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# LOCUSTS AND THEIR CONTROL IN SOUTH AUSTRALIA 1956 TO 2010

## 1. INTRODUCTION

The first record of a plague, probably of locusts, in South Australia is the year 1844. This is the first European record and not necessarily the first plague in South Australia. The inference is that locusts were migrating across South Australia before European settlement.

There are other reports from the 19<sup>th</sup> century. The South Australian Register of 18 December 1871 reported that some of the farmers in the north appear to have suffered very seriously from swarms of locusts that suddenly appeared and at this moment the Adelaide plains are covered with myriads of the creatures. The Register also reported locusts at Gladstone on 20 November 1877 and the Daily Telegraph, from Sydney, on 19 March 1890 noted that the train into Peterborough in northeastern South Australia was delayed by locusts making the line slippery so the train could only proceed very slowly.

The insect was not accurately described until 1934. There is some confusion in the parliamentary records as to the correct name of the insect. Questions asked in the State Parliament refer to the presence of plague numbers of grasshoppers. The record of the Legislative Council in Hansard of 23 October 1934 describes a plague as grasshoppers. However, photographs taken in November 1934 by the University of Adelaide Entomologist, D.C. Swan who determined that there was a *Chortoicetes terminifera*, plague locust band at Nackara indicate this outbreak must have been plague locusts.

In their various guises the Government Departments responsible for Agriculture in South Australia have undertaken control programs since 1955.

Control of locusts has become increasingly complex as more equipment and technology are used, different insecticides applied, and stricter restrictions and operating constraints introduced to minimise organisational risk.

It is worth noting that from 1844 to 2024 the discovery of a plague, mapping of infestations and application of any control first requires the sighting and assessment of the locusts by a human.

## 2. ABOUT THE INSECT

According to the Department of Primary Industries and Regions, South Australia, PIRSA, website, July 2024, locusts are large herbivorous insects that are a serious pest of agriculture when they form dense and highly mobile swarms. They are a

species of short-horned grasshoppers that periodically form large, dense migrating groups. Individuals differ in several characteristics from those living separately.

In Australia there are three main pest species of locust

- the [Australian plague locust](#) (*Chortoicetes terminifera*)
- the [spur-throated locust](#) (*Austracris guttulosa*)
- the [migratory locust](#) (*Locusta migratoria*)

All three species are native to Australia. Locusts belong to the same order of insects as grasshoppers, katydids and crickets - the Orthoptera.

The Australian plague locust is a significant agricultural pest that can produce several generations a year and periodically forms swarms in South Australia. After hatching, locusts undergo five juvenile growth stages (instars) before reaching adulthood. Immature locusts are known as hoppers or nymphs. Locusts generally mature within two weeks of becoming adult,

A plague infests a large area covering hundreds of square kilometres. There have been at least nine major and seven minor plagues in South Australia during the twentieth century. The largest ever control program occurred in 2010.



*Figure 1: An adult locust showing the dark spot on its wings that identifies *C. terminifera*. They also have distinctive red coloured hind legs.*

## How Locust Plagues Develop

Australian plague locusts are gregarious and band together. When the food supply is plentiful in their home territory of Queensland and northern New South Wales their numbers build until they aggregate and form flying swarms. These swarms migrate with the prevailing wind and so radiate into the Northern Territory, New South Wales and other parts of Queensland as well as South Australia. They move in rolling

flights up to 20 km in a day but can fly between 200 km to 500 km in 24 hours when atmospheric conditions are suitable.

Swarms that migrate to South Australia from their source areas, particularly in autumn, are the basis of a plague.



*Figure 2: The typical migration pattern of an autumn fly in*

Plague development is a two-stage process. In autumn, swarms that create the plagues of concern migrate into the pastoral and marginal agricultural land across South Australia from Penong, near Ceduna, to the Murraylands. They prefer country with annual plant species that provide a food source.

On arrival the locusts lay millions of eggs in beds that are characteristically in hard ground. The locusts that hatch in spring may then cause a plague. Locusts that migrate to other areas of outback South Australia and the Northern Territory dissipate without creating alarm.

In 1955, tonnes of locusts were washed up along the shores of Saint Vincent Gulf during December and January. This indicates the migration path of swarms from settled areas of South Australia is consistently south.

All Spring hatchings have remarkably similar time frames as do the control program that follows. Locusts hatch in early spring and form bands of sufficient number and size to control by the first or second week in October.

By contrast, control in autumn is virtually impossible: -

- Migrating swarms fly into sparsely populated areas and are difficult to find and there are few people to observe them
- Egg laying can occur upon arrival and egg beds are practically impossible to find and destroy

- It is administratively impossible to organise a response aimed at destroying incoming swarms and prevent egg laying in the few days available.
- Control of an emerging plague during spring is the best option.

Two other species of grasshopper endemic in South Australia, the Small Plague Grasshopper, (*Austroicetes cruciata*) and the Wingless Grasshopper, (*Phaulacridium vittatum*) can form swarms that require control.

Major plagues of locusts have been experienced in SA during 1844, 1871, 1890, 1934, 1947, 1955, 1976, 1979, 1987, 1992, 1993, 1997, 2000, with 2010 being the biggest program to date. There were also minor plagues in 1950, 1969, 1971, 1972, 1973, 1974, and 1984.

The Small Plague Grasshoppers required control in 1998, 1999 and 2006.

The locust plague of 1844 indicates that agriculture settlement spread across South Australia into the ancient pathways of migration.

### 3. NATIONAL AND STATE RESPONSIBILITIES FOR CONTROL

#### The Australian Plague Locust Commission

The Australian Plague Locust Commission (APLC) was established by the Commonwealth and State governments in 1974 when the need for a coordinated approach was recognised in response to unsuccessful control programs.

The APLC is jointly funded by the Australian Government and member states of New South Wales, Victoria, South Australia and Queensland. Commissioners, drawn from member States and the Australian Government, oversee the Commission.

The Commission has an important research function and has an impressive practical research history. It includes a major program to assess the environmental effects of insecticides. The Commission is also the central repository of detailed information about the biology and control of Australian locusts.

At the practical level, the Commission co-operates with States by providing guidance in control operations and maintaining a store of chemical that is readily available. States replace chemicals “borrowed” from the Commission’s central store. They provide an early warning about flights into South Australia and the need to undertake autumn surveys.

#### Locust plague surveillance

The Commission undertakes monitoring of locust populations in inland eastern Australia and manages outbreaks that have the potential to build up, migrate and inflict significant damage to agriculture in more than one member state.

It is responsible for monitoring three main pest species of locust:-

- the [Australian plague locust](#) (*Chortoicetes terminifera*)
- the [spur-throated locust](#) (*Austracris guttulosa*)
- the [migratory locust](#) (*Locusta migratoria*)

The Australian Plague Locust Commission monitors population densities and movement of locusts in eastern Australia on an ongoing basis and publishes bulletins used by the States to assess the locust threat.

When locust populations are likely to cross into another state the Commission undertakes:

- surveillance
- threat assessment
- forecasting
- control measures.

In plague years the Australian Plague Locust Commission undertakes control measures in source areas where locusts have the potential to move across State borders.

In South Australia the Commission undertakes control to the north of an east west line through Leigh Creek. There is potential for locusts from north of this line to migrate to another State.

#### **4. LEGISLATION TO ENABLE A CONTROL PROGRAM**

The response from the government of 1934 and was consistent with their long-term approach. Although sympathetic to the plight of the affected farmers the responsibility for control was with the landowner and local councils. This policy remains in place.

At this time, control measures under consideration included applying molasses plus arsenic mixtures, trampling with flocks of sheep, and possibly using aircraft to spread arsenical dust.

New Legislation for control programs was enacted, and the *Noxious Insects Act 1934* prescribed a hierarchy of responsibility for control.

This act was amended in 1955 during the hopper stage of that year's plague to enable District Councils to enforce control measures and undertake control at the landholder's expense. The Act always confirmed that landowners then councils were primarily responsible for control of noxious insects. State government could

intervene by the Minister declaring a pest under the Act and then, via a notice in the Gazette, facilitate a control program.

The *Noxious Insects Act* was replaced by the *Plant Health Act 2009*.

## 5. JUSTIFICATION FOR CONTROL PROGRAMS

### Damage

In the pastoral areas of South Australia locusts consume annual herbs and grasses, reducing feed supply for livestock and native herbivores.

Locusts normally mature and migrate south into the agricultural areas of South Australia as cereal harvest begins during November.

Ripening cereals are lopped just below the head. Foliage on lucerne, potatoes and other vegetable crops is consumed, and tree crops can be damaged. Home gardens, ovals and bowling greens are damaged in suburban areas.

The amount of damage may vary from season to season. For instance, in most plagues, vines are not extensively damaged, but during 1976/77 there was extensive damage to vines in the Clare and Barossa Valleys.

Damage is transient. In South Australia locusts normally consume the available food supply then move on. Although weakening of lucerne stands is observed, permanent damage to perennials is not normally experienced.

While the cost of a control program is known the value of locust damage to crops, pastures, native vegetation and longer-term income is difficult to estimate. So, Benefit to Cost calculations are difficult to make and vary from year to year.

In 1976 losses were estimated at \$2.04m while the control program cost \$300,000.

The Minister's response to questions in parliament about the largest ever control program in 2010 and 2011 cited an independent assessment made by the Australian Bureau of Agricultural Resource Economics and Science (ABARES) indicating the \$11.9m control program avoided \$465m in potential damage providing a benefit/cost ratio of \$44.6/\$1.

### Scale of the incursion

During a plague, locusts are present in damaging numbers across many hundreds of square kilometres.

Hansard of 1934 acknowledged that effective control is often beyond the financial and physical capabilities of individual landowners or local councils. In addition, multiple incursions into an area mean that an individual will be faced with undertaking multiple treatments for incursions outside of their control.

It was recognised that State Government should assume responsibility for delivering Statewide or multi regional responses.

### **Timing of Locust Control**

The aim of each control program is to reduce damage to an acceptably low level. The preferred control zone is pastoral and marginal agricultural country containing locust hatchings. Some damage must be accepted in these areas.

Minimising migration begins with band control in spring to prevent formation of swarms. This is followed by swarm control in pastoral districts and the agricultural fringe. Most frequently in the northern marginal country but also across the entire marginal zones of South Australia.

Swarm control in agricultural areas (as opposed to pastoral and marginal country) is now too difficult. While landholders may undertake their own control programs, aerial spraying on a large scale in closely settled agricultural areas is almost impossible. Every facet of organizing a target to spray is beset with difficulties and effective control rarely achieved, a lesson learned in the 1976 program.

## **6. MAKING THE DECISION TO RUN A RESPONSE**

### **Autumn Surveys**

Autumn surveys provide some data as to the extent and scale of the autumn incursion, but its actual size and the extent of egg laying is an educated guess based on experience.

Autumn surveys are conducted in response to reports of fly-ins being received. The surveys are undertaken by technical staff using road based transects to evaluate the extent of local reports as is illustrated by this chart of autumn surveys of northern areas in 1992 and 2010. Similar surveys of the Riverland were also undertaken.

Information from the Australian Plague Locust Commission and phone calls to landholders is added into the pool of information but the decision to run and the scale of a program is based on limited information so the ability to adapt its scale is an important factor in planning the Spring control program.



*Figure 3: Surveys 1937*

*Sometimes wet sometimes dusty on Murnpowie Station. This 303 Ford utility from 1936 was used for field trips by D.C. Swan who elucidated the South Australian grasshopper and locust species. Surveys by observers in the field remain the only way to ascertain locust presence and density. Grilles of vehicles travelling in locust affected areas were often covered by fly wire to prevent locusts blocking the radiator and causing overheating.*

# PLAGUE LOCUST - ADULT ACTIVITY APRIL - MAY 1992

APPENDIX 1

15.5.93

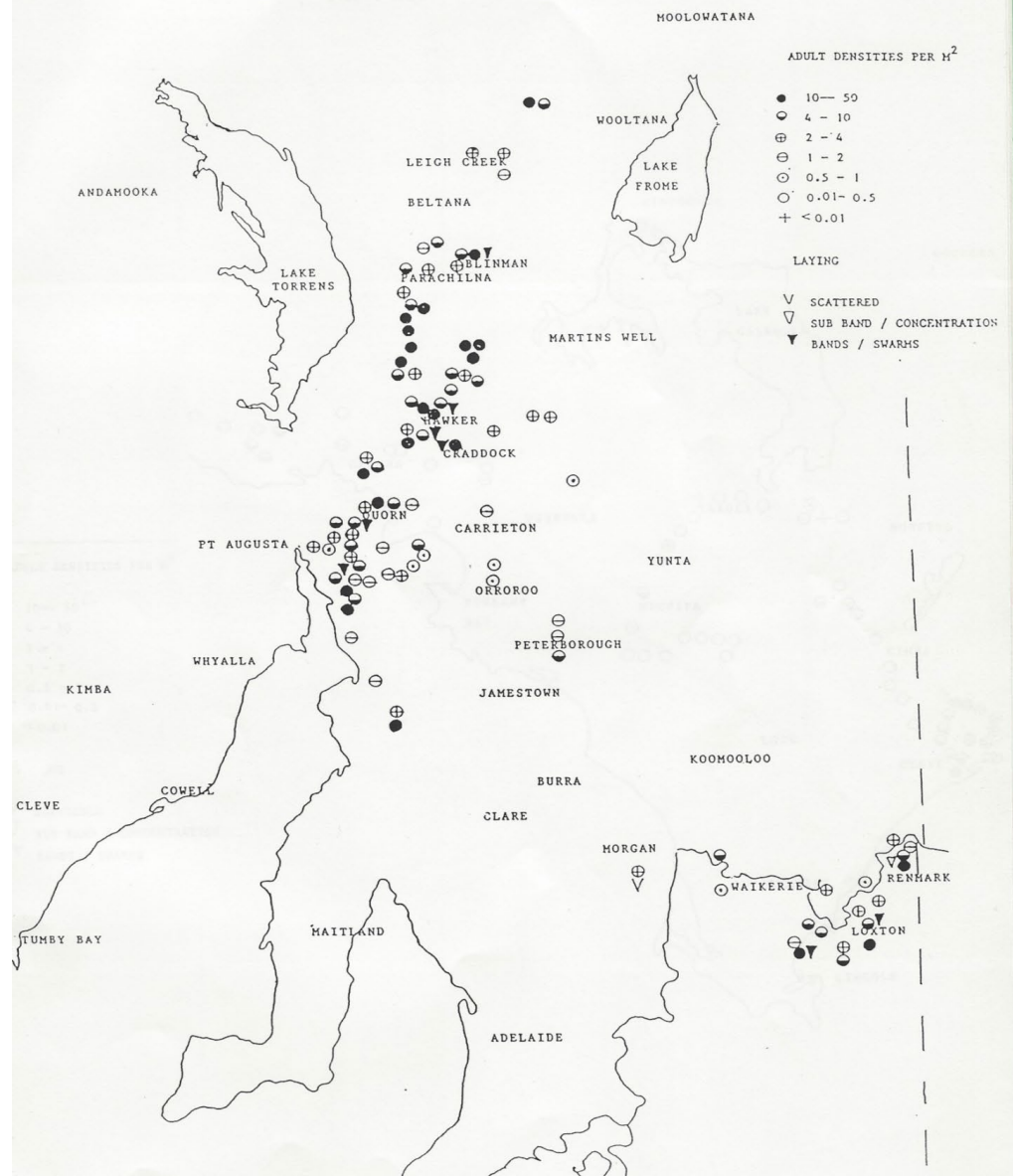


Figure 4: This Autumn Survey chart from 1992 shows the numbers found on road surveys. Transcribed by hand onto a photocopy of a map the density is described using a code. Suitable for black and white reproduction this code has its origins in C.S. Swan's work on the 1930's. The limited information from charts such as this provided data for a decision to undertake a control program.

# South Australian Locust Autumn Survey 2010 - Northern Regi 19th April - 14th May

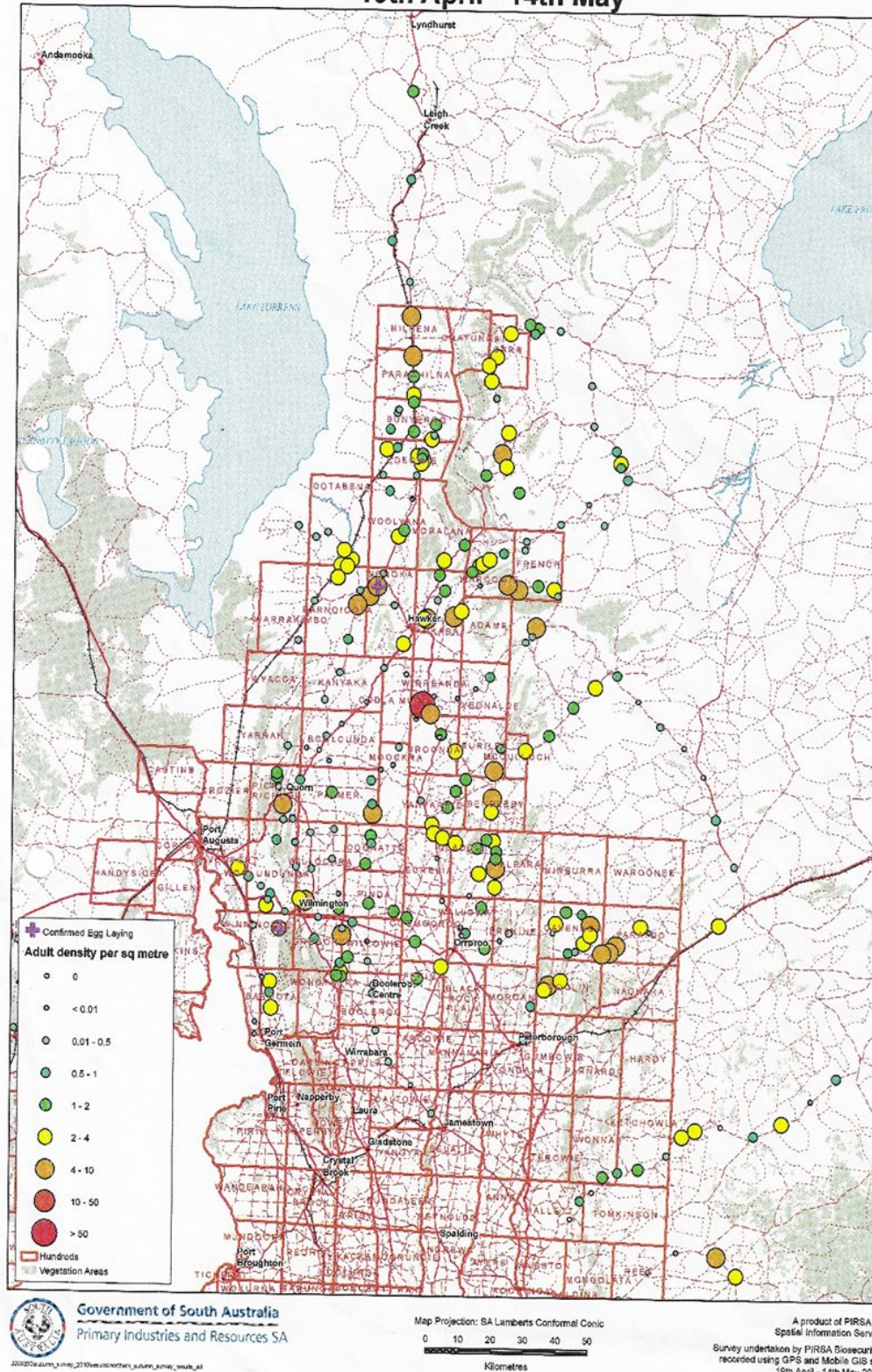


Figure 5: The latest mapping programs result in a more colourful picture with more spatial information to assist decision making. Critical information about locust presence is still based on road surveys.

## Timing of Control Programs

In all years, the first phase of a control program is the spraying of early instar hoppers, normally begins in the northern areas in the first half of October. This occurs first in pastoral country with increasing soil temperatures that promotes hatching. Operations after Christmas experience difficulties in controlling the plague due to its scale swamping the program (as occurred in 1955), or to planning and execution difficulties (as occurred in 1976).

The 1970s policy was to spray all stages of locusts while they were on the ground compared with on the ground and in the air. This policy of only spraying on ground was adjusted as it limits spraying opportunities and does not make use of the improved technology of curtain and drift spraying. The 2010 program reverted to ground spraying by the program. This means control of ground dwelling hoppers and fledgling bands with control of flying adults becoming the responsibility of the landowner.

Progress in control and capability has been aided by improving technology – especially aircraft size and capability, Guidance utilising Global Positioning System technology and the connectivity between mapping of targets by ground crews and spray application by aircraft improves labour efficiency and spray application accuracy.

The area sprayed per day provides a measure of efficiency increases – from a few hundred hectares per day using Tiger moth aircraft in the 1960s to the present-day capability of specialised turbine engined machines of 10,000 ha per day where the minimum target size is 100 ha.

## 7. EVOLUTION OF PROGRAM ORGANIZATION

These descriptions of programs from different years contrast changes in procedures and organization over time. The 1955 program is the first recorded program where the Department of Agriculture organised a control program and so sets the baseline for comparison.

### 1955

The 1955 control program was the first recorded large-scale program undertaken by the Department of Agriculture. Elements of its organization continue to this day.

In 1955 a total of 24 personnel from across South Australia were co-opted to work full time on the program and most were drawn from regional Department of Agriculture personnel. They reported to Mr J. D. McAuliffe, District Advisor based in Jamestown. In all, over 40 Departmental staff were involved.

Preparations for the 1955 program began in autumn. When adult locusts appeared in Agricultural Areas in March 1955, District Agricultural Advisers, often aided by Field Officers, focused heavily on extension work to manage the situation. (The Australian Plague Locust Control Campaign of 1955, J.D. McAuliffe, Agronomy Branch Report Number 84).

Although the *Noxious Insects Act 1934* defines a hierarchy of responsibility for control that begins with Landholders and Councils, they did not understand or have the equipment to carry this out. This is an ongoing problem for the next sixty years.

In 1955 Councils purchased and distributed chemical to landholders then claimed reimbursement for the insecticide from the Department of Agriculture. In pastoral areas commercial agents at Yunta, Burra and Quorn set up depots. This arrangement worked well.

It can be concluded from the tone of the 1955 report that the intention was for landholders and District Councils to undertake control, however, the government stepped in to help the individuals with:

- provision of free insecticide.
- provision of Army Jeeps fitted with Sayer Spray units to assist pastoralists.
- access to aircraft and ground equipment to treat flying swarms.

Once the magnitude of plagues was identified, landholders were supportive of treatment with aircraft, normally by using aerial spraying contractors. The size and density of hopper bands suited to aircraft treatment was formalized in the Locust Manual of 1987.

The 1955 program was the last in which individual landholders were responsible for all spraying and bore the chemical and application costs. This pricing policy was abandoned during this program. From 1971, insecticide was provided free to district councils for control of major plagues.

## Sourcing Personnel

Hansard from 1934 reports that the Minister for Agriculture through his Department “rendered considerable help” in the West Coast districts affected by the grasshopper plague. However, it did not provide details of how personnel were sourced.

Organisational commitment, flexibility of policy and rapid adaptation are evident in the 1955 program. A plan for hopper control was rapidly superseded by a plan for adult swarm spraying during November.

During the 1970s technical knowledge, management and conduct of programs resided in the entomology group based at the Northfield Research Centre.

For the 1984 and 1987 programs, Mr. P Mobbs from the Pest Eradication Unit was the Officer in Charge. The Entomology unit provided technical support. Operational teams were sourced from across the Department and by employing local casuals. There was formal training for all people engaged on the program. It was expected that staff from all levels from regions affected by the plague would volunteer, which they did.

During the 1990s operational management reverted to Dr Dennis Hopkins from the SARDI Entomology Unit with the Officer in Charge of Field Operations being Mr Philip Warren, the District Manager from Jamestown.

In 1999 management evolved so that Mr Michael McManus, Manager Biosecurity Investigations, was appointed Officer in Charge and reported to Entomologist, Dr Dennis Hopkins. Barry Windle, Executive Director of Agriculture and Dr Don Plowman, Deputy Chief Executive Officer completed the chain of command.

From the year 2000, Biosecurity Division ran the response programs as the Pest Eradication Unit with its background in running locust programs was integrated into this Division. The Division had policy people able to write proposals for and expertise to organise and manage emergency responses. A locust control or abatement program is aligned with the framework of an emergency response. Technical expertise is co-opted into this framework. This was the case in 2000 with operational labour outsourced and the misters that were part of the paraphernalia since the 1980's were disposed of.

A larger proportion of operational labour and Field Centre management was outsourced for the 2010 abatement program.

As of 2025, there is group within PIRSA tasked and funded to undertake a control program. Individual Officers and small groups within a branch are responsible for monitoring then organizing a program.

## **Lessons from 1976**

In 1976 the decision to run an aerial program was made too late on December 15. These aerial operations ceased on December 24, with 4,000 ha sprayed between Spalding and Blyth, locations that are no longer considered effective or safe for aerial operations. This large plague, that relied on landowner and local Councils to undertake spraying, was never adequately controlled.

In that year the recently established control centre was moved from Jamestown to Clare in mid-December, chasing swarms. This timing was too late with the result there was substantial damage to crops and grapes in the Clare Valley. Other

technical factors such as the decision to only spray settled swarms mostly in late evening or early morning when the locusts settle (as is their habit), meant that the required scale of control was never attained.

Fortunately, PIRSA never forgot the lessons learnt from this 1976 program and since has been planning programs in early autumn allowing adequate time to prepare.

## **The Planning and Operations Committee**

The 1979 strategy basically remains unchanged in the year 2025.

A Planning and Operations Committee was established with personnel from the Department, convening throughout the winter and early spring. The Committee was chaired by a senior executive-specifically a Director-and comprised nine members along with a Minute Secretary. Representatives were included from each of the four impacted regions: Central, Northern, Eyre, and Murraylands. Notably, only a small number of committee members possessed advanced expertise in entomology.

This Committee:

- Reviewed data gathered during autumn surveys.
- Established the scale of spring operations.
- Gathered personnel and materials and let the major contracts for supply of chemical, aircraft and helicopter.
- Determine the location of the base, and its organization
- Organized training days for co-opted staff.
- Organized radio communications.
- Organized publicity, technical information and media communication.
- Initiated liaison with local Councils.
- Importantly they organise the Policy Advisory Committee as provided under the Noxious Insects Act 1934 and 1955.

## **The Policy Advisory Committee**

This Committee advises the relevant Minister and is appointed by the Minister. It comprises seven people and a secretary. It is important that two landholder representatives are included.

The Policy Advisory Committee's role is to:

- Oversight operations and review the Operational Committee's plan.
- Advise the Minister on
  - Overall strategy
  - Finance
  - Deployment of staff
  - Contracts and deployment of aircraft

- The use of external resources and publicity on matters relating to control policy.

In practice, it is appointed after the decision to run a control program and early meetings of the Operational Committee.

### Community Reference Groups

These groups comprise landholders affected by the locusts, is organised by the Program manager, is Chaired by a landholder and advises on operational issues emerging from the program.

From 1987 to 2000, where programs were centred on the north, under the Chairmanship of Mr Malcolm Byerlee, farmer from Carrieton, with the presence of Mr Richard Warwick, pastoralist from Holowilena Station and support of other local members, this guiding group provided practical advice to enhance the running of the program.



*Figure 6: From the left; Don Plowman, 2IC, PIRSA, Malcolm Byerlee, long serving Chair of the Community Reference Group and Michael McManus, OIC Field Operations in 2010.*

For the significantly larger 2010 campaign that would have a major impact on the Murraylands region, the Community Reference Group was jointly chaired by Dr Don Plowman, the Deputy Chief Executive of Agriculture and a farmer from Waikerie. Other members included land holders from the dryland and irrigation sectors, local councils,

Natural Resource Management Board and the local House of Representatives member.

## **Media and Communication**

Interaction with mass media in all programs is controlled centrally through the current media group at the time

The closer locusts are to Adelaide, the closer the media scrutiny. Most stories for general consumption are focused on the potential for catastrophe but also transmit key pieces of information.

## **8. FIELD OPERATIONS**

In 1970, the operational control of the program was run from Hawker by two people, Ken Henry and Les Hoff, using the back of a station wagon equipped with HF radios and a card table.

For the following programs there was one or more Operational Headquarters located as near as practicable to the anticipated centre of activity. In 1987 the Headquarters were located at Jamestown with a satellite base at Hawker. Three Operational Centres were required during the 2010 outbreak.

The Operational Headquarters were, generally, configured with an Officer in Charge, Technical Advisor, Aerial Control Officer and supported by an Administrative Officer. The two-person survey teams reported to Headquarters as did a Technical Liaison/Loader person from the Aerial Contractor. Media was managed centrally through via departmental media staff located in Adelaide.

## **Australian Army Input**

In 1955 Army Jeeps, fitted with Sayer Exhaust Sprayers, and personnel were made available to pastoralists. The first of these vehicles began operations at Koomooloo Station on 17 October 1955. Over 20 Jeeps were in the field at any one time operating from 17 October to 12 November 1955.

It was planned that pastoralists would pay the operating costs of the vehicle and accommodation of the personnel. Pastoralists showed little interest in this scheme until conditions were altered so that they only had to accommodate personnel with all other costs borne by the government.

Thirty-four staff were drawn from within the Department of Agriculture to run the 1979 program. This program was notable for the use of Radio Operators and their equipment from within the Army. The experiment was not entirely successful, in part due to the army personnel receiving insufficient training in the nature and

requirements of the task. Their field services were withdrawn on 28 November 1979. However, the Army personnel continued to provide base radio operations from the Jamestown Operations Centre.

In an innovation for the 2010 program, staff from Natural Resource Management Boards managed on property ground spraying for on farm areas greater than 75 hectares. They were also responsible for monitoring and ground spraying of council land.

The name change from Locust Control to Locust Abatement for the 2010 program reflects a clarification of the objectives aimed at treatment of locusts.

For 2010, the program aim was to mitigate the loss of production and community impact by strategic reduction of spring/summer locust numbers. The aim was not to control every locust:

Its Objectives were to:

- identify and suppress locust numbers and minimise locust migration
- undertake all activities with zero injuries or fatalities.
- minimise impacts on the environment, community and industry
- minimise production losses to less than 15%; and
- manage community expectations.

## 9. SCALE OF PROGRAMS

By the 1990s the minimum target size or area sprayed by air was 100 hectares or one square kilometre. This is an effective use of the resources required to define the area and is efficient use of aircraft. Smaller areas become the responsibility of the landowner. This table of the number of targets and area sprayed by air provides an indication of the size of the infestation and accompanying control program.

### Locust Program Aerial Operations Statistics

| Year              | Number of targets | Total area sprayed by air<br>(ha) |
|-------------------|-------------------|-----------------------------------|
| 1984              | 132               | 58,000                            |
| 1992              | 246               | 160,000                           |
| 1993              | 115               | 56,000                            |
| 1997              | 173               | 93,000                            |
| 1999 grasshoppers | 204               | 179,400                           |
| 2000              | unknown           | 414,900                           |
| 2006 grasshoppers | 237               | 173,644                           |
| 2010              | 549               | 459,800                           |

For 1987, there were 13 by two-person survey teams spread from Loxton to the Eyre Peninsula reporting to the operational base at Jamestown. This arrangement proved unwieldy as most aerial operations were centred on Hawker. So, a second control centre operating from a caravan in the Chace Terrace Caravan Park, Hawker was set up. This was crewed by a Technical Officer and Radio Operator. The aerial contractor brought their ground crew.

It is noteworthy that telephone services at Hawker were provided by a manual exchange that shut down at 10.00 p.m. each night. This exchange eventually closed at 08.00 p.m. on Wednesday 7<sup>th</sup> September 1988. A High Frequency, (HF), radio base in the Adelaide hills patched into the telephone system provided an avenue of communication for employees to talk with their families

From the aerial spraying perspective, the year 2000 was a large program. without taking account of areas treated by landholders. The Rural Finance and Development Group administered a Grant Scheme of \$1.00/ha for treated areas.

The “Grasshopper Control Program 2006” was based at the Orroroo CFS. It began on 18 September and concluded six weeks later, on 27 October 2006.

Strong emphasis on Occupational Health Safety and Welfare resulted in only one minor incident, a cut hand from a barbed wire fence, and no “lost time” incidents. The program responded to 181 reports of grasshoppers from landholders, a total of 173,000 hectares were sprayed to cover 237 targets. A core group of six staff; Mapping, Logistics, Administration, Technical and Aerial Control were based at Orroroo CFS Headquarters and coordinated by an Officer in Charge. This group supported six Field teams who consisted of experienced locals operating in teams of two on a rotation basis.

The Spring 2010 program was the largest ever, (Minute to the Minister for Agriculture Food and Fisheries 3 December 2010). Despite the Australian Plague Locust Commission spraying 204,000 hectares in March there were major fly-ins from the remnant massive populations in New South Wales and Queensland. These swarms migrated into the Riverland, mallee and northeastern pastoral and agricultural areas of South Australia. There were low densities in the eastern Eyre Peninsula.

The SA Government made \$12.8 million available for the program response including a chemical rebate scheme for landholders affected by locusts and financial assistance to Natural Resource Management Boards and Local councils to offset costs incurred through their control operations. The program expenses came in at \$11.9 million.

There were three Control centres for the 2010 program, a State Control Centre in Adelaide, an operational centre in Orroroo that opened on 13<sup>th</sup> September followed by a second centre at Loxton that was opened on 20<sup>th</sup> September. Normally there were 65 staff working on locusts at any time. Many more people were involved overall because of shift operations.

In the 10-week period between late September and early December, 549 aerial targets were sprayed covering 459,827 ha. Natural Resource Management Board staff managed 1,046 cases using contractors to treat 667 ground targets. There were 2,663 reports of infestations entered into BioSIRT, the data base used to manage records.

During February additional assistance was provided to 11 Councils to treat second generation locusts on Council land and roadsides by supplying chemicals, survey advice and financial support to hire contractors. (Minute to the Emergency Management Council. Subject: Australian Plague Locust Response Program – Update 4 January 2011).

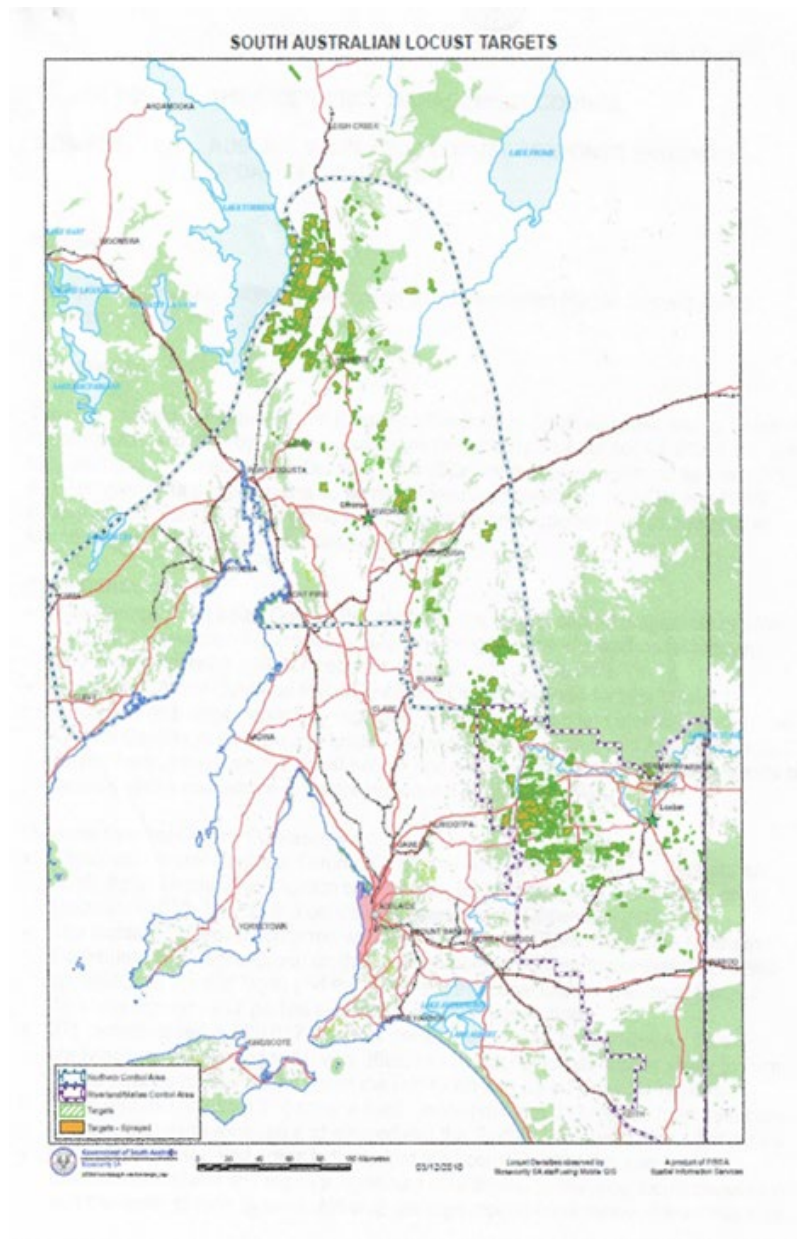


*Figure 7: This Chart shows the targets for aerial spraying in the 2010 program with spraying in the near pastoral country around Hawker and the more difficult operations around the Riverland.*

## 10. TOOLS OF THE TRADE

### Central Control Base

A control base located close to operations provided a focus for operations. The Officer in charge of field Operations, assisted by the Technical Officer, Radio Operator/target coordinator and Administrative Officer were in the base as was the aerial spraying contractor's liaison person.

## Survey Equipment

### Locust Control Manual

A Locust Manual was written following the 1987 program to provide staff with technical detail about locust control and program operations. It remains the technical reference for locust control and is categorised as an incident specific response plan.

Guidelines for helicopter operations were written following an accident when a Bell JetRanger collided with powerlines while surveying a target near Jamestown. The pilot, Mr Ragg, and observer, K. Henry, survived. These helicopter operating guidelines were adopted by the Australian Plague Locust Commission and circulated to all State organisations. Stepping outside these guidelines contributed to a fatal crash at Pekina, South Australia, in 1992, in which the pilot and observer died while flying a piston engined Robinson helicopter.



*Figure 9: Treva Hebbermann, field worker, and the helicopter from Norris Dinan used in 2010. This Bell JetRanger chopper complies with the guidelines by being turbine powered and fitted with cable cutting devices that protrude from the top and floor of the cabin.*

### Motor Bikes

Locust is not sprayed until they have been observed and assessed. It has been shown by experiment that Hopper bands are difficult to detect from the air and motorcycles are ideal for undertaking surveys in locust country. Motor bikes have

been used since 1984. However, they require a driver's license endorsement, a consideration when assembling teams.



*Figure 8: The latest equipment used by field workers. More developed than that available to D.C. Swan in 1934.*

## Radio

Instant communication between field teams and the Control Centre is critical. Early programs attempted to use High Frequency, HF, radios. These were technically unsuited to operations but maintained until the Government Radio Network, GRN, was established. Very High Frequency, VHF, radios were utilised in the 1980s and 1990s. The use of repeater networks powered by solar systems provided satisfactory communication. Both systems were replaced by the GRN around the year 2000. Having one radio unit also freed up space in vehicles and simplified radio communication in the Control Centre.

## Data Management

The BioSIRT database helps manage information about program activities and locust incidence. The Biosecurity Surveillance Incident Response and Tracing software is a web-based information management system developed to provide national consistency in the management of information, resources and responses to

routine or emergency incidents associated with animal or plant pest incursions. It was developed for Emergency Response and Surveillance in 2007.

BioSIRT was used in the 2010 response in combination with other spatial mapping technology. BioSIRT mapping limitations required the NSW template to be reduced for recording reported locust sightings only.

BioSIRT had other limitations. It did not have the capacity to record other electronic information generated by the campaign, e.g. consent to spray spreadsheets, chemical usage and flight times, were not placed into the SA template. However, once activated for the campaign, the State Administrator found it extremely useful to be able to view information from all control centres simultaneously. This enabled rapid respond to queries and resolve many issues.

From the year 2000, the Australian Interservice Incident Management System, (AIIMS) also applied to the conduct of this program. AIIMS is an Incident Management System that enables the integration of activities and resources from multiple agencies participating in an emergency response. It operates effectively for any type of incident, imminent or actual, natural, industrial or civil, and many other situations where emergency management organisations operate.

## **Mapping**

Development of mapping technology has had a major impact on program operations. Prior to the 1990s, mapping systems were paper based, either printed or hand drawn.

Since the 1990s, handheld satellite tracking systems that are linked to computer-based mapping have been providing greater accuracy, reliability and easier transmission of data. The ability to feed locust mapping information into spray plane guidance systems, has greatly enhanced accuracy of treatment.

## **11. APPLIED TECHNOLOGY**

### **Insecticides**

According to Peter Birks, *The Eighth Plague: Still With Us.* National Emergency Response Magazine c1987." In 1934, autumn control was limited to ploughing egg beds – the scale required was not possible at the time. Poisoning required the use of arsenicals mixed with molasses and bran – highly toxic, indiscriminate and not very reliable against locusts".

In the 1950s, the organochlorines - dieldrin and lindane were introduced and subsequently used in 1955. The range of chemicals, application and spraying rates for that program was borrowed from New South Wales and Victorian

recommendations. This included Benzene hexachloride, Aldrin, Chlordane and Toxaphene. These persistent products could be used to protect crops for up to three weeks in the case of Benzene hexachloride while dieldrin was effective for up to six weeks. Lindane is very effective on locusts but not effective on the small plague grasshopper. Because of availability, Benzene hexachloride and Dieldrin were the main chemicals in 1955.

Organochlorine chemicals were not used after the early 1970s. Fenitrothion, an organophosphate, had become available, was very effective on locusts and grasshoppers and has a field life of three to four days.

By the 2000s, the nicotinamides had become available. Adonis, (active fipronil) was introduced for use on pastures. Pyrethrins were also introduced into the insecticide mix. Spray rates followed guidelines developed by the Australian Plague Locust Commission.

A new biological control product was developed and utilized by the Australian Plague Locust Commission in the 1990s. Marketed as Green Guard it is made up of spores of the nematode, *Metarhizium anisopliae* var. *acridum*. Green Guard was applied in situations where a chemical insecticide was not appropriate (e.g. on properties growing organic produce). The nematodes are specific for locust and grasshopper species and take 8 to 12 days to infest and kill the host, during which time it still feeds. This is effective but slow control.

Ordering the correct quantities of various products during planning of a program was challenging. The Australian Plague Locust Commission assisted by releasing tonnages of chemical they normally keep in store. These were later replaced from fresh supplies obtained by South Australia.

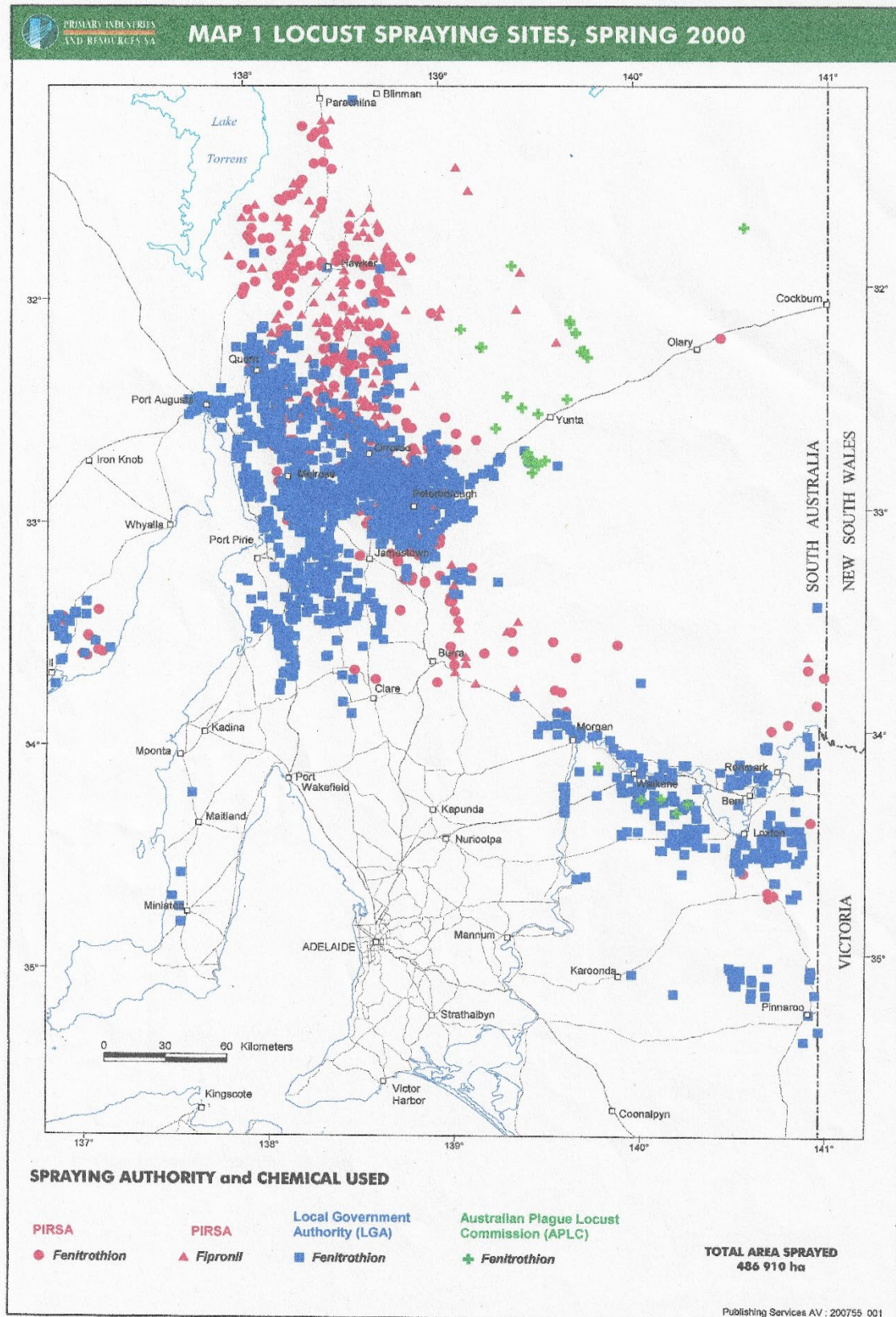


Figure 10: This chart shows the use of insecticides in the 2000 program. The sites are typical of most programs.

The 2010 program used a wide range of insecticides through the Loxton control centre: -

- Organophosphate – Fenitrothion, 35,238 litres
- Organophosphate – Malathion, 13,591 litres
- Pyrethroid – Alpha-cypermethrin, 4,265 litres
- Nematode – Green Guard, 1,260 litres.
- Summer oil – 41,994 litres that was mixed with Green Guard when applied.

## **Application Rates**

High, low and ultra-low volume spraying by air or ground fogging and baiting of hopper bands have been used to control hoppers and adults.

## **12. DEVELOPMENT OF AERIAL SPRAYING**

In the 1955 Agronomy Report Number 84 noted that aerial spraying of large targets is recorded as being used in Victoria “in recent years to deal with extensive swarms that threatened irrigated areas in the Murray Valley”. This report noted that aerial operations require “adequate ground facilities and an elaborate organization scouting, marking targets, providing flight indicators and two-way communication between ground and aircraft.”

In comparison to the organization required for aerial spraying, in 1976, in the Wilmington area, 80 men and up to 25 spray units achieved a high level of control in an area of about 100 km<sup>2</sup>. This is equivalent to 2 to 4 plane loads of Ultra Low Volume application.

Tiger Moths were used to apply water-based insecticide in the 1950s and 1960s. In 1955 five Tiger Moths were contracted from the Rural Aviation Co., and two Tiger Moths and a Cessna supplied by Robby's Aerial Services were used to spray swarms. The best day's spraying by one of these aircraft covered 463 hectares (1,144 acres).

A total of 20,218 hectares (50,000 acres) was sprayed from the air in 1955, contrasting with 459,827 hectares (1.135 million acres) sprayed in 2010. Notable is that 640 hectares (1,520 acres) of targets were sprayed as far south as Two Wells and Virginia, near the northern outskirts Adelaide.

During 1976, locusts were adequately treated on the Eyre Peninsula with an estimated 22,000 ha sprayed. However, between 24 December and 7 January, locust swarms from the northern pastoral areas reached Adelaide, the central Adelaide Hills and the Murray Plains damaging horticultural crops, potatoes, vineyards and to a lesser extent, lucerne and summer forage crops.

On 30 December in the 1976 program, it was decided that technical fenitrothion could not be applied by air in the more densely populated areas due to the environmental and safety hazards to both people on the ground and aircraft. Damage to bees and vehicle paintwork are mentioned as risks. Isolated pockets were being treated at the end of January. Insecticide for the treatment of 7,000 hectares was used for this summer control.

It was estimated that crop losses during 1976 totalled \$2.04m and direct expenses on the program were \$243,000, not including labour costs. This program was not as effective as desired and became the subject of a Ministerial Review.

## **Development of Aircraft**

Tiger Moths were phased out by 1965. Their tiny payload of 125 litres, high volume spraying in 20 metres (22 yard) swathes and slow cycle rate of the aircraft made successful control a difficult objective.

In the late 1960s and early 1970s Ultra-Low Volume (ULV) or drift spraying was developed in Africa by the London based Anti-Locust Research Centre. In this technique around 375 mls of low volatile insecticide is misted per hectare providing a density of 30 to 40 droplets per 625 square millimetres. No water is required, a huge logistical saving.

By 1976, ULV technology was used in South Australia.

A Cessna, fitted with ULV misters and with a payload of approximately 200 litres was used to apply fenitrothion in the 1987 program. The Cessna's capability of 550 ha per load was just adequate. The Australian built Transavia air truck with a 1 tonne payload was also utilized in 1987.

In 1992 the aerial agricultural company, Aerotech, using specialised Air Tractor agricultural planes, equipped with ULV Misters and flight tracking computer equipment were contracted. Initially, these aircraft carried payloads of 1 tonne, with later models capable of a 3-tonne payload being used in 1997.

Flight tracking equipment was imported from America shortly after its development. This enabled: -

- Accurate tracking of the aircraft.
- More accurate placement of the chemical to optimise the quantity of chemical used.
- More cost-efficient use of aircraft.
- Accurate, to the metre, recording of chemical application enabling effective analysis of treatment and dispute resolutions about spray placement.



*Figure 11: An Air Tractor used in 2010 fitted with Ultra Low Volume sprayers.*

In 2010 chemical was applied in alternate swathes so half the treated area received chemical. This took advantage of the habit of hoppers and swarming adults marching or flying in a particular direction, thus moving over the treated area and receiving a lethal dose of insecticide.

Insecticide that can be applied through landholder owned spray equipment was made available in all programs from 1976.

### **13. GROUND SPRAYING**

An array of handheld or vehicle mounted applicators have been utilised for locust control.

#### **Knapsacks**

Knapsacks are useful for small areas especially in inaccessible country but have limited capacity. Motorised knapsacks can also be adapted for small areas of low volume spraying.

#### **Fire Fighting Units**

Firefighting units can be adapted for spraying by the addition of a boom. However, it was often difficult to obtain a suitable boom.

## Sayer Spray Units

These exhaust driven units were useful for treating small bands and swarms in rough country using a four-wheel drive such as army Jeeps in 1955. Their advantage was their use of only two gallons of spray per acre (22.4 litres per hectare, imperial gallons).

## Air Blast Machines

Used dust and so eliminated the need for a water supply and could treat large areas when mounted on a four-wheel drive but required a crew of two to operate.

## Sand Blast Units

This device, mounted on a three-ton truck and adapted for spraying, was used in 1955. It utilized dust or spray, required an operator to swing a hose and are reported as being useful for covering large areas. They operated at 12 to 20 miles per hour (19 to 32 kph) and could treat 40 acres per hour (16 hectares/hour).

## Terra Mistors

Under the *Noxious Insects Act 1934* or *Plant Health Act 2009*, local Councils are responsible for assisting landholders with locust control. The Department of Agriculture assisted councils by providing motorised trailer/tractor mounted Terra Mistors and motorised backpack misters for use with Ultra Low Volume insecticide, initially technical maldison. These were also loaned to local landholders. Around 20 large misters were held in stock. Ultra Low Volume chemical along with a small quantity of water-soluble insecticide was supplied with the machines.

Between programs these misters were stored at Northfield, then at Blackwood and later Lenswood. The policy of providing misters was in place from 1972 until 1999 and assisted a few landholders, but uptake was limited.

The response of Councils to borrowing equipment was variable and dependent on the experience of staff with locust programs. Often council staff were unaware they had a role in controlling locusts defined in legislation.

## Night Spraying

Spraying swarms at night with air and sand blasting equipment, often when aircraft were unable to operate, was reported as effective in 1955.

## 14. OTHER LOCUST CONTROL METHODS

### Cultivation of egg beds

In the 1955 report it was noted that cultivation of egg beds was not completely effective in removing that egg bed and preventing hatching.

## **Burning**

600 acres (243 hectares) of dry grass was burnt and destroyed an aggregation of hoppers in 1955.

## **15. TARGET DELIMITATION OR MARKING**

From 1972 to 1997 aerial targets were defined with a two metre square of dayglo placed over a bush or on the ground for the pilot to spot as they surveyed the target from the air. This was supported by a paper map drawn up by the headquarters based aerial control officer using information radioed in by a survey team.

Dayglo is highly visible, heavy-duty cloth similar to hi-vis used in modern safety clothing. Secured over a bush it provides a three-dimensional marker visible from the air. In some programs expensive dayglo was replaced with cheap orange builder's plastic that is less visible. Often the three-dimensional effect was lost as teams placed the markers over a fence – visible from a direct approach but invisible from the side. These are a challenge for the pilot to see while flying at 150 kph but did mean that effective air to ground communications were continually practiced.

During the 1990s development of Global Positioning System (GPS) technology provided ever increasing capability in mapping and aerial control of target spraying.

## **17. RESTRICTIONS TO CHEMICAL APPLICATION**

### **Sensitive Sites**

Exclusion sites, where insecticide application is not advisable to avoid potential off-target damage, were not considered until the 1990s. The need to avoid spraying households, people, waterways and dams, since fish and crustaceans are very sensitive to organophosphates, was accommodated during target definition.

Use of organochlorine insecticides may also have resulted in off-target damage. However, an extensive body of research held by the Australian Plague Locust Commission into the nature of the organophosphates concludes that when used in Ultra Low Volume treatments off-target damage, even to other insects, is limited.

During the 1990s, following consultation with a broader group of stakeholders, such as National Parks custodians, a few exclusion sites, began to be listed to prevent environmental damage to populations of a moth and the pygmy blue tongue lizard in the Jamestown to Burra area. Since then, there is a proliferation of sensitive sites that add another degree of complexity to an abatement program as is shown by this chart for the 2010 program.

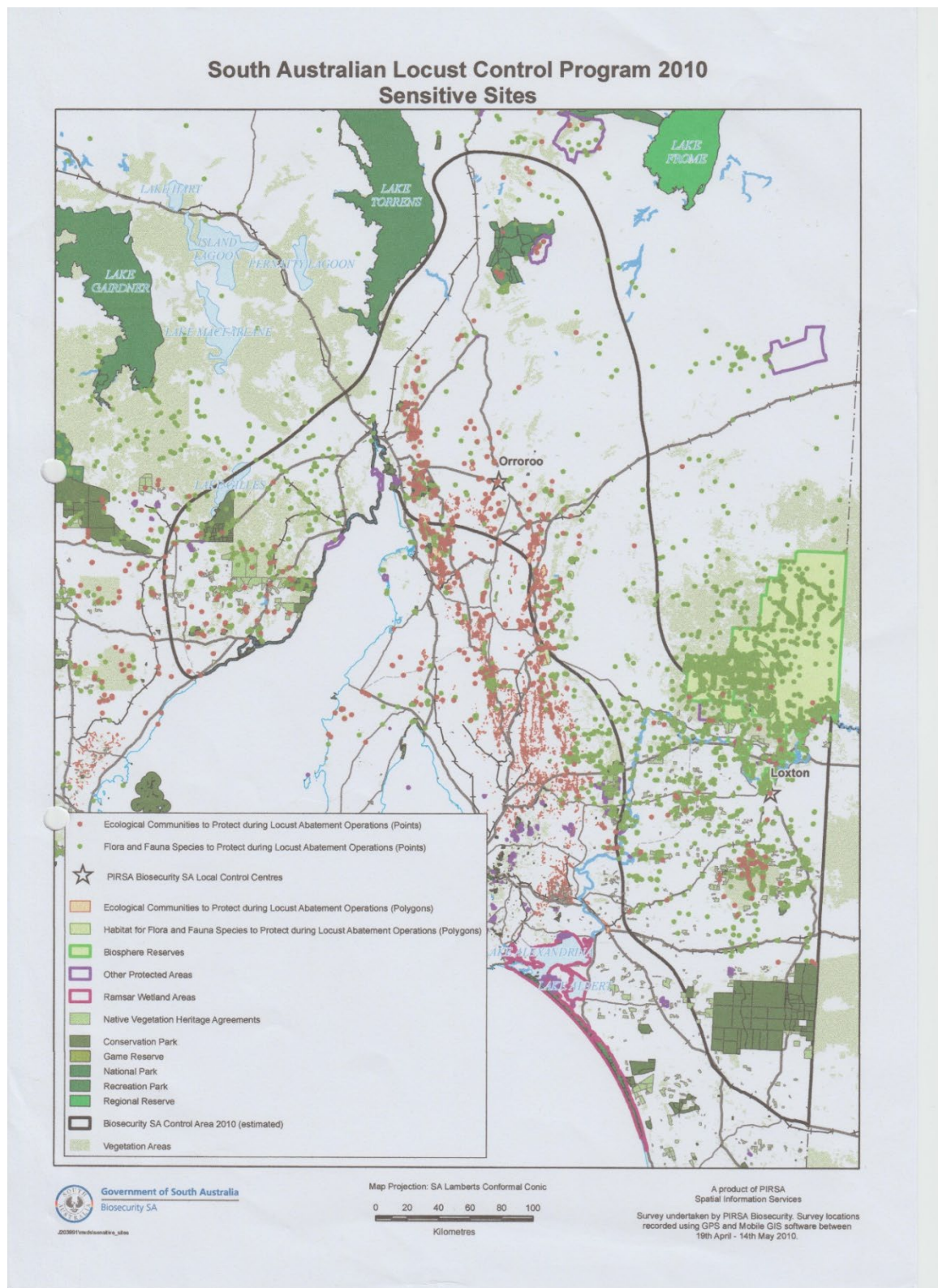


Figure 12: Chart showing Sensitive Sites for the 2010 program

## Beekeepers

Numerous insecticides are toxic to honeybees so liaison with beekeepers for the duration of a program enables them to move hives and avoid bee losses. This

movement may result in reduced honey flow and affect pollination of canola and lucerne seed crops.

## **Kangaroo Hunters**

Kangaroos may ingest feed that contains insecticide. Hunters need to be aware of locust operations, so they avoid harvesting kangaroos in treatment areas.

## **16. IMPOPRTANT PEOPLE**

### **D.C. Swan**

From the 1930s C.S. Swan, an entomologist, from the University of Adelaide determined that the plagues were due to the plague locust and clarified their biology and distribution in South Australia.

### **Dr Herbert G. (Andy) Andrewartha**

Professor of Zoology, University of Adelaide

Provided the 1955 program with detailed information about the habits of adult locusts.

### **Ken Henry**

Ken Henry, Senior Technical Officer, with the PIRSA Entomology Group was involved with all locust and grasshopper control programs from 1970 to 2010. He was the technical advisory person in all locust control programs over 40 years. His expertise in the biology and control of locusts played a critical role in the success of these control programs.

### **Dennis Hopkins**

Dr Hopkins began his career as an entomologist in the Department of Agriculture working as a field operator on the 1976 program. He continued as the Entomologist providing technical advice to programs until the 1990s. During this time, he was the Officer in Charge of each program as part of his role as Senior Entomologist managing the Entomology group.

### **Rob Matthias**

From 1987 and during the 1990s Mr Rob Matthias was PIRSA's Emergency Management Coordinator. He was crucial in setting up effective communications and an efficient headquarters and contributing to the headquarters group operations. Rob found the empty Elders agency at Hawker, and a service station at Quorn to utilize as Operational Centres. He used his contacts to enable operations from the Country Fire Service base at Orroroo for several programs. He provided radios, a caravan and incidentals from his Aladdin's cave of equipment. Rob's role ended with

the 2006 program prior to his retirement. He was brought out of retirement as a casual to provide his expertise during the 2010 program.

## **18. CONCLUSION**

This history describes locusts and their control in South Australia from 1956 to 2010. There will be more locust incursions but when and how large is unpredictable. Will climate change effect their migration pattern and frequency? How they are managed will depend on changing technology and the evolution of the organisations responsible.

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Subject: Australian Plague Locust Response Program – Update 4 January 2011.  
By: Will Zacharin, Executive Director, Biosecurity SA and AAS Deputy State Controller.

Author: Phil Warren with assistance from Ken Henry

Date: July 2026

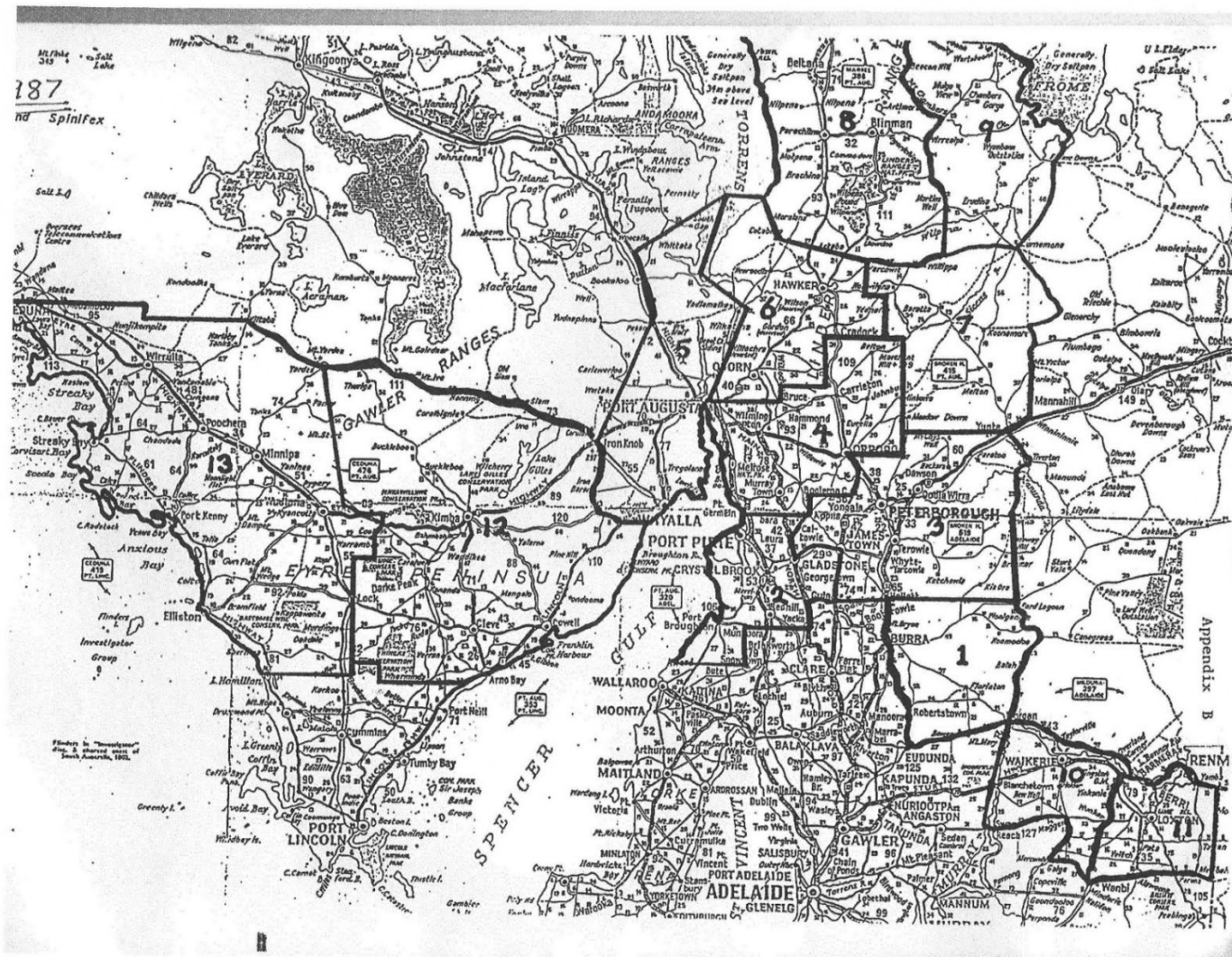


Figure 13: Initial operational areas for the 13 two person teams in the 1987 program. The major infestations were around Hawker and so the focus shifted from Jamestown with most teams operating from Hawker.



*Figure14: Loxton Airstrip 2010. Reasonably busy. The five propeller blades indicate the craft can carry 3 tonnes. The three blades on the plane in the left background indicates a 1 tonne payload.*