centre (1996-1997) and used to detect trachoma in bush flies trapped from the field. Bush flies trapped in the field were also tested by AgWA Animal Health Laboratories to detect *Salmonella spp.* and Shigellosis.
- An experiment was unable to be conducted to determine if bush flies, as possible vectors of trachoma, could move from face to face infecting people. The design of this experiment required that either a health worker or nurse administer a different colour dye to the eyes of 5 children (Fluorescein) with, and 5 children (Indocynine

Green) without facial secretions. This experiment would have a) demonstrated that bush flies are capable of cross infecting eyes and b) whether children with facial secretions are visited more often by bush flies.

- The bush fly was monitored using wind oriented fly traps over a 1 km grid at each community. This technique is currently in use to estimate fly density in south-west Australia. Data collected was analysed in a model developed by CSIRO from which estimates of absolute density were calculated. The presence of other fly species was also determined. This data indicates those times of year when bush flies are in large numbers.
- Surveys by pitfall trapping and manual observations of dung were used to monitor the abundance and occurrence of dung beetles in all Aboriginal communities. Pitfall traps were baited with the available dung in the community and presence and abundance of dung beetles was recorded.
- Schools in each area were approached and asked to join **BIOSCAN** to help with the bush fly and dung beetle monitoring program. The BIOSCAN package was distributed to each school in the Kimberleys and Goldfields but no school participated. Healthway has a copy of the package, which was completed in 1995.
- In 1996 following the submission of a grant to the Ophthalmic Research Institute of Australia monies (\$10,000) become available for one year to examine the incidence of trachoma in the communities of Looma, Bayulu and Yiyili during the wet season. The normal trachoma screening program carried out by Health Department of WA is only conducted in the dry season and bush flies only occur during the wet season. The communities were visited and screened for trachoma 3 times (July 1996 (dry season), December 1996 (early wet season) and February 1997 (mid wet season))

3. TIMELINE

- Commencement - June 1994; Termination - June 1997

4. BUDGET

- See attached Financial Statement

5. EVALUATION

- **BIOSCAN**: Entomology in schools program was distributed to 100 schools throughout Western Australia. This includes some schools in Tasmania and South Australia. A section of this promotes hygiene in reference to faeces and flies. The frontispiece features the Healthway logo.

- The Healthway logo featured on displays of the dung beetle/bush fly program at numerous Field Days, Landcare shows and the Perth Royal Show.
- A seminar was presented on October 20th 1994 in Derby titled "Dung Beetles: Past, Present and Trachoma".

6. OTHER RESULTS

- Bush flies were trapped fortnightly at 6 aboriginal communities from October to May from 1994 to 1997. The data has been entered onto a data base and will be analysed by a model developed by CSIRO to determine the absolute number of flies per hectare throughout the wet season. No bush flies were trapped during the dry season.

The peak periods for fly activity for 4 communities are listed below

Looma	Nookenhah	Bayulu	Yiyili
Early November	End November	End December	Mid December
Early January	Early February	Mid January	Mid January
Mid May		April/May	Early February

- Dung beetles were trapped fortnightly at 6 aboriginal communities from October to May from 1994 to 1997. No dung beetles were trapped by pitfall traps at Coonana.

	Looma	Nookenhah	Bayulu	Gibb River	Yiyili
Introduced					
<i>Onthophagus gazella</i>	Y	Y	Y	Y	Y
<i>Onitis alexis</i>	Y		Y		Y
<i>Euoniticellus intermedius</i>	Y	Y	Y	Y	Y
Endemic					
<i>Onthophagus bicarinaticeps</i>			Y		Y
<i>O. consentaneus</i>	Y	Y	Y	Y	Y
<i>O. cruciger</i>				Y	
<i>O. fissiceps</i>		Y		Y	Y
<i>O. mutatus</i>			Y		
<i>O. rubrimaculatus</i>	Y		Y	Y	Y
<i>O. rubescens</i>			Y		Y
<i>O. villosus</i>					Y

- Three species of dung beetle were released into the Kimberleys and one species into the Goldfields. Dates indicate year of release.

Release Site	<i>Onthophagus taurus</i>	<i>Sisyphus spinipes</i>	<i>Onitis viridulus</i>	<i>Onitis alexis</i>
Looma		4000 (1996)		1200 (1995)
Bayulu			1000 (1995)	1200 (1995)
Yiyili				1200 (1995)
Gibb River		4000 (1996)	1500 (1995) (recovered 1996)	
Coonana	16,000 (1995) (recovered 1996)			

- A total of 1450 bush flies were trapped in 3 aboriginal communities in the Kimberleys (Looma, Bayulu and Yiyili). These bush flies were processed using a PCR technique developed by Pathcentre and adapted by this project at the State Agriculture Biotechnology Centre to detect *C. trachomatis* in bush flies. 0.5% of bush flies tested positive for *C. trachomatis*. Bush flies tested positive in all 3 communities.
- This study demonstrated that bush flies in the laboratory carry viable *C. trachomatis* for up to 7 hours in the crop, 9 hours in the gut and 2 hours on the legs. The time from ingestion to egestion in bush flies is approximately 15 hours. We are currently extending this experiment to measure viable *C. trachomatis* in bush flies alimentary tract up to 15 hours.
- This study demonstrated that bush flies in the laboratory carry *G. duodenalis* for up to 20 hours in the gut. However, no cysts were observed in either the regurgitate or the faeces of the bush fly. *G. duodenalis* was not detected in bush flies trapped at communities.
- No *Shigellosis* was recorded from adult bush flies trapped at all communities. Fourteen *Salmonella species* were recorded from bush flies trapped at communities.

	Species of Salmonella	% of samples Salmonella
Looma	2	9.5
Bayulu	7	37
Yiyili	7	39
Coonana	2	28

7. COMMENT ON RESULTS MEASURED AGAINST OBJECTIVES

- Most objectives were achieved. The only objectives not achieved were

1. Only one community was interested in this study in the Goldfields. A minimum of 2 communities was required to record bush fly populations before and after the release of dung beetles.
2. No communities were interested in this study in the mid-west Gascoyne
3. An experiment was unable to be conducted to determine if bush flies, as possible vectors of trachoma, could move from face to face infecting people. This experiment needs to be conducted in a community where there is a high density of bush flies. The current study has indicated the times of year when adult bush fly density is high and at which communities the experiment should be conducted. The logistics of coordinating medical personnel to apply the dye to childrens eyes, the children and entomology personnel is of paramount importance to achieve the required outcomes of this experiment.

8. COMMENT ON THE IMPLICATIONS FOR YOUR WORK FOR HEALTH PROMOTION

This project has the potential to reduce by a sustainable form of fly control, debilitating diseases such as gastro-enteritis, trachoma and possibly *Giardia* in Aboriginal communities. If the project was expanded in the future, then many other Aboriginal communities would benefit. Furthermore, this project has ascertained that *M. vetustissima* is a passive vector of *C. trachomatis*, *Giardia spp.* and *Salmonella spp.* Equally important is that dung beetles as they become established will decrease the amount of available faeces, and hence reduce enteric diseases and possibly parasites in Aboriginal communities.

9. COMMENT ON HOW YOU PLAN TO DISSEMINATE YOUR PROJECT FINDINGS

Project results and interpretation will be disseminated through scientific journals and popular science articles.

10. COMMENT ON HOW YOUR PROJECT WILL CONTINUE NOW HEALTHWAY FUNDING IS FINISHED

Following publication of the bush fly/ *C. trachomatis* study a proposal will be submitted to NH&MRC for funding. This proposal will

1. measure the prevalence of *C trachomatis* in the 3 aboriginal communities in the Kimberley region
2. measure the dosis of *C.trachomatis* in bush fly reguritant and feaces
3. complete the experiment to determine if bush flies, as possible vectors of trachoma, can move from face to face infecting people
4. collaborate with Pathcentre to refine the PCR technique used to detect *C.trachomatis* from eye samples. This will detect low level infections of *C. trachomatis* in communities and will aid in the administration of drugs to treat this disease.

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Communities

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