

DEPARTMENT OF AGRICULTURE AND FISHERIES, SOUTH AUSTRALIA

Agronomy Branch Report

PART I:

THE PLAGUE LOCUST CONTROL CAMPAIGN -
SOUTH AUSTRALIA - 1976-77

PART II:

RECOMMENDATIONS FOR THE FUTURE CONTROL OF
THE PLAGUE LOCUST IN SOUTH AUSTRALIA

Report No. 83

Ministerial Review Committee,
1977.

AGRONOMY BRANCH REPORT

PART I:

THE PLAGUE LOCUST CONTROL CAMPAIGN -
SOUTH AUSTRALIA - 1976-77

PART II:

RECOMMENDATIONS FOR THE FUTURE CONTROL OF
THE PLAGUE LOCUST IN SOUTH AUSTRALIA

Ministerial Review Committee,
1977.

- CONTENTS -

PART I:

	<u>Page</u>
1. <u>INTRODUCTION:</u>	1
2. <u>SUMMARY:</u>	2
3. <u>THE LEGISLATIVE BASIS OF THE CAMPAIGN:</u>	3
4. <u>A HISTORY OF THE PLAGUE LOCUST CAMPAIGN, <u>1976-77</u></u>	3
5. <u>FINANCE:</u>	12
6. <u>DAMAGE:</u>	14
7. <u>MASS MEDIA PROGRAMME:</u>	18

PART II:

1. <u>INTRODUCTION:</u>	25
2. <u>SUMMARY:</u>	26
3. <u>ECONOMIC JUSTIFICATION FOR PLAGUE LOCUST <u>CONTROL IN SOUTH AUSTRALIA:</u></u>	27
4. <u>NEW LEGISLATION:</u>	31
5. <u>IMPROVED DEPARTMENTAL OPERATIONS:</u>	33
<u>APPENDICES:</u>	38

THE PLAGUE LOCUST CONTROL CAMPAIGN - SOUTH AUSTRALIA, 1976-77

PART I

1. INTRODUCTION:

Following the major campaign conducted by the Department of Agriculture & Fisheries to control the plague locust (Chortoicetes terminifera) during the latter part of 1976 and early 1977, the Minister of Agriculture, the Honourable B.A. Chatterton, requested a Departmental review of the operations and recommendations for any improvements that could be planned for future campaigns.

The Director of Agriculture & Fisheries appointed the following Working Party to carry out the review:-

Mr. A.F. Tideman	-	Acting Assistant Director (Chairman)
Mr. P.G. Allen	-	Senior Research Officer (Entomology)
Mr. P.R. Birks	-	Senior Entomologist
Mr. A.E. Hincks	-	District Agronomist, Jamestown
Mr. I.R. Lewis	-	Senior Horticultural Extension Officer
Mr. C. Phillips	-	Technical Officer (Entomology)
Mr. R.L. Raines	-	Editor
Mr. M.V. Smith	-	Senior Research Officer (Agronomy)
Mr. G.D. Webber	-	Acting Principal Agronomist
Mr. R.L. Wishart	-	Senior Horticultural Adviser

The Australian plague locust is a desert insect normally inhabiting arid inland areas, especially northern South Australia, south-western Queensland and north-western New South Wales. Widespread summer rains in these areas results in rapid increases in plague locusts and, following suitable rains in two successive summers, plague locusts will move into our near pastoral and marginal agricultural areas. Adults fly into these areas in autumn and lay diapause eggs which hatch in the following spring.

Major plague locust plagues have occurred in South Australia in 1844, 1871, 1890, 1934, 1947 and 1955. Minor plagues, occurring in isolated districts, have occurred in 1950, 1969, 1971, 1972, 1973 and 1974.

2. SUMMARY:

- 2.1 This Report gives an historical account of an extensive plague locust campaign conducted in South Australia during 1976 and early 1977.
- 2.2 The cost of the field operation to the South Australian Government was approximately \$200,000.
- 2.3 At the time this Report was compiled damage was estimated at \$2.04M. Final losses will vary between \$1.3M. and \$2.4M., depending on subsequent seasonal conditions.
- 2.4 A record of the mass media programme and the publications available to inform the public have been included.

3. THE LEGISLATIVE BASIS OF THE CAMPAIGN:

The Noxious Insect Act, 1934-55, provides legislation to cover the destruction and suppression of plague locusts throughout South Australia.

This Act states that it is the responsibility of landowners:-

- * to mark and report egg-beds to their district councils or to the Pastoral Board, Adelaide
- * to notify the time of hatching
- * to take measures prescribed in the Schedule for the destruction of egg-beds and plague locusts

District councils and the Pastoral Board are required:-

- * to inform the Department of Agriculture & Fisheries of the above information
- * to ensure that control measures are carried out
- * to issue the required insecticide to landowners.

In years of minor plagues, the Government has supplied insecticides to district councils on the basis of a 50% subsidy. With major plagues, the insecticide has been provided free of cost since 1971. Ultra-low-volume (U.L.V.) misting machines have also been provided by the Government to district councils for use by landowners in both minor and major plagues.

4. A HISTORY OF THE PLAGUE LOCUST CAMPAIGN, 1976-77:

4.1 Autumn Invasion of Adults, 1976

In the Far North Region of South Australia, more rain than normal fell during the 1974-75 and 1975-76 summers. The rainfall, expressed as the percentage of departure from normal, for the Far North was:-

	<u>1974-75</u>	<u>1975-76</u>
October	+ 307%	+ 279%
November	- 85%	- 77%
December	- 87%	+ 150%
January	- 35%	+ 317%
February	+ 295%	+ 740%

This resulted in adults invading the western agricultural areas on Eyre Peninsula and near pastoral areas in the north during the period, mid-February to the end of March. Swarms were first recorded at Wudinna on February 17 and Bruce on February 23.

During February and March, surveys for adult plague locusts were conducted by Departmental officers. Details from these surveys are shown in Figures 1 and 2. Also, district councils were contacted to provide information on adult locusts and egg-laying. The information from the Department's and councils' surveys is summarised in Figure 3.

Following these surveys, relevant district councils were reminded of their responsibilities under the Noxious Insect Act, 1934-55. As in previous years of plague locust activity, councils were asked to estimate the area which would require treatment for plague locust control in spring within their districts, based on autumn egg-laying. This provided a basis for the purchase of insecticide by the Government. The areas are listed in Table 1.

Table 1

District Councils	D.C. estimates of areas requiring spring treatment (ha)	"Hectare equivalents" of insecticide forwarded to D.C. ⁺
<u>Western Agricultural</u>		
Murat Bay	3240	3328
Streaky Bay	-	3359
Elliston	650	199
Le Hunte	162	9781
Kimba	356	4864
Cleve	1620	170
Franklin Harbour	220	374
	<u>Total</u>	<u>22075</u>
<u>Northern Pastoral</u>		
Hawker	400	731
Carrieton	- *	621
Orroroo	3240	3978
Peterborough	390	3130
Quorn	-	216
Wilmington	356	4714
Pt. Germein	356	544
	<u>Total</u>	<u>13925</u>
<u>Northern Agricultural</u>		
Jamestown	No estimates made	5983
Hallett	"	546
Bute	"	37
Snowtown	"	16
	<u>Total</u>	<u>6582</u>
<u>Lower North Agricultural & Horticultural</u>		
Eudunda	"	500
Kapunda	"	1250
Department Agriculture (Nuriootpa)	"	3000
Tanunda	"	1500
Angaston	"	250
Freeling	"	3400
Barossa	"	2500
Mudla Wirra	"	1150
Munno Para	"	1300
Gumeracha	"	1400
Mt. Pleasant	"	1000
Onkaparinga	"	1500
Mannum	"	250
Mobilong	"	1500
Balaklava	"	60
Tea Tree Gully	"	30
East Torrens	"	16
Owen	"	65
	<u>Total</u>	<u>21665</u>

* No estimate - sufficient insecticide left over from 1973

+ Insecticide used against - hoppers and adults, Western Agricultural
- mainly hoppers, Northern Pastoral
- adults, Northern Agricultural

4.2 Egg-beds

During late winter, Departmental officers surveyed near Ceduna, Minnipa, Wudinna, Kimba, Orroroo, Bruce and Peterborough. Only a few egg-beds were found but experience in previous years had shown that significant egg-laying from autumn invasions can go unnoticed.

4.3 Initial Distribution of Insecticide

Part of the insecticide needed to treat the expected hatchings was forwarded to district councils during August and September, prior to the advent of hatching. Prevailing drought conditions at that stage lessened the concern of all involved in plague locust control.

Insecticide was forwarded on the basis of a 50% Government subsidy.

4.4 Spring Hatching of Eggs

The first hatching reported on Eyre Peninsula was at Pinkawillinie on September 16. The main hatchings began in late September in areas around Ceduna, Minnipa to Wudinna and Kimba.

The first hatchings reported in the northern region was 40 km north of Hawker on September 24. The main hatchings occurred in early October, though the time of hatching was over a longer period than on Eyre Peninsula due to cooler weather and more variable rains.

The general areas of spring hatching are shown in Figure 4.

4.5 Treatment of the Spring Generation

4.5.1 Western Agricultural Region

The first treatment of hoppers was in the Ceduna area on September 24. Treatment of these continued through October. Hopper bands were up to 2 km long. Fledging began in early November and treatment after mid-November was almost entirely against adult swarms.

Treatment was carried out by landowners using their own equipment or Government U.L.V. misting machines supplied through district councils. Landowners were familiar with this procedure because of their experience with minor plagues in 1972, 1973 and 1974.

Insecticides supplies to the Western Agricultural Region and their rates of application were:-

Diazinon EC (400 g/ha)
Lindane EC (250 g/ha)
Technical malathion (830 g/ha)
Technical fenitrothion (370 g/ha)
Technical diazinon (400 g/ha)

Treatment against adults ceased by late November. The estimated area treated in the Western Agricultural Region is shown in Table 1.

Generally, control measures were effective and, while some damage occurred, especially to late maturing barley crops, landowners were not particularly concerned about the losses. There were some exceptions in areas with the heaviest damage. Low density, scattered adults caused more damage than expected because locusts settled in the more open, droughted crops.

4.5.2 Northern Pastoral Region

The first treatment of hoppers was just north of Hawker on September 29 but little treatment of hoppers occurred during October due to the previous dry conditions and limited hatchings.

The rain in early October, up to 146 mm in some areas, changed the situation. Green feed became plentiful and hopper bands became more obvious. The bands were small, often only a few hundred square metres in size, scattered over a very large area (Figure 4).

Treatment of hopper bands was intensified by many landowners in early November. Through Departmental surveys and consultation with landowners and district councils, it appeared that the treatment was being carried out on an adequate scale to achieve general control. However, it was realised that some swarms would emerge from the Northern Pastoral Region, especially as some landowners were not treating.

The estimated area treated in the Northern Pastoral Region is shown in Table 1 (see page 4).

Insecticides supplied to that area were the same as those supplied to the Western Agricultural Region.

Fledging began in late November and by December 7 swarms were migrating from the pastoral areas south into the agricultural areas. The larger swarms, up to 30 km long, were coming from the Johnburgh-Black Rock and Nackera-Ucolta areas.

It was then evident that many areas of hoppers were not reported or treated by landowners. Departmental surveys also did not reveal the significance of the hoppers.

East of Yunta was an example where hatchings were not reported. These hatchings were known only from a single landowner report on December 3, well into fledging. A quick survey by Departmental officers within a week assessed this area as about 3500 km² compared with the previously known area of about 2500 km².

4.5.3 Northern Agricultural Region

Migration of swarms into the Northern Agricultural areas is shown in Figure 5.

At the earliest stages, late maturing cereal and lucerne (seed crops and forage) were the only crops susceptible to damage. Landowners were urged to spray settled swarms in an attempt to break up the southerly migration before they reached the major lucerne seed producing areas.

Departmental officers conducted demonstrations at Yongala, Mannanarie and Yatina with lucerne growers from Bundaleer and Canowie Belt in early December on the treatment of settled swarms. Little spraying was carried out by landowners because most were involved with reaping cereals and the risk and amount of damage to crops in the immediate area was minimal. Also, lucerne growers to the south were not prepared to treat swarms before they reached their areas.

Because the spraying of swarms with ground equipment by landowners at this stage was making little headway, an aerial campaign conducted by the Department was recommended. The aim was to break up heads of dense swarms and lessen the potential impact that these swarms could have on lucerne seed crops, summer forage crops and horticultural crops further south.

The Government made \$150,000 available on December 15 for this programme which enabled 40,000 ha to be sprayed if necessary. The programme, first based at Jamestown then Clare, commenced on December 19.

Nearly all the aerial spraying (technical fenitrothion - 300 ml/ha) was conducted in an area between Spalding, Booboorowie, Farrell Flat and Blyth.

Spraying was confined to dense infestations of plague locusts where there was minimal risk to bees, houses and vehicles. No flowering crops were sprayed, nor were crops within one kilometre of beehives. Permission to spray on properties was obtained from landowners wherever possible. In the more densely populated areas, especially around Clare, permission was obtained from all landowners.

Spraying broke up some large swarms, especially in the Barinia and Hill River districts. However, during the same period, there was also a natural dispersion of swarms, probably due to topography and weather conditions which resulted in their dispersion over thousands of square kilometres.

The main concentrations of plague locusts were on lucerne crops and vines and the last treatments of the programme provided crop protection rather than the aim of breaking up swarms. Treatment of such crops could be carried out by landowners with ground equipment.

For this reason, aerial operations were ceased on December 24 after 4000 ha had been sprayed. On December 24 all district councils with plague locusts and immediately south were advised by telephone that the programme had reverted back to landowners being responsible for the treatment of their own properties. Insecticide and U.L.V. misting machines were still available free through district councils.

The estimated area (not including the aerial campaign) treated by landowners in the Northern Agricultural areas is shown in Table 1 (see page 4). The insecticides supplied were technical fenitrothion, technical maldison and lindane E.C.

4.5.4 Lower North Agricultural & Horticultural areas

From December 24 to January 7, there was a steady south to south-easterly movement of swarms (Figure 5). By the end of this period, plague locusts had infested the Adelaide Plains, Barossa Valley, Central Adelaide Hills and the Murray Plains. They also invaded Elizabeth, Salisbury and the north-east suburbs of Adelaide.

The most susceptible crops were horticultural crops, especially seedling vegetables, vineyards and potatoes, and, to a lesser extent, lucerne and summer forage crops.

Treatment was carried out by landowners and was mainly confined to protecting these crops rather than breaking up swarms. Technical fenitrothion and U.L.V. misting machines were available to landowners through district councils. In addition, many vegetable growers protected their own crops with their own insecticides applied from both the ground and the air. Departmental recommendations made to these growers are shown in Table 2 below.

Table 2: Insecticides not supplied by the Government but recommended for use on vegetables & vineyards

Insecticide	Rate of Product	Withholding Period (days)
Carbaryl 80% WP	650 g/ha	3
Diazinon 80% EC	710 ml/ha	14
Maldison 50% EC	1.1 l/ha	3
Methidathion 40% EC	710 ml/ha	7 (vegetables) 14 (fruit)
Mevinphos 60% EC	350 ml/ha	2
Parathion 50% EC	350 ml/ha	14

On December 30, the Department decided that technical fenitrothion supplied by the Government could not be applied by aircraft in the more densely populated areas of the Lower North because of environmental hazards, especially to bees and paintwork. Compared to ground U.L.V. spraying, the drift hazard from aerial U.L.V. spraying was considered greater in the more densely populated horticultural areas than in the agricultural areas further north. This was mainly due to the higher altitude spraying which is often required with aircraft in horticultural areas because of houses, powerlines and trees. Also, some higher altitude aerial spraying had been only partly successful earlier in the campaign.

During the Christmas-New Year period there were some difficulties in communication between the Department, district councils and landowners. For this reason, the Department maintained a continuous service from the Northfield Research Laboratories and the Nuriootpa district office from December 27 to January 9. This service provided technical information, both for commercial production and home gardens, and ensured that district councils or their districts were supplied with adequate insecticide and U.L.V. misting machines. Daily movement of the swarms was also monitored so that insecticide and U.L.V. misting machines could be supplied before a district was invaded.

Isolated pockets of adults were still being treated at the end of January. The estimated area treated in the Lower North agricultural and horticultural areas is shown in Table 1 (see page 4).

Insecticide was not provided by the Government for control of locusts in domestic situations.

4.6 Assistance with Aerial Application

In early November, the Wilmington District Council requested Government assistance for the aerial spraying of hoppers. The situation was inspected on November 8 and in agreement with landowners it was decided that aerial spraying would not be economical because of the small size and scattered nature of the hopper bands. Treatment with ground equipment and a concerted district effort gave a high level of control. It involved some 80 men and up to 25 spray units working in an area of about 100 km².

A further request for aerial assistance came from a landowner in the Black Rock area in late November. However, he was unaware of his obligations with plague locust control and that his neighbours were treating similar infestations with ground equipment.

On December 1, a landowner from Nackera advised the Department that aerial spraying of a large swarm in his area could be worthwhile. At this stage, control was still reliant on landowners treating infestations with ground equipment, especially as most infestations were still considered to be in relatively small scattered areas.

4.7 Free Insecticide

A request was made by the Murat Bay District Council in late October for insecticide to be provided free by the Government because of prevailing drought conditions. In early November, the District Council of Wilmington also requested free insecticide.

On November 10, the Minister announced that the plague would be regarded as a "major" plague and that insecticide would be provided free by the Government, retrospective to the 1976 spring hatchings in South Australia. This decision was made because the real extent of the plague locust problem was becoming more apparent and because of the dry conditions in many of the infested areas.

4.8 Treatment of the Summer Generation, 1977

Egg-laying was reported from all the areas invaded by adults and for the greater part beds were established close to irrigated or other green crops.

The main areas of hatching were in the Murray Town-Wirrabara, Booborowie and Clare areas in the north, in the hills from Angaston to Eden Valley, and in the Gumeracha, Mt. Pleasant and northern Onkaparinga District Councils' areas. Hatchings also occurred on the Adelaide Plains between Salisbury and the Gawler River, and in the Tea Tree Gully Council area.

The hoppers were mainly confined to small, dense bands. In early March, hoppers commenced fledging and the adults either dispersed or remained in very loose swarms. The intensive treatment of hopper bands in many areas reduced the potential number of adults.

On January 17, the Department decided that free maldison E.C. should be made available to landowners for use through their own spray equipment for the control of hopper bands. Technical fenitrothion would also be available with U.L.V. misting machines, especially for treatment of larger hatchings in agricultural areas. A fact sheet on the use of maldison for hopper control was prepared for district councils to give out with the insecticide.

Through a press conference on January 20, the Director of Agriculture & Fisheries warned the public of these hatchings and informed commercial producers of the availability of maldison through district councils. Also, 34 district councils were informed personally by Departmental officers.

The first maldison was delivered to district councils on January 24.

The estimated area treated by landowners to control hoppers of the summer generation is shown in Table 3. Most of this area (75%) was treated with maldison applied with landowners' own spray equipment.

Damage caused by the hoppers was minimal and was mainly confined to seedling vegetables, especially carrots and celery, potatoes and irrigated pastures and other summer fodder crops. The adults were of little consequence, though they did defoliate and drop bunches from some vines in rows adjacent to grassland in the Eden Valley area.

Table 3: "Hectare equivalents" of insecticide used through district councils for control of hoppers of the summer generation, 1977

District Councils	"Hectare equivalents"
<u>Northern Agricultural:</u>	
Jamestown	107
Spalding	67
Clare	560
Hallett	27
Laura	53
Gladstone	27
Georgetown	27
Wilmington	27
Melrose	267
<u>Lower North Agricultural & Horticultural:</u>	
Balaklava	93
Owen	53
Auburn/Saddleworth	40
River ton	40
Kapunda	107
Freeling	93
Tanunda	160
Angaston	427
Barossa	80
Department Agriculture (Nuriootpa)	945*
Mt. Pleasant	267
Gumeracha	1,780
<u>District Councils:</u>	
Onakaparinga	1,070
East Torrens	133
Mudla Wirra	53
Munno Para	213
Salisbury	80
Tea Tree Gully	27
Mannum	53
Mobilong	80
Strathalbyn	53
Total	7,009

* 945 hectare equivalents of U.L.V. fenitrothion mainly used in Angaston District Council

5. FINANCE:

Finance has been made available from the Minister of Agriculture, Miscellaneous - Noxious Insect Funds.

5.1 Control of Spring Generation

The following is a summary of the finance either spent or committed to 17/1/77.

<u>Date of Allocation</u>			
1975-76	Stock of insecticide		\$45,000
12/11/76	Insecticide	\$54,285	
	Equipment, travelling re-imburement, freight of insecticide & misting machines	<u>6,000</u>	60,285
15/12/76	Insecticide	\$82,000	
	Aircraft hire	8,000	
	Overtime	6,000	
	Radio communication	2,000	
	Travelling re-imburement	<u>10,000</u>	<u>108,000</u>
	<u>Total</u>		<u>\$213,285</u>

5.2 Control of Summer Generation

The following is a summary of the expected expenditure for control of the recently hatched hoppers:-

Insecticide	\$26,000
Servicing misting machines	2,500
Travelling reimbursement & freight	<u>1,000</u>
<u>Total</u>	<u>\$29,000</u>

5.3 Salary Costs

Salaries of field officers who worked on the campaign until the end of January, 1977 amounted to \$48,000. This does not include the salaries of administrative staff or clerical staff.

5.3.1 Departmental staff

The Entomology Section, Agronomy Branch, was responsible for the organisation of plague locust control in South Australia. In a major plague, assistance is co-opted from other sections and branches in the Department. A summary of the manpower used in this plague to date is:-

February-November, 1976

Entomology Section	1 full time 3 part-time
District agronomists	3 part-time

The part-time officers were involved in administration and assistance with field surveys. For the most part, this only involved minor commitments.

November/mid-December, 1976

Entomology Section	5 full time
District agronomists	2 part-time

December 13-17, 1976

Entomology Section	7 full time
Agronomy Branch	2 full time
District agronomists	1 full time

December 19-24, 1976

Entomology Section	8 full time
District agronomists	3 full time
Agronomy Branch	4 full time
Horticulture Branch	5 full time
Soils Branch	1 full time

December 27-January 3, 1977

Entomology Section	5 full time
District agronomists	1 full time
Agronomy Branch	2 full time
Horticulture Branch	3 full time
Soils Branch	2 full time

January 4-January 28, 1977

Entomology Section	3 full time 1 part-time
District agronomists	2 full time 2 part-time
Agronomy Branch	2 on call
Horticulture Branch	4 Horticultural advisers on call 2 part-time
Soils Branch	1 part-time

January 29-March, 1977

Entomology Section	1 full time 3 part-time
--------------------	----------------------------

This summary does not include the extra work load placed on the Agronomy Branch, Executive nor the Administration and Finance Branch.

6. DAMAGE:

6.1 Summary & Extent of Damage

Plague locusts invaded agricultural areas of South Australia from two major fronts during the period October, 1976 to January, 1977. The first plague invaded northern Eyre Peninsula and the second the Upper North down through the Barossa Valley to the Adelaide Plains and the Lower Murray area. By the end of January these locusts had caused damage to cereal crops, pastures, lucerne seed crops and horticultural crops of approximately \$2 million (Table 4).

Damage resulting from each of these locust plagues was similar but most publicity resulted from the plague heading in the general direction of Adelaide from the North East pastoral areas. This plague did less damage to cereal crops and pastures than the plague on Eyre Peninsula, but considerable losses occurred in lucerne seed production areas and with some horticultural crops. Regions, areas, crops and estimated losses are detailed in Tables 5 and 6 (see pages 15 and 16). While losses in particular districts and to individual growers may have been of major proportions, overall on a State-wide basis the losses have been only 0.29% of the total value of agricultural production and hence will have minimal effect on supply/demand for agricultural products. The only industry seriously affected was the lucerne seed industry where a loss in excess of 20% is anticipated in the 1976-77 crop. Horticultural industries most affected were potatoes, carrots, cabbages and celery where losses of 1-2% of total production are anticipated.

Table 4: Summary of Plague Locust Damage, 1976-77

(\$ x 1000)

Region	Central	Lower North	Upper North	East E.P.	West E.P.	State Loss	% of Total Value (Mean 73-4, 74-5, 75-6)
Cereals	-	-	50	489	150	689	0.33%
Pastures & Forage Crops	60	20	130	198	200	608	0.19%
Lucerne seed	-	200	250	-	-	450	22.5 %
Horticultural Crops	189	107	-	-	-	296	0.29%
Total	249	327	430	687	350	2043	0.29%

6.2 Source of Data

Data for damage assessment listed above came from a standard form (see Appendix 1). This was completed by all district agronomists and horticultural advisers in areas affected by the locusts.

Details requested included type and severity of crop damage, area involved and an estimate of the economic loss.

Table 5: Summary of Plague Locust Damage, 1976-77

Agricultural Crops

Region		Cereals - Severe			Cereals-Partial			Lucerne Seed	Lucerne Forage	Other Forage	Pasture*	Total
		W	B	O	W	B	O					
Central	ha							300	300	500	1,100	
	\$000							5	5	50	60	
Lower North	ha								500		500	
	\$000						200	17	3		220	
Upper North	ha				500 @ \$100				1,000		1,500	
	\$000				50			250	8	122	430	
East. E.P.	ha	5,000	3,000	1,000	30,000 @ \$10			300			39,300	
	\$000	100	80	9	300			3		195	687	
West. E.P.	ha				3,000 @ \$50						3,000	
	\$000				150					200	350	
State Totals	ha	5,000	3,000	1,000	33,500				1,600	800	45,400	
	\$000	100	80	9	500			450	33	8	567	1,747
Av. Crop [‡] Value	\$M.				All cereal crops							
					304			2			319+	625
Loss	%				0.23			22.5			0.18	0.28

* Pasture consumed and reduced stubble value

+ Value of all livestock products

‡ Average of 3 years 1973-74, 1974-75, 1975-76.

Table 6: Summary of Plague Locust Damage, 1976-77

Horticultural Crops

Region		Vineyards		Tree Crops	Potatoes	Carrots	Parsnips	Cabbage & Cauliflower	Celery	Lettuce	Total
		Mature	Young								
Central	ha	8			156	8		4	7	1	184
	\$000	15			99	20		18	35	1.7	189
Lower North	ha	80	100	4		13	.1				197
	\$000	47	50	2		8	.4				107
State Total	ha	188		4	156	21	.1	4	7	1	381
	\$000	112		2	99	28	.4	18	35	1.7	296
Avg. Crop* Value	\$M.	28		34	10	2	.1	2.7	1.5	1.1	80
Loss	%	0.4		-	0.97	1.4	0.4	0.67	2.3	0.15	0.48

* Average of 3 years, 1973-74, 1974-75, 1975-76

The estimates arrived at and listed below must be treated with caution because:-

- * Limited time and facilities meant that accurate sampling of losses could not be made. Furthermore, there were no "controls" to determine yields which would have occurred of locusts.
- * Pasture losses relied on judgements involving losses in quantity and quality resulting in forced sales, less wool and reduction in reproduction capacity. Losses in medic seed also occurred which may involve landowners with re-sowing cost in 1977 and reduced levels of soil nitrogen for the following cereal crops.
- * Losses due to the 1976-77 locust plagues may continue into the future. The extent of such continuation of losses will be largely influenced by future seasonal conditions. Thus if good summer/autumn rains fall over the north east pastoral areas then the losses due to locusts could be largely negated. However, if seasonal conditions are poor, then forced selling and sales of "unfinished" livestock could greatly accentuate the locust losses and make grazing losses in these areas comparable to those on Eyre Peninsula. Similarly, heavy rainfall on lucerne damaged by locusts could result in good lucerne growth and given favourable follow-up conditions a late but reasonable lucerne seed crop from the northern area of South Australia. Also loss from vines in subsequent seasons may be accentuated or minimised by seasonal conditions over the next few months.
- * No loss of bees has been quantified in any of the extension officers' forms. However, protection of bees was said to be a major factor in minimising spraying targets. The potential losses from killing of bees should be critically assessed against the benefits of more effective locust spraying.

6.3 Future Seasonal Effects on Losses

Using possible extremes of future seasonal events the modification of locust losses could be as follows.

6.3.1 Most favourable seasonal conditions

* Lucerne seed losses down by	\$300,000
* Eyre Peninsula pasture losses down by	300,000
* Vineyard & potato losses down by	<u>100,000</u>
<u>Total</u>	<u>\$700,000</u>

6.3.2 Most adverse seasonal conditions

* Upper North pasture losses up by	\$300,000
* Vineyard & potato losses up by	<u>50,000</u>
<u>Total</u>	<u>\$350,000</u>

Using these extremes one arrives at locust damage loss varying between \$1.3M. and \$2.4M., depending on subsequent seasonal conditions between January and June, 1977.

7. MASS MEDIA PROGRAMME:

From the beginning of September, 1976, the media received releases from the Department which continued until the second week in January. In broad terms the media programme aimed to:-

- * Inform landowners in agricultural areas and pastoral areas where the hatchings were occurring and then warn of the likely paths and intensities of the locust swarms.
- * Inform local government authorities and landowners of the measures which could be used to control the plague locusts, particularly the chemicals which could be used and the U.L.V. ground spraying equipment available.
- * Inform the general public of the policy decisions made by the Government in its efforts to combat the plague.
- * Finally, it aimed to inform urban dwellers in the Adelaide region of the risks to their home gardens and the measures which could be adopted to protect them.

From December 27, 1976, this programme was integrated with the Advisory Centre, specifically established at the Northfield Research Laboratories to advise the home gardeners and commercial growers, particularly vegetable growers.

From the beginning of September, 1976, until December 15, the media was serviced mainly on an ad hoc basis with district agronomists and Mr. Birks, the Senior Entomologist, playing a major role. The rural press gave excellent coverage and on the whole their reports were factual.

During September the plague locust situation received only a brief comment in the Department's State of Agriculture Report, but in the three following issues the monthly reports were very detailed.

On December 15, Mr. Rains became the Department's media co-ordinator and spokesman for the campaign. This step immediately improved the media coverage and was welcomed by all of those concerned. The media personnel unanimously praised this service because they all had equal and easy access to the releases and the Departmental staff were greatly relieved of the continuous pressure which had been placed upon them by reporters and news personnel endeavouring to get information. The Minister's press secretary advised that only changes in policy should be the basis for a Ministerial release so that most releases continued to be made in the name of Mr. Birks or Mr. Allen who directed the operations in the field, or Mr. Rains as spokesman, particularly when radio required direct comment to tape.

From November 15 to January 20, the campaign received almost daily coverage in the Advertiser and The News, with often front page headlines. A.A.P. contacted Mr. Rains daily, during that period, as did Mr. Andrew Reynolds, from 5DN, and Chris Rudd and other officers of the ABC.

On two occasions, early in the campaign, emotional reporting of the campaign around Wilmington created considerable debate. However, considering the complexities of the campaign and the involvement with the total environment, in respect to the use of insecticides, the campaign overall received very little public criticism.

During the first week of January, ethnic groups were given particular assistance when, mainly through the Vegetable Growers Association, releases were made in twelve different languages. News items were also posted at particular churches in the Virginia area where ethnic groups congregated. This special effort to service the ethnic groups was probably not warranted as advisers in the field and local government offices felt that they had already made adequate contact with these people through their spokesmen, who came and obtained chemicals and equipment on behalf of their friends and close neighbours.

Releases of information of major significance were made as follows:-

- * On October 6, Mr. Birks advised that broad scale hatchings of the plague locust were occurring.
- * On November 10, a release issued by the Minister of Agriculture advised the availability of free insecticide through local government authorities.
- * On November 15, the public was warned that the plague locust infestations were the worst since 1955.
- * On December 16, the Acting Minister of Agriculture announced that an aerial spraying programme would be launched and a further \$150,000 would be made available for the control of the plague locusts.

Despite the shortcomings of our Departmental service to the media, which is discussed in Part II of this Report, and the obvious improvements that can be made, officers who assessed the campaign felt that the mass media programme, overall, was reasonably balanced and that the public were kept well informed considering the rapidly changing biological situation and the tendency for the use of insecticides to raise emotional issues.

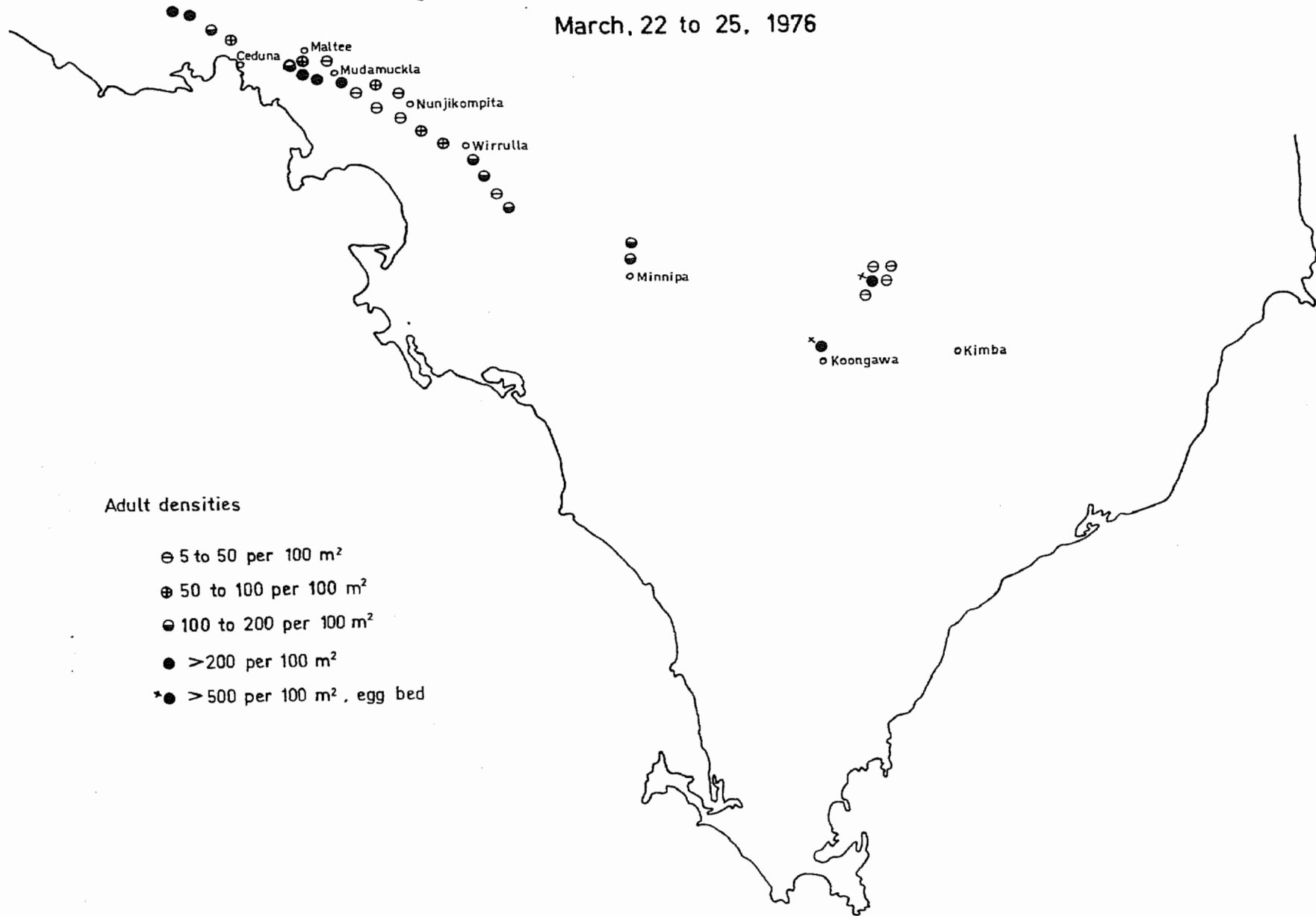
7.1 Technical Leaflets

The following leaflets and fact sheets were made available during the campaign:-

- Birks & Phillips - "The Australian Plague Locust". Leaflet No. 4019.
- Birks & Phillips - "Locust Control with Conventional Spray Equipment". (Not indexed, see Appendix II).
- Birks & Phillips - "Locust Control with U.L.V. Spraying". (Not indexed, see Appendix III).
- Allen - Locust Control - "Maldison Applied with Conventional Spray Equipment". Fact Sheet Agdex 622.
- Birks - "Plague Locust Control". Fact Sheet Agdex 622.
- Birks - Technical Notes (see Appendix IV).

Fig.1: ADULT ACTIVITY - EYRE PENINSULA

March, 22 to 25, 1976



Adult densities

- ⊖ 5 to 50 per 100 m²
- ⊕ 50 to 100 per 100 m²
- ⊗ 100 to 200 per 100 m²
- >200 per 100 m²
- *● >500 per 100 m², egg bed

**Fig. 2 : ADULT ACTIVITY -
NORTHERN PASTORAL AND AGRICULTURAL AREAS**

March, 15 to 18, 1976.

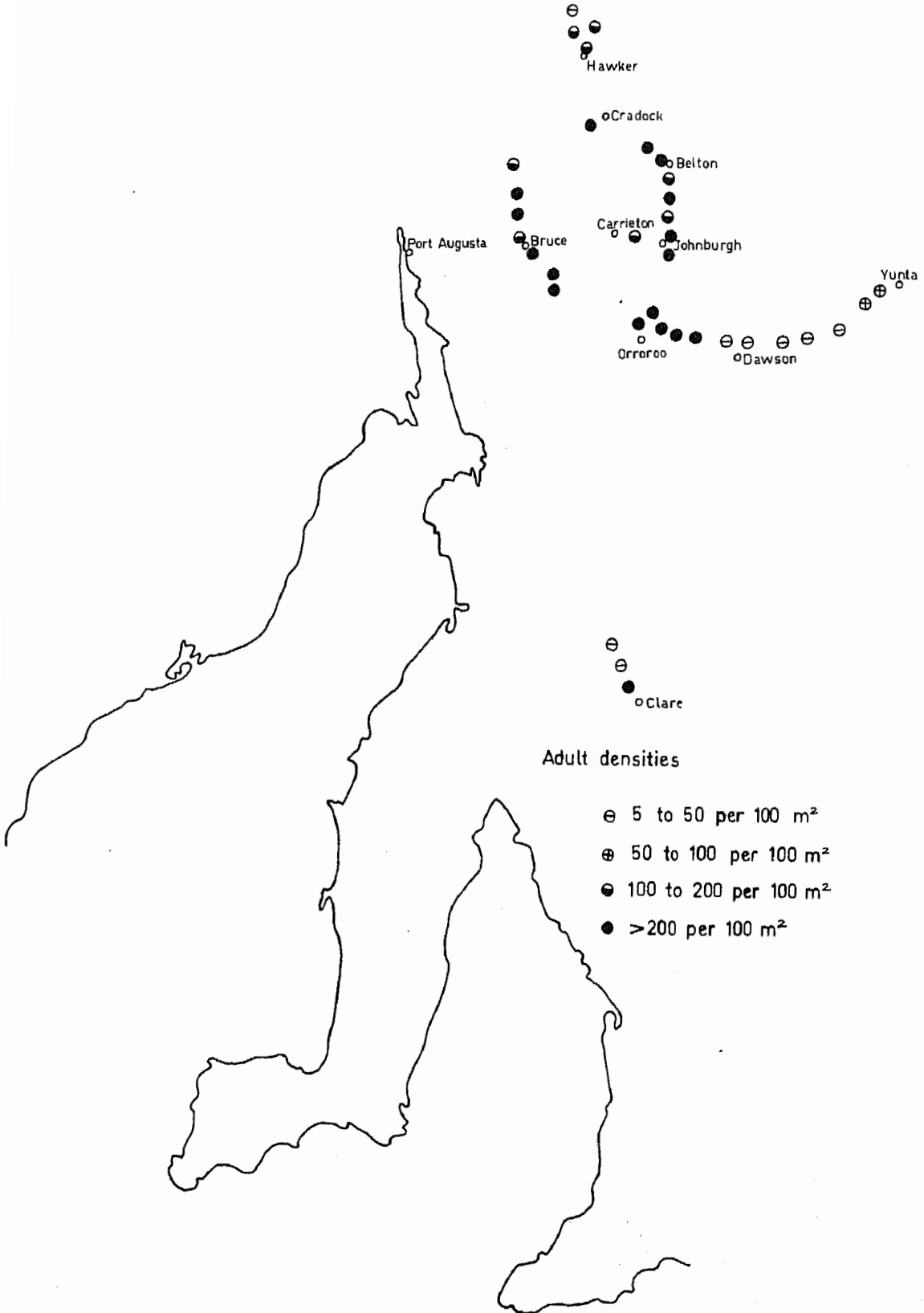


Fig. 3: ADULT ACTIVITY

February - April 1976

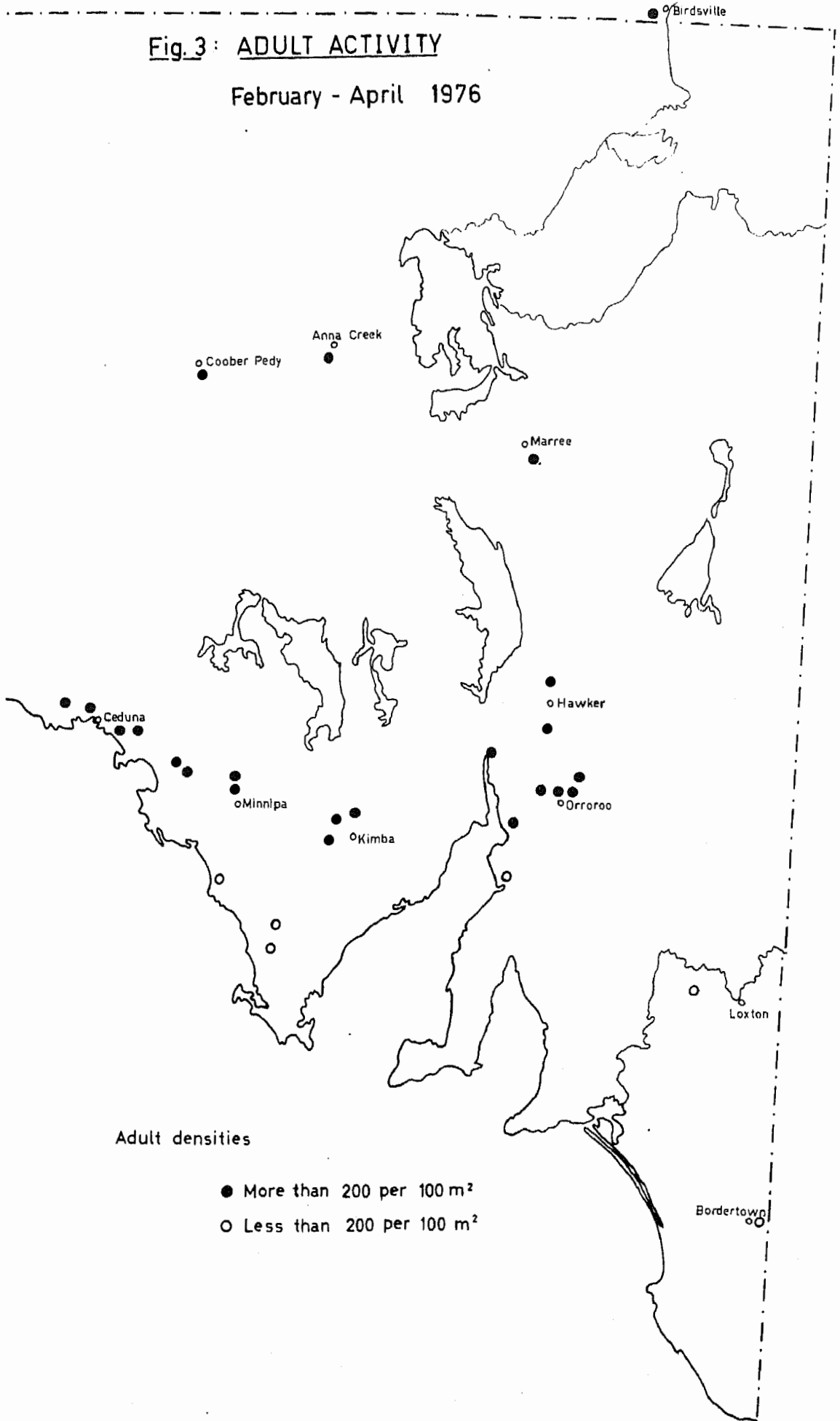


Fig. 4 : AREAS OF SPRING HATCHING - 1976

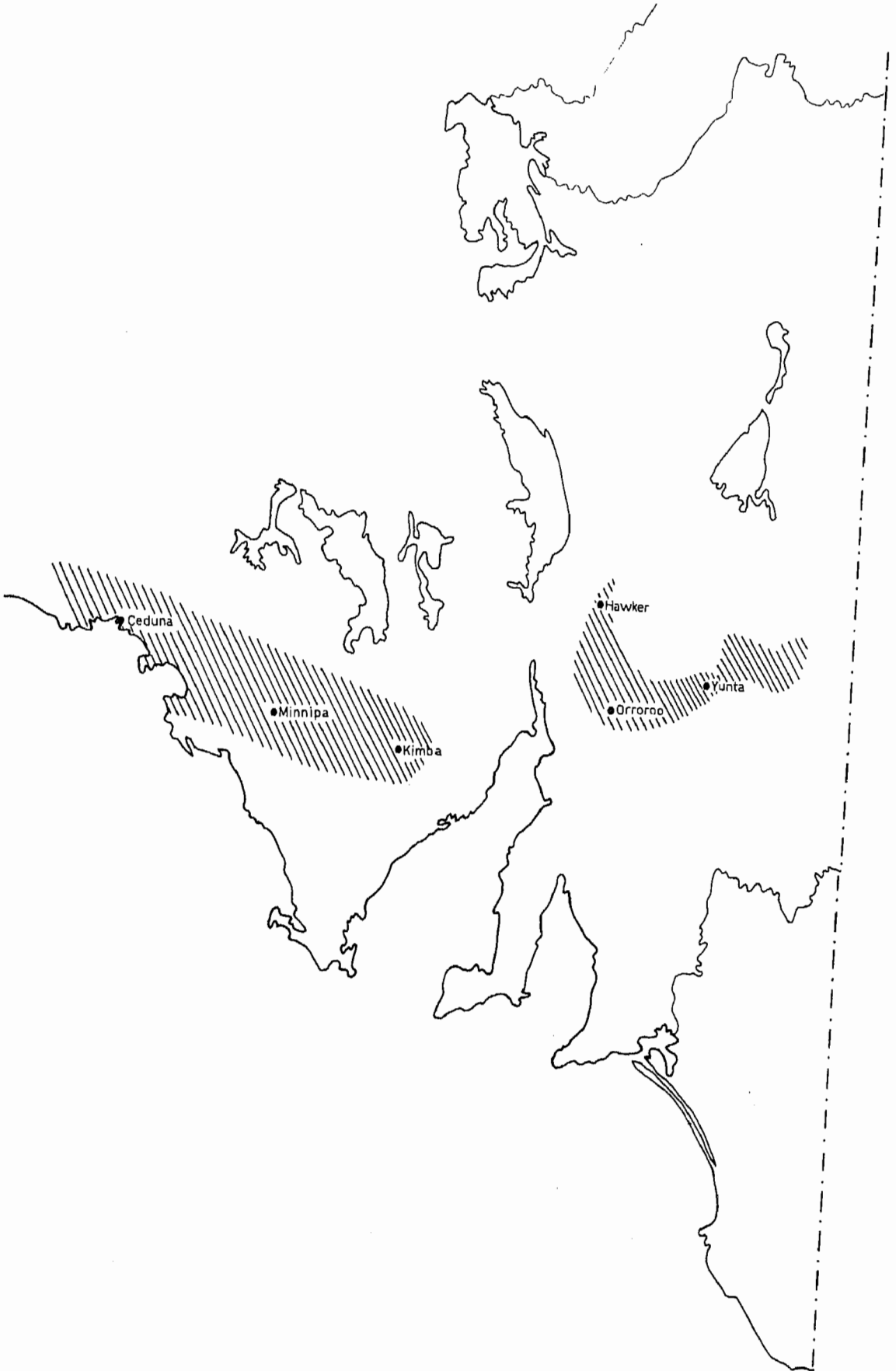


Fig. 5: AREAS OF ADULT SWARMS



RECOMMENDATIONS FOR THE FUTURE CONTROL OF PLAGUE LOCUSTS
IN SOUTH AUSTRALIA

PART II

1. INTRODUCTION:

Part II of this Report, submitted by the Plague Locust Review Committee, explores the economic justification for continued control programmes. It also examines the current legislation and Departmental operational procedures and suggests improvements based on a three zone campaign.

Considering the restricted resources available, the Committee believes that Departmental operations during past campaigns have been remarkably efficient. For example, there has never been a breakdown in insecticide supplies during emergencies despite the enormous logistic problems of delivering and controlling free supplies through local government. The technical information available through the Entomology Section in the Agronomy Branch and backed by field advisory services of agronomists and horticultural advisers has ensured maximum control with least danger to the environment.

However, the Committee, having reviewed the last campaign in detail (see Part I) believes that, given new resources, improvements can be economically made and these have been outlined in detail below to guide those involved in the on-going planning of plague locust control.

2. SUMMARY:

2.1 A benefit cost ratio calculated for plague locust control operations in the past, although based on incomplete data, indicates that there is ample economic justification for the Government to continue to undertake control campaigns and inject more finance on an annual basis to achieve improvements over operations in the past.

2.2 The Noxious Insect Act, 1934 provides for the appointment of an advisory committee to assist the Minister to implement this legislation. The Plague Locust Review Committee recommends that this Committee be appointed on an interim basis to guide development of new legislation proposed in this Report.

2.3 The Review Committee has initiated steps with the State Supply Department to relieve the Department of insecticide storage and handling in the event of another plague. This initiative should be continued by the interim advisory committee suggested in 2.2 above.

2.4 The proposed new legislation outlined in this Report by the Review Committee provides for a "control" committee to replace the advisory committee provided for in the current legislation. It is envisaged that this committee would develop policy under the direction of the Minister, co-ordinate the field programme and provide the technical spokesman for the media programme. It should also ensure the maintenance of adequate monitoring by working closely with the Department's chief regional officers and the Department's Arid Zone Working Party.

2.5 The Review Committee recommends that future plagues be controlled in South Australia in three zones backed by a monitoring service, particularly in the zone covering pastoral lands on the fringe and immediately outside local government areas (see map Zone II). These control programmes to be operational at the regional Departmental level with the Entomology Section in the Agronomy Branch acting as a technical resource unit.

2.6 It is recommended that the Government continues to support the Australian Plague Locust Commission.

3. THE ECONOMIC JUSTIFICATION FOR PLAGUE LOCUST CONTROL IN SOUTH AUSTRALIA:

The Department of Agriculture & Fisheries organises programmes in South Australia to protect rural industries from plague locusts under the Noxious Insects Act, 1934-55. The rural production at risk from plague locusts and the costs and benefits of control of these pests are summarised as follows.

3.1 Frequency Of & Potential Losses from Plagues of Locusts

Locusts are endemic to Australia and major plagues have been recorded at least since the 1840's. Minor plagues have occurred more frequently, but prior to the 1930's poor records of their occurrence in South Australia are available.

Locusts may attack pastures and crops (including horticultural) across broad areas of South Australia, but tend to originate from pastoral and marginal cropping regions. The total value of crop and livestock production in South Australia fluctuates considerably around a mean of about \$700M (\$A1976), with slightly greater than 50% of this value from crop production and slightly less than 50% due to livestock products and livestock slaughtering.

To rationally assess the costs and benefits of locust control, data needs to be on an annual basis. To obtain an estimate of the annual value of rural production at risk, the Committee agreed that the level of production at risk and the frequency with which it is at risk are as follows.

* Major plague - 1 year in 20 with 15% of average annual rural production, viz. \$105M. at risk (15% of \$700M.)

* Minor plague - 4 years in 20 with 1% of average annual rural production, viz. \$7M. at risk (1% of \$700M.)

* Average annual value of rural production at risk =

$$105 + 7 + 7 + 7 + 7 = 133/20 = \$6.7M.$$

While frequencies of major plagues at least are based on over 130 years of data, there is no way of assessing the level of loss (i.e. the production at risk) that would have occurred if no locust plague control measures had been taken. The assumed levels of loss without control will greatly affect the annual value of rural production at risk.

3.2 Benefits from Control of Locusts

Although the annual value of production at risk from locusts is small compared with other factors such as season and market fluctuations, the risk of loss is not spread evenly over all farmers, thus while damage from locusts is largely at random (although tending to be greater on the cropping areas adjacent to pastoral areas) and spasmodic, losses to individual farmers may be very great. Further, since losses may be independent of the farmer's management, it seems reasonable that the Government should assume responsibility for control of locusts (as a public nuisance) if a major outbreak threatens.

Benefits from the control of locusts are:-

- * To the individual on whose property the locusts are controlled - reduction of crop and pasture losses.
- * To those individuals in the future flight path of the locusts - locust movements cannot be accurately predicted and hence these beneficiaries cannot be readily identified. With any reasonable sized outbreak complete control will not be achieved, and Government involvement must be aimed at achieving a maximum level of control with the resources available.

3.3 Costs Incurred in Control of Locusts

3.3.1 Government

3.3.1.1 Fixed costs

Annual costs of monitoring locusts, and maintaining basic equipment, vehicles and insecticides in readiness for any control measures required. Since 1972 this basic figure has been approximately one-half man-year (\$10,000) plus \$5,000 for travel, equipment and materials, i.e. total \$15,000.

Since 1977 this figure should also include the \$60,000 paid annually to the Australian Plague Locust Commission to aid Australia-wide locust control.

Thus annual fixed Government costs are approximately \$75,000 on locust control.

3.3.1.2 Variable costs

Depend on the number and extent of locust plagues - may vary in any given year from nil up to about \$1M. The most recent major locust plagues incurred variable costs of about \$900,000 in 1955 and \$300,000 in 1976 (all figures \$A1976). Such costs consist of:-

- * Insecticide and application equipment supplies.
- * Contract costs of aerial spraying or provision of army manpower.
- * Salary and travelling costs of officers of Government departments seconded to locust control work, e.g. entomologists, media people and district agronomists and horticulturists.
- * Opportunity costs of Government officers in above * not carrying out their normal work. However, such costs are not readily estimated and are not generally included in estimates of variable costs of locust campaigns.

A summary of costs incurred by the South Australian Government (both variable and fixed) in the 1955 major locust plague and with plagues since 1972 are given in Table 7. From these figures an annual public expenditure can be derived, and this may vary from \$20,750 for the 20 year period 1955-76, if only South Australian costs are considered, to \$143,000 for the 5 year period 1972-76 if the \$60,000 annual payment now required to the Australian Plague Locust Commission is included.

Table 7: Public Costs of Plague Locust Campaigns in South Australia

(all values \$1976)

	Materials + Equipment + Transport	Salaries	Sub-Total	APLC*	Total Costs
<u>(a) Annual estimated expenditure since 1955</u>					
1976	250,000	50,000	300,000	60,000	360,000
1975	5,000	10,000	15,000		15,000
1974	30,000	40,000	70,000		70,000
1973	5,000	10,000	15,000		15,000
1972	5,000	10,000	15,000		15,000
1971)	minor outbreaks - no costs				
1969)	available				
1955	750,000+	(say 150,000)	(say 900,000)		900,000
+ Only costs available were £172,308/19/1 for materials and travel. No allowance made for salaries or Army backing.					
<u>(b) Average annual costs of plague locusts in South Australia</u>					
	Base Years		Without APLC* Payment		With APLC* Payment
	1972-76		\$83,000		\$143,000
	1957-76		\$20,750		\$ 80,750
	1955-76		\$60,000		\$120,000

* South Australia's annual contribution is \$60,000 to the Australian Plague Locust Commission to aid Australia-wide locust control.

3.3.2 Private

Although insecticides and limited equipment and vehicles are provided free of charge by the Government during plague locust campaigns, considerable expenses are incurred by private individuals. These are largely variable costs, depending on the size of locust outbreaks and include:-

- * Labour costs
- * Vehicle operating costs plus increased depreciation and maintenance due to insecticide damage and rougher than average treatment involved in locust control work.
- * Opportunity costs of delaying or foregoing time dependent farm jobs, e.g. spraying or harvesting of crops and livestock husbandry.
- * The cost of damage by locusts is borne primarily by the farmers although it finally means reduced public income. Damage losses from the 1976 locust plague were estimated at \$2M., but there are no reliable estimates of damage losses from previous minor or major locust plagues.

Estimates of costs incurred by the private sector (farmers in particular) in locust control (particularly relevant to the first three points mentioned above), have not been estimated. It is likely, however, that they are of similar order or higher than public variable costs. In general farmers incur costs in protecting their own production and that of their neighbours or district. However, they cannot be expected to bear the costs of protecting the production or environment of others (both farmers and urban dwellers) further along the flight path of the locusts. Such control if justified, must be made available by the public sector.

3.4 The Profitability of Plague Locust Control

3.4.1 Under existing Noxious Insects Act, 1934-55

Direct public expenditure with the present system of plague locust control varies annually on average between \$20,750 and \$143,000, depending on which costs are included and the year base used. The most likely figure is that based on costs incurred over the 20 year period 1957-76 and including the annual payment to the Australian Plague Locust Commission, viz. \$80,750.

Benefits arise from the protection of the \$6.7M. average annual production at risk.

In this form public expenditure appears highly profitable with a benefit cost ratio of 83.

If the costs incurred by the private sector (particularly farmers) are included (assume approximately similar costs to the public sector), then overall costs become \$160,000. Further locust control at present is far from complete, and hence only a proportion of the annual production at risk will be protected. Assuming 75% protection then the annual production at risk is about \$5M.

Using this series of assumptions a benefit cost ratio of 31 is obtained. Again plague locust control appears highly profitable.

An alternative interpretation of the above benefit:cost calculations is that with annual costs of \$160,000 and benefits of \$5M. only a 2.4% control of potential locust losses is necessary to cover these costs (i.e. a benefit:cost ratio of 1). Thus a 72.6% fall in the level of locust control (or loss of production) could occur before current levels of expenditure on locust control were not economic, i.e. an annual average loss of \$4.86M. rural production could be sustained.

3.4.2 Under proposed changes to Noxious Insects Act, 1934-55 & improved monitoring & control by the Department of Agriculture & Fisheries

While the investment of funds in plague locust control in South Australia appear to have been very profitable, there have been considerable problems in recent plague locust campaigns, particularly in monitoring numbers and movements, and in the actual operation of control campaigns. Details for greatly improving plague locust monitoring and control are given elsewhere in this Report. Additional costs are involved in achieving these better levels of monitoring and control of locusts. These costs include:-

	<u>Annual Cost</u>
Improved training & extension programmes	\$1,000
Improved monitoring (see page 35 in Zone II map)	9,000
Grants to Pest Plant Boards (provided new legislation allowing this can be developed)	10,000
Insecticide storage contracts	<u>5,000</u>
	<u>\$25,000</u>

The additional annual costs outlined above, viz. \$25,000, would be expected to reduce losses from locust outbreaks in the future. If such improved methods resulted in an increase of 10%, viz. from 75% to 85% of the production at risk protected by locust control measures, then this would be a benefit cost ratio of 27. Hopefully most of these gains would result from earlier identification and control of locusts in major plague years.

Up to \$670,000 could be profitably spent each year to achieve the 10% increase in locust control. It is likely, however, that most of these gains could be achieved by the modest expenditure detailed above, viz. an additional \$25,000 each year. Any further major expenditure may not be justified because of diminishing marginal returns and more profitable alternative insect research and control projects.

Having done this exercise with limited data, the Review Committee is confident that future campaigns are justified and the costs of improvements suggested above are economically worthwhile.

4. NEW LEGISLATION FOR NOXIOUS INSECT CONTROL:

Legislation to control noxious insects has been confined to the control of locusts and migratory grasshoppers. Although it was first introduced in 1934, a number of its provisions have never been actively administered. For example, landowners have only infrequently been advised of their obligations through active extension campaigns. Certainly legal action has only once or twice been sought against landowners, who have failed to face their responsibilities to destroy hatchings. Local government has also often failed to implement its requirements and in many instances technical officers in the Department of Agriculture & Fisheries have had to carry out major search and destroy tasks which should have been done by the local authorities.

It must be recognised that in any plague locust campaign the area within approximately 200 km outside of local government boundaries into the pastoral zone may be critical for treatment if agricultural areas are to be protected. Since the Act was first introduced in 1934, the number of people living in this area has dropped considerably. The requirement of the Act for landowners in these areas to map and advise egg-beds and generally monitor the locust problem is therefore now quite unrealistic. During the recent campaign the lack of knowledge of plague locust densities and movements in this zone was one of the most important factors which lead to the break-through of some large swarms into agricultural areas.

Keeping such aspects as these in mind, the Plague Locust Review Committee has examined the legislation and now recommends that, depending on Parliamentary Counsel advice, either a new Act or an amended Act be prepared using the following guidelines.

4.1 The Act should continue to be called the Noxious Insects Act and should aim to control only locusts and migratory grasshoppers.

4.2 The Act should establish a control committee with powers to administer the Act and allocate funds, including free insecticide (the Noxious Insects Act, 1934-55 made provision for an advisory committee which was never formed).

4.3 The control committee should comprise as chairman, a senior Departmental administrative officer, preferably the assistant director in charge of regional activities, a pastoralist with property in the near arid zone (see map), a farmer with local government experience and a specialist in entomology from the Agronomy Branch to act also as the executive officer.

This proposed committee would probably only need to meet once a year for periods of four or five years at a time, but when plagues develop at least monthly meetings would be necessary.

4.4 The Act should continue to require landowners to control locusts and grasshoppers on their properties. Within local government areas landowners should be required to notify egg-beds and autumn adults after published notices have been issued.

4.5 Local government should be required to administer the above requirement through the Pest Plants Boards.

4.6 The Act should make funds available to the Minister of Agriculture to enable the control committee to:-

4.6.1 Support the Australian Plague Locust Commission.

4.6.2 Monitor locusts or migratory grasshoppers, particularly in pastoral areas.

4.6.3 Provide equipment, such as U.L.V. misters to local government.

4.6.4 Provide casual labour support for local government at the time of our emergency.

4.6.5 Enter into contracts with chemical companies for the supply and delivery of insecticide.

4.6.6 Enter into contracts with ground and aerial spraying operators.

(At current costs the Plague Locust Review Committee estimates that the funds needed four years out of five would be approximately \$80,000, of which the State's current commitment to the Australian Plague Locust Commission is \$60,000. In four years out of 20 the costs would be \$500,000 and one year in 20 in excess of \$1M.).

4.6.7 Provisions should be made for action to be taken when local government or landowners fail to comply with the requirements of the Act.

4.6.8 Provisions should enable Pest Plants Boards to be contracted to make available their resources (inspectors, vehicles and spray equipment) at the time of a serious outbreak. This may require amending the Pest Plants Act, 1976.

4.6.9 Regulations should be able to be prepared by the control committee to prescribe control methods and monitoring methods.

5. IMPROVED DEPARTMENTAL OPERATIONS:

5.1 Mass Media

During its investigations the Plague Locust Review Committee determined from a survey of the media carried out early in February that they were well satisfied with the service provided by the Department during the height of the locust activity.

However, the public image given to the Department was poor in some instances, mainly due to the lack of emphasis given to the control of hopper bands which was very effective in the early phases of the campaign.

The Review Committee recommends that in future campaigns the envisaged statutory control committee, formed under the terms of the revised Act (see 4.2) should appoint its technical member (executive officer) as spokesman for the campaign. All releases involving technical matters of the plague which might affect large areas of the State should then be issued over his name. The Department's new media officer should, at the beginning, plan the media programme and endeavour to help the Minister's press secretary. Policy statements should give particular attention to announcing the commencement of the campaign or any new directions it might take, such as the decision to involve aerial spraying contractors.

Regional media officers should undertake local programmes involving the Department's chief regional officer as the spokesman.

If the Department, to protect wide areas of the State, needs to mount intensive control measures, such as aerial spraying, then the local media officer should be at the operational centre to protect field advisers from the time consuming task of taking press, radio and TV personnel to field sites for pictorial and other news items.

The media officer should maintain a file of press cuttings so that his programme can be assessed continually and mis-informed public statements corrected.

Paid advertising should be considered to announce 'landowners' responsibilities at the beginning of a campaign or to announce where aerial spraying will be carried out and how landowners can co-operate.

The Review Committee considered that the fact sheets and technical notes used in the most recent campaign were adequate and should simply be up-dated when required again.

In any future campaigns the telephone advisory centre should again be set up and manned by advisers from Head Office.

5.2 Insecticide Supplies

Because such large quantities of insecticides are required at short notice and because most are specially formulated for the task and are not normally sold "over the counter" for other agricultural uses, it has been necessary in the past to store large quantities at the Northfield Research Laboratories and use Departmental staff to organise deliveries to councils.

During the course of the Committee's review, new safety requirements have been adopted by the Department of Agriculture & Fisheries which have forced the immediate dispersion of remaining stocks. This, together with possible financial inefficiencies and stock deterioration, encouraged the Review Committee to immediately refer these problems to the Department's Executive. With their authority, help from the State Department of Supply has been sought and currently that Department is investigating, with the chemical industry, ways of setting up contracts for the industry to relieve the Government of these problems, but not to lose access to adequate quantities of the insecticides in an emergency.

Preliminary discussions with six or eight large chemical companies are encouraging but three or four months will elapse before any plans are finalised.

The Review Committee recommends that the implementation of these contracts, if they eventuate, should be a matter for the control committee proposed under the revised Act (see 4.2).

5.3 Field Operations Including Monitoring

The Review Committee has found that the main weakness of previous plague locust campaigns has been inadequate monitoring of locust activity in fringe local government areas and in the Arid Zone.

The Committee therefore recommends that the following be adopted.

The State, for the purposes of improved field operations for plague locust control, should be divided into three zones (see map on page 35).

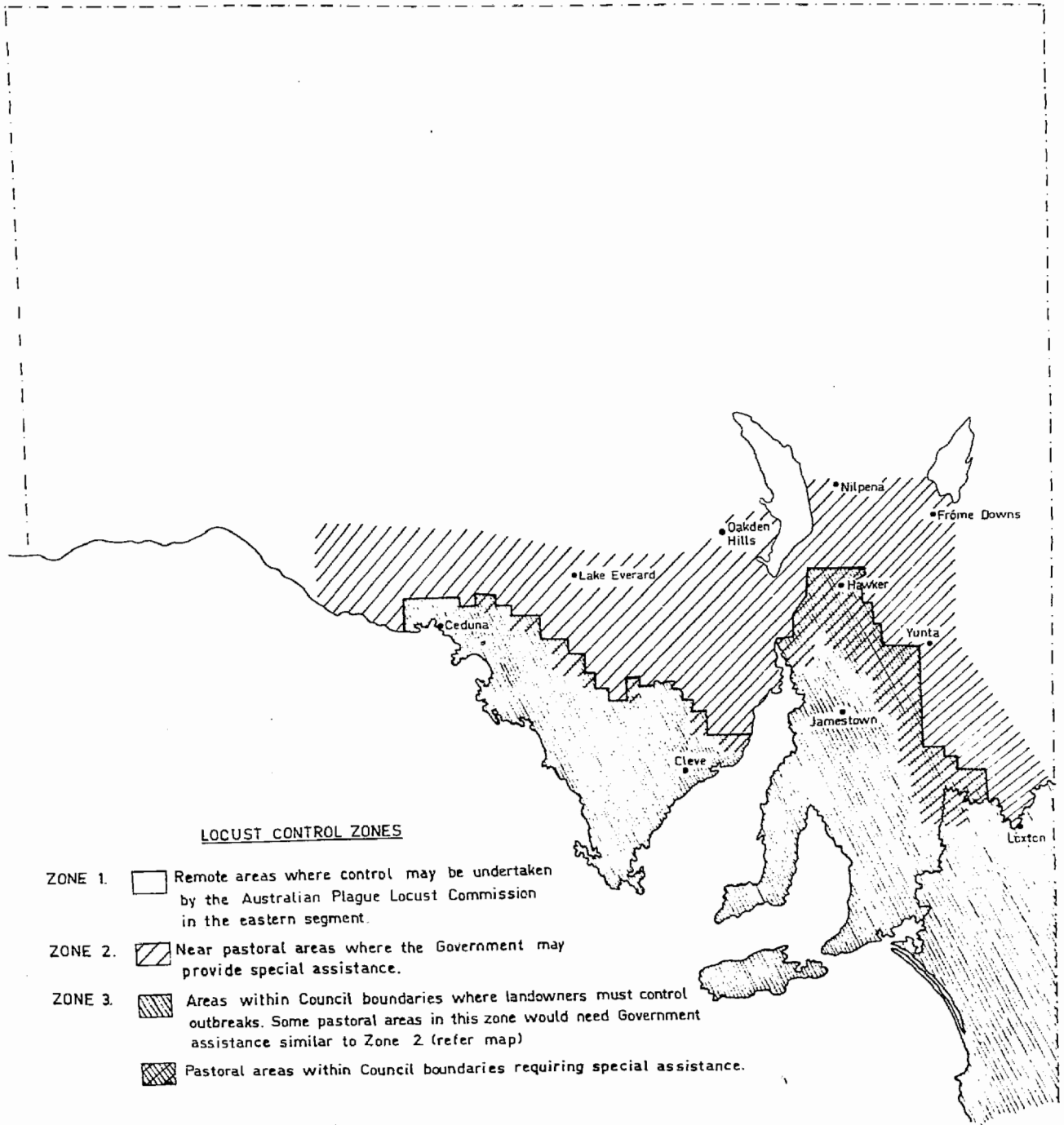
5.3.1 Zone I

The operation in the far northern arid zone should be mainly left to the Australian Plague Locust Commission. Soon this authority will be in a position to monitor locust activity in this area and undertake control if possible. The State control Committee should work closely with this Authority and ensure frequent reports are made available.





5.3.2 Zone II

The Plague Locust Review Committee has identified this Zone as the critical one for the protection of agricultural areas. Extending from the boundaries of local government into the arid zone for about 200 km, it covers about 200,000 square kilometers of sparsely populated country.

It is from this territory that major infestations of locusts can invade the agricultural areas. In past campaigns landholders have generally failed to monitor autumn flights and resultant egg-beds and information gathered has depended almost entirely on the efforts of the small Entomology Section in the Agronomy Branch. Consequently, important research projects, such as sitona weevil control and testing insecticides to replace DDT have suffered.



LOCUST CONTROL ZONES

- ZONE 1.  Remote areas where control may be undertaken by the Australian Plague Locust Commission in the eastern segment.
- ZONE 2.  Near pastoral areas where the Government may provide special assistance.
- ZONE 3.  Areas within Council boundaries where landowners must control outbreaks. Some pastoral areas in this zone would need Government assistance similar to Zone 2 (refer map)
-  Pastoral areas within Council boundaries requiring special assistance.

The Review Committee believes that in future far more attention should be given to locust control in this area by devising an on-going plan to continuously monitor the area using all Departmental officers who work in the area and also, if possible, Department of Environment rangers, Pastoral Board inspectors and Vertebrate Pest Control Authorities.

Within the Department of Agriculture & Fisheries alone, there are 19 officers who work from time to time in this Zone. The Review Committee has noted that an Arid Zone Working Party within the Department has recently been formed under the Chairmanship of the Deputy Director, Mr. Trumble. As one of its first tasks this Working Party should be asked to make a monitoring service operational. Most of the work will need to be done between late February and April when adults are flying in to the Zone. The information gained will be co-ordinated and assessed by the Entomology Section in the Agronomy Branch and reported to the statutory control committee. When plagues are found to be developing in this Zone the chief regional officers involved should then be briefed and it is recommended that from that time they should conduct the campaign in their regions backed by the technical resources of the Northfield based entomologists.

If this recommendation is adopted it will be necessary to ensure that the Eyre Peninsula Region and the Northern Region of the Department are both equipped with at least two four wheel-drive units manned by two well trained officers to pin-point the locusts in Zone II. Under the direction of the chief regional officer these units would then direct ground operations in the Zone involving landowners and the proposed control committee (see 4.2), when the scale of the locust invasion made it imperative for Government resources to be used to protect other parts of the State.

Where the scale of invasion in Zone II indicates a need for control in pastoral areas, it is suggested that surveys and search and destroy operations might be undertaken on the following basis:-

- One tray top 4-wheel drive vehicle equipped with
ULV mister
- Two motor cycles approximately 150 CC
- One ULV knapsack mister

This unit could intensively search about 400 sq. km and treat about 15 sq. km of dense bands in a period of four weeks provided that they are not required to treat more than 100 ha per day.

For larger operations a team of 10 units as above combined with the following support resources would be required:-

- One helicopter for preliminary aerial surveys
- One fixed wing aircraft for spraying

This₂ team could search an area of₂ about 4000 sq. km and treat about 150 km² from the ground plus 140 km² from the air in a four week period at a cost of about \$100,000, excluding accommodation, salary costs. Operation of one or more of these teams may require the assistance of the armed services.

The total area treated by a team is about 300 km² which is 7.5% of the area searched. This is of the same order of treatment as required for effective control of locusts overseas.

5.3.3 Zone III

It is recommended by the Review Committee that in future plague locust campaigns in this Zone, which is within local government boundaries, be conducted by the councils. This may involve the Pest Plants Boards currently being formed.

The proposed locust control committee should equip local government, possibly through the 10 or so Boards. Their operations will have to be backed technically by regional Departmental staff. U.L.V. equipment will need to be held at Board centres for use by landowners. Permanent Pest Plants Board staff will need to be trained and finance made available to hire casual labour at the time of an emergency.

At times of major plagues it may be necessary for the teams contracted for Zone II to move into local government areas to treat large swarms which may have penetrated from the pastoral areas.

The Review Committee estimates that the Government will need to inject approximately \$1000 annually into each board to ensure that the service can be operational in the years when campaigns are necessary. If the boards cannot be used, then a sum of approximately \$10000 annually will have to be distributed to the 25 local government authorities bordering pastoral areas.

APPENDIX I

6th January, 1977.

MEMO. TO:

Plague Locust Damage Assessment

Following the extensive locust activity in South Australia during late 1976 and early 1977, it has been decided that an assessment of damage caused by locusts should be undertaken.

Would you please complete the attached questionnaire, giving estimates of damage to crops and feed supplies in your district.

In order that a State-wide estimate of damage can be compiled by the end of January, it would be appreciated if you could forward the information requested to me by 21st January, 1977.

(Signed) A.F. Tideman

Enc.

CHIEF AGRONOMIST.

(2) Crops Partially Damaged.

<u>Type</u>	<u>Area</u>	<u>Value</u>
Lucerne (forage)
Lucerne (seed)
Green forage
Cereal crops
Vines
Vegetables
Tree crops
Other
	<hr/>	<hr/>
<u>Total</u>	<hr/>	<hr/>

(3) Grazing.

(a) Pastoral Areas - Area of feed loss or assessment of stock reduction due to damage.

<u>Type of Damage</u>	<u>Value</u>
.....
.....
.....
.....

(b) Agricultural Areas - Not included previously.

<u>Type of Damage</u>	<u>Value</u>
.....
.....
.....
.....

(4) Total Value of all Damage.

Comments on comparative susceptibility of crops to locust attack:

Comments on campaign:

Suggestions for future locust plagues:

Any other comments:

.....

Officer.

APPENDIX II

SOUTH AUSTRALIAN DEPARTMENT OF AGRICULTURE

LOCUST CONTROL WITH CONVENTIONAL SPRAY EQUIPMENT

By Peter R. Birks,
Senior Research Officer (Entomology)
Campbell Phillips,
Technical Officer (Entomology)

The Australian plague locust (Chortoicetes terminifera) can be controlled by spray application of insecticide using conventional farm spray equipment such as boom sprays, misting machines, jet sprayers, modified sheep jetting equipment, fire fighting equipment and knapsacks.

Insecticide:

The insecticide currently available is diazinon, formulated as an emulsifiable concentrate (E.C.), i.e. it will mix with water. Diazinon is not very persistent, and can only kill locusts for about three days after application. Therefore it should be applied directly onto locusts and not used as a protective barrier. Diazinon begins breaking down as soon as it is mixed with water, so only mix enough spray for about half a day's use.

Rate of Application:

500 ml per hectare of 80 per cent diazinon (E.C.)

7½ fl. oz. per acre of 80 per cent diazinon (E.C.)

Livestock Withholding Period:

Livestock for slaughter must not be grazed on treated areas for seven days to avoid chemical residues in meat.

Bees:

Diazinon is toxic to bees. Do not spray flowering vegetation while bees are foraging. Where possible spray these areas in late afternoon or at "first light" before foraging commences. Do not spray over hives. Notify beekeepers as early as possible of intention to spray.

Operator Safety:

Like most insecticides, diazinon is poisonous, but if handled carefully no special safety equipment is necessary. Do not take unnecessary risks.

Handle the concentrate carefully - avoid splashing. Keep out of spray drift. If spilled on the skin and on completion of spraying, wash thoroughly with soap and water. Wash contaminated clothing before re-use. Do not eat or smoke while spraying.

Guidelines for Spraying:

With high density infestations the hoppers (the young, wingless stage) form into dense bands. These form the most strategic spray targets; very large numbers are killed for least cost and effort. Spraying unbanded hoppers is generally unwarranted.

Always start spraying at the head of the band where the hoppers are most dense.

Hopper bands are usually most compact in the early morning, late afternoon, or during cooler weather.

Early morning and late afternoon are often the most suitable times for spraying because they are usually the calmest times of the day.

Avoid spraying if rain is likely to fall before the spray can dry.

Hatching often continues for several weeks. The presence of small yellow hoppers indicates that hatching is still continuing. Unhatched eggs can be found by digging or scraping the soil surface. Avoid spraying egg-beds until bands form and start moving away. This also minimises killing the tiny wasp parasite of locust eggs.

Check the Output of the Spray Machine:

Failure to make a reasonable calibration can result in either failure to kill locusts or wastefulness.

Calibrating a Boom Spray:

Ensure that all nozzle outputs are the same, by operating the boom at the pre-determined pressure and measuring the water output from each nozzle for one minute.

Metric:

Check the output per hectare by carrying out a practice run using water only.

- (a) Decide on working pressure and speed of travel.
- (b) Measure the length of the boom in metres and divide this into 5000. The answer obtained will tell you how many metres you must spray to cover 0.5 hectare.
- (c) Measure this number of metres along a fenceline.
- (d) Run the pump to ensure that the boom and spray lines are full of water, then top up the tank.
- (e) Spray the measured distance at the speed of travel and working pressure selected.
- (f) Refill tank to original level measuring the number of litres needed, multiply by 2 and this will give the output in litres per hectare.

If the output is 45 litres per hectare and the spray tank holds 450 litres, the tankfull will spray 10 hectares. The recommended spray application rate is 500 ml of 80 per cent diazinon E.C. per hectare, therefore 10 x 500 ml of emulsifiable concentrate should be added to each tankful of water.

Imperial Units:

Follow the preliminary procedures as for metric calibration, but instead, measure the width of the boom in feet and divide this into 660. The answer will tell you how many chains you must spray to cover one acre.

Spray the measured distance at the intended speed of travel and spray pressure.

Refill tank to the original level. The number of gallons needed will be the output in gallons per acre. Add $7\frac{1}{2}$ fl. oz. of 80 per cent diazinon E.C. for each acre to be sprayed by the contents of the tank.

Misters & Jet Sprays:

These can be calibrated by measuring the effective spray swath and using the formula as for boom sprays. Care should be taken not to over-estimate the distance of the spray swath if effective application is to be achieved.

Knapsacks:

A 14 litre (3 gallon) knapsack will spray about 130 square metres (160 sq. yd.) as a very fine spray.

Water is only a carrier for the insecticide. Excessive wetting wastes time, effort and chemical. Test yourself and your knapsack by spraying with water only using $4\frac{1}{2}$ litres (1 gallon) to cover 45 square metres (54 sq. yd.).

Add 9 ml ($\frac{1}{3}$ fl. oz.) of 80 per cent diazinon E.C. for each 14 litres (3 gallons) of water.

Modified Fire Fighting Equipment or Sheep Jetting Pumps:

Again water is only a carrier of the insecticide. A light application of concentrated material applied as a fine spray will save time and effort. Use a fine spray nozzle to avoid using large volumes of water.

Test spray using water over a measured area. Refill the tank with water to the original level to determine the output in litres per hectare. Add 500 ml of 80 per cent diazinon E.C. for each hectare to be sprayed, or $7\frac{1}{2}$ fl. oz. of 80 per cent diazinon E.C. for each acre to be sprayed.

APPENDIX III

SOUTH AUSTRALIAN DEPARTMENT OF AGRICULTURE

LOCUST CONTROL WITH ULV SPRAYING

Peter R. Birks,
Senior Research Officer, Entomology

Ultra low volume (ULV) spraying involves the distribution of very small volumes of spray, as little as 300 ml/ha (4 fl. oz./acre) of spray can be applied. Fine droplets of low volatility are required.

Savings of time and effort are considerable as no water or other bulky carrier of insecticide is used, however, accurate calibration of ULV equipment is most important.

WARNING:

Ordinary insecticides contain volatile petroleum solvents and emulsifiers which enable them to be mixed with water. They CANNOT be applied by ULV techniques. Conversely, ULV formulations will not mix with water and CANNOT be applied with conventional spray equipment.

ULV Insecticides:

Maldison, fenitrothion and diazinon are being used as ULV formulations for locust control. They are of relatively low toxicity to mammals, and short residual life in the field so they can be used with safety to the operator and minimum danger to the environment.

Handling precautions. Handle carefully, pour slowly to avoid splashing and spilling. Keep out of spray drift. If spilled on clothing or skin wash with soap and water. Wash hands before smoking or eating. No special safety equipment need be worn if handled with care and common sense.

Locust targets. Because the sprays have short field lives (about 3 days for maldison and diazinon, 5 days for fenitrothion), they must be applied directly onto locusts, especially onto hopper bands. They should not be applied generally to crops for crop protection.

Other dangers. These sprays are all toxic to bees and should not be applied to flowering vegetation while bees are actively foraging. (Bee activity is usually minimal in late afternoon). Do not spray over or upwind of hives. Paint work of motor vehicles may be damaged by ULV sprays. Livestock for slaughter should be kept off treated areas for 7 days after spraying to avoid residues in meat.

STARTING INSTRUCTIONS:

1. Check oil in motor.
2. Turn grease cup on gear pump - refill if necessary - attention every five hours.
3. Fill fuel tank - standard grade petrol.
4. Turn on petrol.
5. Turn on insecticide at end of filter.
6. Check and clean breather hole in top of insecticide tank.
7. Turn 025 or 020 nozzle into air flow spout. (See calibration)
8. Adjust choke - start - run at full throttle after initial warming up period.

CALIBRATION:

1. Disconnect spray head from air flow spout while it is in the horizontal position. (Don't drop nuts and bolts down the spout). Place spray head in clean bucket.
2. Select correct jet size and approximate pressure for the chemical to be used from the following table.

Chemical	Jet size	Approx. pressure GUIDE ONLY	Time to deliver 380 ml (13½ fl. oz.)	Application rate/ ha - 10km/h - 40m swathe
Maldison ULV	.025	40 p.s.i.	62 sec.	550 ml (8 fl. oz./ac.)
Diazinon ULV	.025	20 p.s.i.	93 sec.	400 ml (6 fl. oz./ac.)
Fenitrothion ULV	.020	20 p.s.i.	124 sec.	275 ml (4 fl. oz./ac.)

3. Set correct jet and approximate pressure with machine at full throttle and the insecticide tap open. Pressure adjusting valve is on the gear pump.
4. Measure the time to completely fill a drink can (380 ml).
5. Increase pressure if time is too long. Decrease pressure if time is too short. (Be careful of knuckles when adjusting pressure).

Always check the calibration of a mister before first using it, then re-check the calibration at least every second day of use. Do not calibrate with pressure gauge reading only, measurement of time to deliver set volume is essential.

FIELD SPRAYING:

The ULV mister delivers a swathe of 40 m (2 chains) downwind. Winds of 5 to 20 km/hr (3 to 12 mph) are necessary. Calibration is made for a ground speed of 10 km/hr (6 mph).

1. Survey the target area - a complete band or the denser head of the band.
2. Move towards the downwind end of the target area into a position 40 m (2 chains) upwind of the end of the target.
3. Point the nozzle downwind at an angle of 20° to 30° to the ground and spray while travelling at 10 km/hr (6 mph) across the direction of the wind.
4. Switch off chemical - (top handle) - turn 40 m (2 chains) upwind - turn nozzle downwind and begin second swathe.

Remember start downwind, keep speeds as accurate as possible, avoid too calm, too windy or too gusty weather. Never run gear pump for more than 1 minute.

AT THE END OF THE DAY - OR COMPLETION OF THE JOB:

Turn off insecticide at filter.

Drain and wash insecticide filters in petrol - replace immediately.
Failure to clean filter will result in corrosion overnight.

Wash nozzle in petrol.

Turn off petrol.

Record operating times in log book.

APPENDIX IV

TECHNICAL NOTES

DEPARTMENT OF AGRICULTURE & FISHERIES STAFF

LOCUST CONTROL CAMPAIGN - 1976

1. The insecticide being used is technical fenitrothion - trade name "Sumithion" supplied by Ciba-Geigy Aust. Ltd.
2. It is one of the insecticides safer to man and the environment.

LD50 oral	- mice	624 - 1740
LD50 dermal	- mice	1802 - 4275

compare with DDT 112-118 LD50 oral - 2510 LD50 dermal.
3. Fenitrothion is an oily liquid of low volatility so it can be split into a large number of very small droplets (100-150 microns diameter) and these droplets will not be lost by evaporation. This allows waterless or Ultra Low Volume (ULV) spraying.
4. ULV spraying can be carried out with suitable ground spraying equipment, or with aircraft fitted with fan jets or rotary atomisers. Rotary atomisers provide the most uniform droplet size patterns and can be very readily adjusted to regulate droplet size according to conditions.
5. Both fixed wing and rotary wing aircraft will be used for spraying. Aircraft will carry sufficient chemical to treat 2,000 to 4,000 acres. They do not have to land and reload during operations. They will operate at least initially from a common base at Jamestown. The helicopter will also be used by Field Operations officer and assistants for aerial reconnaissance.
6. ULV fenitrothion is highly toxic to bees. No flowering crop is to be sprayed for locust control. Bees should be removed wherever possible and not returned for 1 week after spraying. Do not spray by air if an apiary is within one mile downwind. It is better to let a swarm or part thereof escape rather than risk damage to bees.
7. Under the Noxious Insects Act it is the responsibility of landowners to control locusts on their properties. District councils can enforce these provisions. Similarly the State Government can require councils to take action and it can provide assistance to councils. This is usually in the form of assistance with part or total insecticide costs and with some spray equipment. In this instance with extensive swarms of adult locusts, the State Government is not only providing the insecticide but also the costs and technology of application.
8. The aim of this campaign is to destroy or break up the locust swarms to reduce or prevent damage to lucerne and horticultural crops. Cereals in the infested areas are now mostly too ripe or too rank to be badly damaged.

9. Organisation:

Policy and Press - P.R. Birks, Northfield Laboratories, 261 3288
Officer-in-Charge, Field Operations - P.G. Allen, Jamestown 641408
Assistants - C. Phillips, A. Hincks, Jamestown 641408

10. Publicity:

Any officer engaged in the campaign is welcome to provide any information to the media regarding the location of swarms and damage caused by locusts. He must not comment on policy matters, such as safety or environmental aspects, accidental damage, the effectiveness, purpose or duration of the campaign. Such enquiries are to be directed to Mr. Allen or Mr. Birks.