

Baiting operations: *Western Shield* review—February 2003

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Introduction

Introduced predators have been identified as a significant threatening process to the conservation of native wildlife (Environment Australia 1999, Braysher 1993). *Western Shield* is an initiative of the Department of Conservation and Land Management (CALM) targeted at reducing the predation of native fauna by introduced foxes and cats. The program reduces predation pressure to a level that ensures the continued persistence of native fauna and particularly those within the critical weight range (CWR) of 35 to 5500 gm (Burbidge and McKenzie, 1989). The program involves the regular delivery of 1080 fox baits to approximately 3.4 million ha of conservation estate in the southern half of Western Australia.

This paper addresses aspects of the *Western Shield* baiting operations. The terms of reference are set out in Appendix 2 in Possingham *et al.* (this issue). Essentially, they require the paper to address:

- The areas being baited, their progress and cost
- The outcome of operational research and its implications for future baiting plans
- Bait production and costs
- The development of Pro bait
- The history of baiting programs and
- Changes made to baiting protocols.

The task is covered in four sections headed:

- Procuring bait material
- Management and use of the 1080 toxin
- Contracts for supply and management of aircraft and navigation technology and
- Coordination and management of baiting operations.

For each, problems, potential economies and potential improvements are summarized in subsequent sections.

PROCURING BAIT MATERIAL

Current bait supply contract

Dried meat baits (DMB) have been the preferred bait for most *Western Shield* fox-control programs, particularly aerial baiting. Dried meat baits are manufactured using 200 gm chunks of fresh kangaroo meat that are dried to

a weight of approximately 45 gm. Supplies of DMB for *Western Shield* are purchased from the Western Australian Department of Agriculture (DAWA), which is the only commercial supplier in this State.

The current annual DMB requirement for *Western Shield* for both aerial and ground based operations is 780 000 baits. To facilitate production scheduling, CALM advises DAWA of its anticipated annual DMB requirements in advance and submits firm orders quarterly. Baits are collected from the DAWA Bait Production Unit (BPU) at Forrestfield by CALM staff in a custom-built freezer truck and distributed to departmental storage facilities throughout the State where they are held in locked freezers on departmental premises (Table 1 and see section Bait Management below).

TABLE 1
Departmental bait storage facilities.

LOCATION	NUMBER OF FREEZERS	STORAGE CAPACITY (DMB)
Karratha	1	7 000
Exmouth	3	21 000
Denham	2	14 000
Kalbarri	3	21 000
Jurien Bay	2	14 000
Wanneroo	1	7 000
Mundaring	2	14 000
Jarrahdale	2	14 000
Dwellingup	4	28 000
Collie	2	14 000
Harvey	2	14 000
Busselton	2	14 000
Manjimup	6	42 000
Pemberton	1	7 000
Walpole	1	7 000
Albany	2	14 000
Jacup	6	42 000
Esperance	2	14 000
Katanning	2	14 000
Pingelly	3	21 000
TOTAL	49	343 000

Dried meat baits are manufactured manually. The method is slow, wasteful, unreliable expensive and production capacity is limited.

- The meat preparation process is time-consuming and drying meat pieces to their final form requires four days per batch

- Bait production is limited by the production capacity of the meat driers (currently 4000 baits/week)
- Because 200 gm chunks are required, only the large muscles of a kangaroo carcass can be utilized
- The quality of meat delivered to the BPU is variable and wastage in excess of 20% is not uncommon
- Reliability of supply is often jeopardized by field conditions precluding kangaroo shooters from harvesting. *Western Shield* operations have, at times, needed to be modified because the BPU has been unable to obtain sufficient quantities of kangaroo meat. For example a shortfall of 55 800 baits for the June 2001 baiting program had to be accommodated by reduced bait-density in a number of cells. The uncertainty of supply and the long lead times required by the manufacturer are significant threats to the effectiveness of routine baiting operations
- The quality of the DMB can be affected by micro-organisms causing spoilage. Rotten ('puffy') baits are extremely unpleasant to handle and are of questionable effectiveness and often have to be discarded. For example, in 2000, spoilage required the destruction by deep burial of \$9000 worth of baits that had been delivered to Manjimup
- The per-bait cost (which is the DAWA factory-door cost-price) has steadily increased (Table 2) in line with cost increases and progression to government full cost recovery principles. At current bait requirements, every one-cent rise increases the annual program cost by \$7800.

TABLE 2
Change in cost of DMB from 1994 to 2003 (excluding GST).

YEAR	PER-BAIT COST	ANNUAL COST OF 780 000 DMB
1994	\$0.650	\$507 000
2003	\$0.964	\$752 000
Increase	\$0.314 (48%)	\$245 000 (48%)

The 1996 central budget for *Western Shield* was \$1.15 million (excluding resources allocated by other cost centres and resources provided by corporate sponsors). As the central budget has not changed from 1996 to 2003, the increased cost of baits has reduced central budget funding for other components of the project by \$245 000 (21%). Any reduction in bait cost would constitute a significant saving to the project. Indeed, bait procurement and aircraft hire for deployment is currently equivalent to 99% of the central budget.

Future bait supplies

There have been several attempts to find new manufacturers. In 1999 the Agriculture Protection Board (APB; a component of DAWA) attempted to outsource the manufacture of all 1080 bait products by inviting

proposals to lease the BPU at Forrestfield for up to three years. Four proposals were received. The preferred proponent was unwilling to proceed without a commitment by CALM to purchase baits. CALM agreed, subject to guaranteed pricing which was unacceptable to the proponent. The APB repeated its invitation in 2001 but all four responses were unacceptable.

In 2002 the APB advised CALM that the BPU would cease to manufacture 1080 baits as of the 30 June that year. As a result CALM called a tender for the manufacture and supply of dried meat baits. The feasibility and cost effectiveness of the tenders received were assessed and the cheapest tender found to add 75% (\$566 200 per annum) to bait procurement costs. As this was considerably in excess of the current bait price and considerably above the costs of CALM producing in house, the tender was withdrawn. On receipt of this advice the APB/DAWA advised CALM that the BPU would continue to manufacture and supply baits to CALM.

In view of the precarious bait-supply situation, in 1998–99 CALM (with advice from the small-goods processing industry) developed a sausage-bait (Probait) based on the salami manufacturing process. Advantages were:

- an automated process
- large production runs
- minimal wastage
- improved shelf-life
- an estimated factory-door cost of \$0.45 per bait (less than 1994 prices).

Moreover, the product's uniform shape and size allows

- improved packaging efficiency
- reduced transport and storage costs
- automated bait-laying procedures (see below).

Finally, there would be an opportunity to supply baits commercially, returning a profit to the Department, or subsidizing the cost of *Western Shield*.

A business plan was developed and submitted (in 2000) to the Director of Nature Conservation who referred it to a project team for review. The team endorsed the proposal and recommended an injection of \$400 000 for the first step, construction of a pilot plant. Although the capital has not yet been committed, opportunistic savings have financed some progress. At Harvey, south of Perth, plant and equipment capable of producing 200 000 Probait units per week has been installed and small scale, bench-top production and drying experiments have been undertaken over the past two years. The factory is now licensed to manufacture trial baits incorporating 1080 toxin. The National Registration Authority (NRA) registered Probait for manufacture and use in September 2002 (Product No. 53187). However, production of sufficient Probait units for *Western Shield* will require additional investment in drying equipment.

While the capacity to produce Probait proceeds, work is progressing on testing its efficacy as a fox bait, and its potential risk to non-target species:

- A captive fox population at CSIRO's laboratories in Canberra readily took and consumed both Probait and DMB without evident caching behavior but trial-design problems have hampered analysis of preference (R. Brazell, CALM, Collie personal communication).
- Feeding trials have investigated the palatability of (toxin-free) Probait and DMB to the native species thought most at risk from 1080 baiting operations. Results indicate that risks posed by Probait and DMB are approximately equal (Martin *et al.* 2002) and the risk to non-targets from DMB in the *Western Shield* operational area is acceptable.
- In trials involving a wild fox population near Yalgoo/Paynes Find, uptake of DMB was 11% greater than Probait. However, degradation by ants and/or the effect of inserting bio-markers may have reduced the persistence or palatability of Probait in the field (N. Marlow unpublished data).

Production of cat baits

In liaison with Science Division staff, development of an effective cat-bait has progressed in parallel with the development of Probait for foxes. The formulation and manufacturing process for cat baits is well advanced (Algar and Burrows, 2004). The NRA has registered operational-scale manufacture and deployment of the cat bait (incorporating 1080) for experimental purposes. Application for full NRA registration is progressing (D. Algar, CALM, personal communication). The ultimate aim is to produce a bait carrying a cat-specific toxin. In the meantime, a cheap and effective bait that can be deployed for simultaneous fox and cat control would be useful.

CONTROL AND USE OF 1080 TOXIN

Authority and procedures for use of 1080 bait products

Originally, the use of 1080 products was restricted to DAWA officers and persons they authorised under conditions they stipulated. However, DAWA officers were accustomed to using 1080 products for agricultural protection, not nature conservation. The frequent baiting of large areas of natural vegetation necessary for *Western Shield* fox control was outside their experience. The approval process required to utilize 1080 for nature conservation purposes involved a time consuming bureaucratic process between CALM and DAWA.

This inefficient arrangement was reviewed by CALM, DAWA and the Western Australian Department of Health.

As a consequence, the legislation has been changed. Pesticides containing 1080 are now controlled under the *Poisons Act of Western Australia 1964*. A Code of Practice on the Safe Use and Management of 1080, 2000 (the Code) has been developed under the provisions of 'Section 24, Poisons Notice of the Poisons Act. Registered Pesticide 1080'. The Code is the basis for CALM's standard operating procedures.

Accredited CALM officers can use 1080 bait products for nature conservation purposes. Accreditation requires successful completion of a training package approved by the Executive Director of Health. Currently, 179 CALM officers are authorised to use registered 1080 bait products. In addition, 38 officers are Authorised Risk Assessors. They are authorised to assess applications by landowners and managers to use 1080 bait products on any land for nature conservation purposes. Accredited departmental staff train and accredit CALM personnel as well as contract aerial baiting bombardiers in the use and possession of fox baits. All accreditations lapse after three years. Re-accreditation requires re-assessment of competence.

The Code requires that every *Western Shield* target area be subject to an application to bait. Approval requires (amongst other things) a satisfactory risk assessment. All approved programs are reviewed annually to ensure adherence to the Code and to accommodate circumstantial changes that may affect risk levels. This has been useful because changed circumstances (notably urban encroachment) at several target areas have affected risk levels and required prescription modifications. Baiting prescriptions are also reviewed after non-target incidents (notably, alleged dog poisoning).

Bait management

CALM maintains a register of all baits:

- collected from the BPU
- delivered to storage facilities
- issued from storage facilities for field use.

There are also quarterly checks of stored baits in each storage facility (Table 1). Bait numbers delivered to each facility take into account the requirements of approved prescriptions and the baits already on hand. Records are audited annually (as required by the Code) and audited records are made available to the Department of Health. They are also available on CALM files.

Orders are placed with the BPU under the authority of 1080 Authorisation Vouchers for *Western Shield* baiting cells. Issue and Receipt Vouchers are used to track all subsequent transfer transactions within CALM. Bait orders are released from the BPU into the custody of an 'authorised' driver of a CALM, purpose-built freezer truck who delivers them to the custody of 'authorised' district officers who secure them in departmental storage facilities. A Bait Register at each storage site records all deposits and withdrawals.

Recorded details are:

- the name of the person into whose custody baits are received or released
- the location where baits are to be used
- Issue and Receipt Voucher details.

National Registration Authority—1080 bait registration

The National Registration Authority (NRA) is currently reviewing the use of 1080 in Australia. Use and management practices vary considerably between State and Territory jurisdictions. Issues being examined include non-target impacts and the humaneness of 1080 as a vertebrate pest toxin. A whole of Western Australia government submission, including a comprehensive information package, has been provided to the reviewers. The written submission was supported by personal presentations and field trips for the NRA Board and its officers. The possibility of further restriction or prohibition of the use of 1080 is of great concern. This could restrict or abolish opportunities for economically feasible conservation of threatened fauna. Results of the review are expected in late 2004.

Irrespective of the NRA review, public tolerance of the use of 1080 is essential to its continued availability for conservation use. This reinforces the importance of proactive communication with the public and careful, conservative risk assessment for each baiting application. Selection of baiting targets near to urban or built up areas or areas of high public use could jeopardizes the future of the entire program. Protection of small populations of vulnerable fauna in these areas cannot be achieved using 1080 bait products if it puts the continued use of this tool at risk. Not all proponents of baiting operations appreciate this restriction and their lack of understanding is sometimes a cause of friction between portfolios within CALM.

MANAGEMENT AND COORDINATION OF BAITING OPERATIONS

Baited areas and baiting regimes

About 3.4 million hectares are baited under the *Western Shield* program. The baited areas (Appendices A,B,C and D) were selected in 1996 as the areas that best met the strategic aims of the original project proposal. The *Western Shield* program also incorporated a pre-existing experimental baiting program, *Operation Foxglove*, located in the northern Jarrah forest.

Operation Foxglove commenced in 1994 with corporate sponsorship from Alcoa World Alumina Australia under the CALM Alcoa Forest Enhancement

(CAFE) agreement. Its aim was to experimentally determine the most economically effective baiting regime required to meet fauna recovery objectives in the northern jarrah forest. The work was undertaken by Paul de Tores (CALM, Science Division). The experiment compared fauna response to baiting two, four and six times per year against an unbaited control. Fieldwork was completed in March 2002. The outcomes have been used to adjust baiting prescriptions on all Foxglove cells to four times per year. A plan to bait a 10 km strip along the eastern margin six times per year to reduce fox immigration from adjacent farmland has been developed and will be implemented if funds are available. The future of the unbaited control areas have not yet been determined. Ongoing support is being sought from CAFE.

The list of baited areas was reviewed in 2001 and several were discontinued for various reasons (Table 3). The review was undertaken in conjunction with the annual review of baiting applications and risk assessments. Given the large areas that are baited frequently each year and the degree of public access to baited areas, poisoning non-target domestic or working animals is inevitable and a few incidents are reported each year. Each incident is investigated and remedial action taken where risk of recurrence can be reduced. The risk is managed by proactive media advertising, articles in the popular press, direct neighbour notification (Kawalilak *et al.* this issue), conservative risk assessment and meticulous adherence to operational prescriptions.

TABLE 3
Areas deleted from active baiting since 2001.

CELL NAME	AREA (HA)	REASON FOR REMOVAL
Karroun Hill NR	40 000	Numbat – introduced to the area on a number of occasions - was found to be in continuing decline and baiting was not arresting decline.
Torndirrup NP	3 844	Baiting area immediately adjacent to populated town site. Continued baiting would not have met risk assessment guidelines.
Millbrook	1 484	Small size and isolation. Only quenda thought to be present. They are adequately represented elsewhere.
Helms Arboretum	3 778	Fauna monitoring since 1998 did not indicate any fauna response to baiting. Area is too small and isolated for re-introduction sites.
Capel NR	<15	Too small, isolated and disturbed to be of any nature conservation benefit to CWR mammals.
Ruabon NR	<15	Too small, isolated and disturbed to be of any nature conservation benefit to CWR mammals.
Fish NR	<10	Too small, isolated and disturbed to be of any nature conservation benefit to CWR mammals.

Management functions

From the outset, the project has been a high departmental priority. It was allocated a central budget of \$1.15 million but other resource needs have had to be found from existing programs. Thus, a substantial component of a CALM Environmental Protection Branch officer's time was assigned to co-ordinate and manage the project. Other personnel from Wildlife Branch, Regions and District-based Nature Conservation Officers provided significant additional support.

Currently, a Project Manager and an Operations Officer, located in the department's Environmental Protection Section, manage the baiting program. Their salary is met from the normal Branch budget and, although *Western Shield* is the largest component of both officers' workload, they also have other duties. A new position of Western Shield Zoologist was created with a salary drawn from the *Western Shield* central budget to work full time on *Western Shield* monitoring and field-staff training (Orell, this issue).

While the Operations Officer coordinates baiting operations, District staff undertake the roles of Aircraft Baiting Coordinators (ABC) and bombardiers. District resources cover most of the costs but there is modest assistance from project funds. Where it is needed, Districts resource all additional ground baiting.

The project manager developed a five-year strategic plan for 1999–2004 that defined an organizational structure and identified areas of responsibility. Although the plan was submitted to the Director Nature Conservation for approval the Corporate Executive has not formally ratified it. Nevertheless, many components of the document are used informally. Four groups have been formed to provide direction.

1. A Strategic Committee comprising the Project Manager, Director of Nature Conservation and the Manager, Biodiversity Group, Science Division was formed to maintain the strategic direction of the program. It served a useful purpose in early days but it has not met regularly and has been ineffectual at achieving its intended role.
2. A Management Committee was formed to prioritise operational aspects of the program in the State's southwest. It met periodically but should have met more regularly. It did achieve most of the role for which it was established.
3. A Management Committee was formed to guide implementation of Project Eden because it is a large program that integrates predator control with fauna reconstruction in a geographically discrete area, Shark Bay. Membership is drawn from people involved in that project and the Western Shield Project Manager who provides a link to the *Western Shield* program. It works well.
4. Similarly, an effective Management Committee guides implementation of Montebello Renewal.

SUPPLY AND MANAGEMENT OF AIRCRAFT AND NAVIGATION TECHNOLOGY

Aerial baiting operations were first outsourced in 1994 for Operation Foxglove. The contractor used a single engine aircraft and navigation technology designed for aerial photography. The aircraft was flown at 1000 ft AGL at 90 knots and baits were laid at 200 m intervals along parallel flight lines 1 km apart (5 baits per km²). The aircrew consisted of a contract pilot and a departmental bombardier from the local District. An incident involving an engine failure in this aircraft over forest near Dwellingup in 1996 resulted in the Department stipulating the use of twin-engine aircraft when there are CALM officers on board.

A twin-engine aircraft contracted to the Department for controlled-burn ignition and equipped with Department-owned navigation equipment and software was used for six months. This interim arrangement allowed time to establish a dedicated aerial-baiting contract.

The contractor was required to provide GPS navigation equipment that met departmental specifications for accuracy, inputs and outputs. A non-differential GPS with a maximum error of 90 m was allowed. Unbaited buffers adjacent to private property were set at 1000 m to accommodate GPS (and possible human) error as well as wind drift while baits were falling. The new contract performance specifications required:

- recovery from an engine failure under full fuel and useful load burden and the maintenance of a climb gradient of 1.5% on one engine to 3000 ft ASL
- endurance of 270 minutes
- minimum safe operating speed of 150 knots
- cruising speed of 180 knots
- ability to operate from 900 m gravel airstrips.

Besides the safety factors, the specifications permitted four hours of useful baiting on each sortie, minimised ferry times and enabled use of local airstrips for re-fuelling and reloading. These specifications were used for two years.

Meanwhile, bait-drop trials indicated that DMB were not particularly aerodynamic. At an altitude of 500 ft AGL and an airspeed of 160 knots with a 10-knot tailwind, baits carried forward no more than 77 m. These results, combined with the accuracy achievable with a differential GPS, led to the opportunity to reduce the unbaited buffers alongside private property to 500 m and the operational flying altitude to 500 ft. New tenders were called.

Digital navigation files are prepared for each baiting cell. They specify flight lines designed to minimise unnecessary turns and unproductive time. They incorporate un-baited buffers adjacent to private property boundaries and baiting exclusions over internal high-risk areas (e.g. recreation sites in national parks). The contractor uploads the files into the aircraft's navigation system. Whilst in the air, the location at which any object

leaves the aircraft via the bait-drop tube is recorded to within +/- 10 m by infrared sensors at the bottom of the tube. The information is subsequently plotted on a map of the baited cell and used as an audit tool.

Originally, a digital LED display on the instrument panel allowed the pilot to fly along the flight line and to count down the distance to the entry and exit from the cell along each flight line. A flashing green light indicated to the bombardier that the aircraft was within the prescribed baiting area and a red light indicated that the aircraft was outside it. A timer calibrated to the aircraft speed controlled the flashing intervals informing the bombardier when to drop baits down the bait tube. This ensured an inter-bait distance of 200 m. An audible alarm sounded if the infrared sensors were triggered when the aircraft was outside the prescribed baiting area. Baiting halted immediately and the aircraft circled until the cause of the alarm was determined and recorded in the flight log. Common causes included flies, bait chips, pieces of ice, packaging material from bait bags and vomit.

An automated baiting machine now eliminates the risk of dropping baits outside the prescribed area because of human error. It consists of a carousel (loaded by the bombardier in flight) that rotates under the control of the navigation equipment and, being linked to the DGPS, releases baits at 200 m intervals, irrespective of air and ground speeds. When the aircraft is not over the prescribed area, the carousel locks. If 'free flying' (e.g. following the edge of a gorge) is required, a timer can over ride the navigation control of bait release to maintain 200 m bait intervals.

In 2002, a new five-year aerial baiting contract was awarded. A Memorandum of Understanding between the Department and the contractor provides guidelines for the operational implementation of the contract. The contractor provides the flight crew (pilot and bombardier). Payment is based on area baited, not aircraft flying time. Aircraft specifications are not defined so that the contractor can choose the number and type of aircraft (including single or twin-engine, fixed or rotary-wing) best suited to the job and resources available. However, the baiting specifications are narrowly defined and the contractor has to provide post-operational plots depicting bait locations, aircraft track and altitude. Moreover, daily flight diaries detail the cells baited, the number of baits dropped, wind speed and direction, and the incidence of any alarms for objects leaving the aircraft outside the prescribed baiting areas. These are auditable documents. The contract specifies completion of each baiting cycle within 56 days.

DIFFICULTIES

Bait procurement

- DMB production methods are slow, wasteful and expensive and DMB are prone to spoilage.

- DMB supply problems sometimes cause insufficient bait for routine operations
- Outsourcing attempts by DAWA have created uncertainty and pose future potential supply risks to *Western Shield*.
- Lack of funds for development and production of Pro bait has delayed securing an alternative (and superior) long-term bait supply.
- Operational production of cat baits will also be affected if the Harvey bait factory is not completed and staffed.
- The durability of 1080 in meat baits is an issue (that is not helped by technical difficulties associated with assay methods). Degradation could lead to sub-lethal dosing and consequently bait-shy foxes. Nevertheless, there is no evidence of widespread bait shyness in Western Australia to date.

Control and use of 1080 toxin

- There is no departmental policy or guideline on managing vertebrate pests. *Western Shield* is setting the direction for predator control but it operates in isolation of other pest management priorities. It is also an issue where urban encroachment impinges on baited areas causing conflict of opinion among staff wanting to protect fauna and those who have to refuse permission to use 1080 baits because of risk assessment outcomes.
- There are perennial problems associated with small but inevitable incidents of non-target poisoning, particularly domestic animals.
- Not all proponents of baiting operations appreciate the risk that public backlash to non-target incidents poses to the continued authority to use 1080 baits for conservation. This lack of understanding has caused debate within CALM on operational priorities. This debate, if not appropriately resolved, could lead to operations with an unacceptable risk to non-targets and consequent restrictions on the use of 1080 in this State.

Management and coordination of baiting operations

- Coordination and assurance that statutory and best practice requirements are met has been difficult because of limited time, the large number of people involved and their dispersed geographic locations.
- The same constraints have limited regular reporting on progress against stated objectives.
- The committee structure secured commitment in the program's establishment phase. However, it has become cumbersome in its operation as some committee members are not directly responsible or accountable for implementing decisions. It is also resource hungry and time consuming.

Supply and management of aircraft and navigation technology

- Any significant extension of the baited area may require further investment by the contractor in capital equipment.

POTENTIAL ECONOMIES

Bait procurement

- Development and application of Pro bait will reduce annual bait-procurement expenditure by about \$401 000, but will require a capital investment of approximately \$400 000 to establish manufacturing infrastructure. It would be possible to achieve this in a staged process that would spread the investment over a number of financial years.
- The irregular shape and size of DMB adds inefficiency to packaging and mechanized delivery. More efficient packaging of Pro bait will reduce handling, and distribution costs.
- Pro bait stability at room temperatures will eliminate the costs of purchasing, maintaining and running storage freezers.
- Automation of ground baiting operations may result in faster bait deployment and significant time saving for District staff.
- If DAWA continues to have a role in providing bait products to primary producers, a whole of government strategy to meet the State's bait production requirement should result in economic efficiencies.

Control and use of 1080 toxin

- This functions well now and no potential economies could be identified.

Management and coordination of baiting operations

- The cost effectiveness of *Western Shield* has probably been very high. However, real costs are not accurately captured because many cost centres absorb costs into routine operational budgets. Internal budgeting arrangements based on internal contracts such as Service Provider Agreements would contribute significantly to accurate and reliable identification of true costs, and potential economies.
- Sponsorship has been vital. More investment in the identification of potential new sponsors, development of sponsorship proposals and servicing the information requirements of secured sponsors could substantially improve the project's funding base. The fixed-term nature of most sponsorship agreements underlines the importance of this activity.

Supply and management of aircraft and navigation technology

- The efficacy of automated aerial bait laying can be improved by using standard-shaped baits (Pro bait). Standard baits could lead to automated carousel loading and reduction of crew to a pilot only.
- The Department of Agriculture uses aircraft to bait wild dogs in the pastoral areas of the State. Cooperative contracting arrangements have not been possible to date, but the issue should be re-examined.
- Fox baiting is gathering momentum in other States and South Australia is now undertaking aerial baiting trials for nature conservation. There are opportunities to assist their operations and offset some of the contract maintenance costs.

POTENTIAL IMPROVEMENTS

Bait procurement

There are many opportunities for innovative improvements to Pro bait. They need to be explored through an ongoing focus on research and development. For example:

- Incorporation of artificial scent and taste enhancers could improve attractiveness and palatability.
- Incorporation of an ant repellent compound could extend field life of baits and reduce the chances of sub-lethal dosing.
- Development of a water-resistant skin could improve the field-life of baits generally and become an alternative to buried egg baits (used in wetlands; they are costly to produce and deploy).
- Inclusion of chemical or physical markers in the Pro bait recipe would facilitate investigation of suspected non-target poisoning incidents.
- Tethering of baits may help to resolve some problems associated with baiting in high-risk areas. Building string loops into Pro baits should be investigated.
- Mechanisation of the bait laying operation. Ground baiting operations could utilise a 'mortar' device to launch baits from a moving vehicle to a safe distance from tracks, reducing staff time and other costs.
- Compact packaging and mechanised bait deployment from aircraft may reduce the number of aircrew required for baiting operations and hence baiting costs.
- Labelling of baits with warning markings could further reduce occupational health and safety risks to operators as well as any member of the public who may come into contact with Pro bait in the field.

Management and coordination of baiting operations

- A policy framework on management of vertebrate pests on Department-managed lands would provide operational guidance for the integration of vertebrate pest control across the Department
- *Western Shield* is now perceived as a generic name for any work dealing with introduced predator control and/or fauna recovery. A clear definition of its parameters is required.
- The Strategic Committee should be abolished and replaced by line-authority of an appropriate manager. This will ensure responsive and timely decision-making and clear lines of accountability, responsibility and reporting.
- Service Provider Agreements between the manager responsible for implementing *Western Shield* and managers responsible for providing the supporting services need to be established and clearly defined. This will ensure that project objectives, and the resources needed to achieve them, are incorporated into normal departmental operations.
- The Project Manager, Operations Officer and Zoologist should be dedicated positions within a management unit. The unit requires an additional L3/4 position to assist with routine management audit functions and administrative support.
- Closer integration of fauna recovery planning with the *Western Shield* program would resolve conflicts and enhance efficiency (many recovery actions have nothing to do with *Western Shield*, but membership of *Western Shield* personnel on relevant recovery teams might be useful).
- The productive and informed working arrangement between the Department of Health and CALM needs to be fostered
- Consistent size and long shelf-life of Pro bait offers the potential to develop and deploy automated bait stations in remote areas that now require expensive travel to regularly protect small, isolated prey populations (e.g. rock-wallabies in the deserts).

Supply and management of aircraft and navigation technology

- The current aircraft contract and arrangements are the result of eight years of experience and continual improvement. It will take time to evaluate the current system, but there may be opportunities for further improvements.

CONCLUSIONS

The development and implementation of the *Western Shield* program has demonstrated considerable initiative and innovation since its inception. The achievements to date have been nationally significant. These achievements have been made with the application of relatively few resources and the incorporation of skills and technologies not usually found in a land management agency. The opportunities for *Western Shield* to become more effective lie primarily in the areas of project management and bait product development.

The development and adoption of the Pro bait product has the potential to realise significant financial savings and operational efficiencies. A valuable adjunct to this work is the ability to contribute significantly to the development of an effective cat control technology that would have international implications for fauna conservation. To enable this work to proceed with confidence will require a consistent commitment to research and development, the establishment of manufacturing capacity and a whole of government approach to implementation.

The facilitation of effective project management requires a clear definition of agency policy on vertebrate pest management and the dedication of resources to ensure consistent operational processes and standards are set and adhered to. Organisational structures are required that clearly define lines of responsibility and accountability. Contractual arrangements within the agency are required to ensure effective financial management, operational execution, reporting and accountability. The inculcation of the *Western Shield* program into normal agency operations should be strived for and existing management structures utilised to achieve effective implementation.

The success of the program to date has been contributed to by effective cooperation and liaison between government agencies such as CALM, DAWA and the Health Department. Liaison and engagement of other stakeholders such as corporate sponsors, neighbouring landholders, aviation interests and community-based interest groups has also been vital to the programs ongoing success. This experience and knowledge has been confined to date to a small number of agency personnel involved in managing the program. This experience and knowledge needs to be spread across the agency to ensure effective managerial succession and continued improvement.

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APPENDIX A

Aerial and ground baiting cell summary

Note: 'Area of the cell' is the total area approved for baiting. 'Approved number' of baits is the number of baits approved by the 'Risk Assessment and Baiting Approval' process for that baiting cell each year.

CELL NAME	TOTAL AREA OF CELL (HA)	APPROVED # BAITS PER YEAR	CELL NAME	TOTAL AREA OF CELL (HA)	APPROVED # BAITS PER YEAR
Argyle	10 412	1 320	Leeuwin National Park	500	3 300
Avon National Park	14 711	5 200	Leschenault	1 071	1 200
Bakers junction	1 090	960	Locke Nature Reserve	187	192
Batalling	45 754	8 400	Magenta	95 000	32 000
Bendering Nature Reserve	1 601	800	Manjimup	133 011	26 840
Boyagin Nature Reserve	4 903	12 350	Manypeaks	10 967	3 164
BramleyForest Block	4 260	640	Mehniup Hill	383	300
Burrup	8 494	1 200	Mt caroline	351	1 430
Cape Arid	205 246	48 400	Mt stirling Nature Reserve	224	845
Cape Le Grande	33 667	7 576	Mullalyup	6 624	640
Cape Range	70 966	14 400	Nambung	140 474	23 200
Corackerup	4 334	2 400	Nangeen Hill Nature Reserve	176	1 040
Creary and Channel islands	74	48	Nornalup	7 979	2 700
Creery Wetland	94	48	Nth Kalgarin	5 119	2 200
Crookes pp	64	546	Peniup	3 630	2 200
D'Entrecasteaux	9 3875	18 000	Peron	105 000	10 800
Denbarker	243 842	43 200	Porongorup National Park	2 621	1 880
Donelly	132 897	30 000	Ravensthorpe Range	25 647	3 900
Dongolocking	2 350	7 200	Roe Nature Reserve	1 246	800
Dragon rocks	32 200	10 600	Sales Rock	65	520
Dryandra	23 838	42 900	Scott National Park	1 920	640
Dwellingup	132 178	25 140	Shannon	312 921	67 600
Ellen Brook	30	60	Stirling Range	101 901	29 860
Fitzgerald River	344 682	78 000	Stokes National Park	18 686	8 160
Gardners pp	10	364	Sunklands	286 310	50 400
Giants	3 026	1 600	Thompsons Lake	509	200
Grimwade	53 757	7 800	Tuart Forest	4 000	2 460
Gull Rock National Park	2 104	520	Tutanning	2 309	9 425
Gundaring	127	455	Twin Swamps	155	90
Hadfield	6 660	800	Two Peoples Bay	5 836	5 120
Harold Holt Aerial Farm	300	540	Walyunga National Park	1 812	3 000
Hills	101 662	21 400	Wellington	58 713	9 200
Irwin	6 177	1 000	West Cape Howe	3 517	1 040
Jaloran	455	1 200	Wilga	14 256	4 400
Jarrahdale	147 607	36 996	William Bay	1 700	450
Jerdacuttup Lakes	14 598	3 900	Worsley	11 083	2 000
Julimar	35 700	7 200	Yalgorup National Park	2 240	3 840
Kalbarri	180 563	34 400	Yelverton	1 000	1 200
Lane poole	87 755	24 300	TOTAL	3 421 206	820 099

APPENDIX B

Aerial fox baiting cell details.

Note 'Area' is the navigation file area not the total area of the cell.

Fiscal Year 1993–94

AIR CELL	DATE COMMENCED	AREA	BAITING PER YR	TOTAL AREA BAITED/YR	BAITS	TOTAL BAIT/YR
Julimar	April 1994	18 400	4	73 600	1 420	5,680
Hills Forest	April 1994	20 000	4	80 000	1 400	5,600
Batalling	April 1994	45 754	4	183 016	1 870	7,480
Gervasse	April 1994	10 200	4	40 800	440	1,760
Hadfield	April 1994	3 000	4	12 000	200	800
Kelmscott	June 1994	66 700	2	133 400	3 350	6,700
Jarrahdale	June 1994	127 800	2	127 800	6 640	13,280
Dwellingup	June 1994	116 500	4	266 800	6 000	24,000
Worsley	June 1994	14 400	2	28 800	720	1,440
TOTAL		422 754		946 216	22 040	66,740

Fiscal Year 1994–95

AIR CELL	DATE COMMENCED	AREA	BAITING PER YR	TOTAL AREA BAITED/YR	BAITS	TOTAL BAIT/YR
Julimar	April 1994	18 400	4	73 600	1 420	5 680
Hills Forest	April 1994	20 000	4	80 000	1 400	5 600
Batalling	April 1994	45 754	4	183 016	1 870	7 480
Gervasse	April 1994	10 200	4	40 800	440	1 760
Hadfield	April 1994	3 000	4	12 000	200	800
Kelmscott	June 1994	66 700	2	133 400	3 350	6 700
Jarrahdale	June 1994	127 800	2	127 800	6 640	13 280
Dwellingup	June 1994	116 500	4	266 800	6 000	24 000
Worsley	June 1994	14 400	2	28 800	720	1 440
Lane Poole	Jan 1995	94 000	6	564 000	3 900	23 400
TOTAL		516 754		1 510 216	25 940	90 140

Fiscal Year 1995–96

AIR CELL	DATE COMMENCED	AREA	BAITING PER YR	TOTAL AREA BAITED/YR	BAITS	TOTAL BAIT/YR
Julimar	April 1994	18 400	4	73 600	1 420	5 680
Hills Forest	April 1994	20 000	4	80 000	1 400	5 600
Batalling	April 1994	45 754	4	183 016	1 870	7 480
Gervasse	April 1994	10 200	4	40 800	440	1 760
Hadfield	April 1994	3 000	4	12 000	200	800
Kelmscott	June 1994	66 700	2	133 400	3 350	6 700
Jarrahdale	June 1994	127 800	2	127 800	6 640	13 280
Dwellingup	June 1994	116 500	4	266 800	6 000	24 000
Worsley	June 1994	14 400	2	28 800	720	1 440
Lane Poole	Jan 1995	94 000	6	564 000	3 900	23 400
Cape Range	April 1996	75 000	4	300 000	3 400	13 600
Karroun Hill	April 1996	40 000	4	160 000	2 000	8 000
Lake Magenta	May 1996	116 921	4	467 684	5 020	20 080
Dragon Rocks	May 1996	32 546	4	130 184	1 380	5 520
TOTAL		781 221		2 568 084	37 740	137 340

APPENDIX B (continued)

Fiscal Year 1996–97

AIR CELL	DATE COMMENCED	AREA	BAITING PER YR	TOTAL AREA BAITED/YR	BAITS	TOTAL BAITS/YR
Julimar	April 1994	18 400	4	73 600	1 420	5 680
Hills Forest	April 1994	20 000	4	80 000	1 400	5 600
Batalling	April 1994	45 754	4	183 016	1 870	7 480
Gervasse	April 1994	10 200	4	40 800	440	1 760
Hadfield	April 1994	3 000	4	12 000	200	800
Kelmscott	June 1994	66 700	2	133 400	3 350	6 700
Jarrahdale	June 1994	127 800	2	127 800	6 640	13 280
Dwellingup	June 1994	116 500	4	266 800	6 000	24 000
Worsley	June 1994	14 400	2	28 800	720	1 440
Lane Poole	Jan 1995	94 000	6	564 000	3 900	23 400
Cape Range	April 1996	75 000	4	300 000	3 400	13 600
Karroun Hill	April 1996	40 000	4	160 000	2 000	8 000
Lake Magenta	May 1996	116 921	4	467 684	5 020	20 080
Dragon Rocks	May 1996	32 546	4	130 184	1 380	5 520
Jerdacuttup Lakes	Sept 1996	17 746	4	70 984	730	2 920
Corackerup	Sept 1996	4 325	4	17 300	150	600
Peniup	Sept 1996	6 318	4	25 272	200	800
Collie	Oct 1996	31 944	4	127 776	1 360	5 440
Wilga	Oct 1996	14 256	4	57 024	530	2 120
Grimwade	Oct 1996	53 757	4	215 028	1 950	7 800
Fitzgerald	Oct 1996	377 641	4	1 510 564	18 300	73 200
Mullalyup	Oct 1996	6 624	4	26 496	160	640
Argyle	Oct 1996	10 412	4	41 648	330	1 320
Manjimup	Nov 1996	133 011	4	532 044	4 560	18 240
Shannon	Nov 1996	312 121	4	1 248 484	14 610	58 440
Denbarker	Nov 1996	243 842	4	975 368	11 000	44 000
Millbrook	Nov 1996	1 484	4	5 936	40	160
Kalbarri	Nov 1996	180 563	4	722 252	8 600	34 400
Stirling	Nov 1996	113 331	4	453 324	6 100	24 400
Two Peoples Bay	Nov 1996	9 274	4	37 096	300	1 200
Manypeaks	Nov 1996	13 393	4	53 572	550	2 200
Porongurup	Dec 1996	2 747	4	10 988	50	200
Irwin	Dec 1996	6 177	4	24 708	230	920
Giants	Dec 1996	3 026	4	12 104	70	280
Nornalup	Dec 1996	7 979	4	31 916	260	1 040
Stokes Inlet	Dec 1996	24 948	4	99 792	1 500	6 000
Cape Le Grande	Dec 1996	33 667	4	134 668	1 750	7 000
Cape Arid	Dec 1996	213 872	4	855 488	12 100	48 400
TOTAL		2 603 679		9 857 916	123 170	479 060

APPENDIX B (continued)

Fiscal Year 1997–98

AIR CELL	DATE COMMENCED	AREA	BAITING PER YR	TOTAL AREA BAITED/YR	BAITS	TOTAL BAIT/YR
Julimar	April 1994	18 400	4	73 600	1 420	5 680
Hills Forest	April 1994	20 000	4	80 000	1 400	5 600
Batalling	April 1994	45 754	4	183 016	1 870	7 480
Gervasse	April 1994	10 200	4	40 800	440	1 760
Hadfield	April 1994	3 000	4	12 000	200	800
Kelmscott	June 1994	66 700	2	133 400	3 350	6 700
Jarrahdale	June 1994	127 800	2	127 800	6 640	13 280
Dwellingup	June 1994	116 500	4	266 800	6 000	24 000
Worsley	June 1994	14 400	2	28 800	720	1 440
Lane Poole	Jan 1995	94 000	6	564 000	3 900	23 400
Cape Range	April 1996	75 000	4	300 000	3 400	13 600
Karroun Hill	April 1996	40 000	4	160 000	2 000	8 000
Lake Magenta	May 1996	116 921	4	467 684	5 020	20 080
Dragon Rocks	May 1996	32 546	4	130 184	1 380	5 520
Jerdacuttup Lakes	Sept 1996	17 746	4	70 984	730	2 920
Corackerup	Sept 1996	4 325	4	17 300	150	600
Peniup	Sept 1996	6 318	4	25 272	200	800
Collie	Oct 1996	31 944	4	127 776	1 360	5 440
Wilga	Oct 1996	14 256	4	57 024	530	2 120
Grimwade	Oct 1996	53 757	4	215 028	1 950	7 800
Fitzgerald	Oct 1996	377 641	4	1 510 564	18 300	73 200
Mullalyup	Oct 1996	6 624	4	26 496	160	640
Argyle	Oct 1996	10 412	4	41 648	330	1 320
Manjimup	Nov 1996	133 011	4	532 044	4 560	18 240
Shannon	Nov 1996	312 121	4	1 248 484	14 610	58 440
Denbarker	Nov 1996	243 842	4	975 368	11 000	44 000
Millbrook	Nov 1996	1 484	4	5 936	40	160
Kalbarri	Nov 1996	180 563	4	722 252	8 600	34 400
Stirling	Nov 1996	113 331	4	453 324	6 100	24 400
Two Peoples Bay	Nov 1996	9 274	4	37 096	300	1 200
Manypeaks	Nov 1996	13 393	4	53 572	550	2 200
Porongurup	Dec 1996	2 747	4	10 988	50	200
Irwin	Dec 1996	6 177	4	24 708	230	920
Giants	Dec 1996	3 026	4	12 104	70	280
Nornalup	Dec 1996	7 979	4	31 916	260	1 040
Stokes Inlet	Dec 1996	24 948	4	99 792	1 500	6 000
Cape Le Grande	Dec 1996	33 667	4	134 668	1 750	7 000
Cape Arid	Dec 1996	213 872	4	855 488	12 100	48 400
Sunklands	July 1997	286 310	4	1 145 240	12 560	50 240
Ravsthrpe Range	Sept 1997	18 140	4	72 560	1 290	5 160
D'Entrecasteaux	Oct 1997	93 875	4	375 500	3 940	15 760
Donnelly	Oct 1997	132 987	4	531 948	5 200	20 800
Burrup Peninsular	Oct 1997	8 494	1	8 494	245	245
Scott	Mar 1998	1 053	2	2 106	100	200
TOTAL		3 144 538		11 993 764	146 505	571 465

APPENDIX B (continued)

Fiscal Year 1998–99

AIR CELL	DATE COMMENCED	AREA	BAITING PER YR	TOTAL AREA BAITED/YR	BAITS	TOTAL BAITS/YR
Julimar	April 1994	18 400	4	73 600	1 420	5 680
Hills Forest	April 1994	20 000	4	80 000	1 400	5 600
Batalling	April 1994	45 754	4	183 016	1 870	7 480
Gervasse	April 1994	10 200	4	40 800	440	1 760
Hadfield	April 1994	3 000	4	12 000	200	800
Kelmscott	June 1994	66 700	2	133 400	3 350	6 700
Jarrahdale	June 1994	127 800	2	127 800	6 640	13 280
Dwellingup	June 1994	116 500	4	266 800	6 000	24 000
Worsley	June 1994	14 400	2	28 800	720	1 440
Lane Poole	Jan 1995	94 000	6	564 000	3 900	23 400
Cape Range	April 1996	75 000	4	300 000	3 400	13 600
Karroun Hill	April 1996	40 000	4	160 000	2 000	8 000
Lake Magenta	May 1996	116 921	4	467 684	5 020	20 080
Dragon Rocks	May 1996	32 546	4	130 184	1 380	5 520
Jerdacuttup Lakes	Sept 1996	17 746	4	70 984	730	2 920
Corackerup	Sept 1996	4 325	4	17 300	150	600
Peniup	Sept 1996	6 318	4	25 272	200	800
Collie	Oct 1996	31 944	4	127 776	1 360	5 440
Wilga	Oct 1996	14 256	4	57 024	530	2 120
Grimwade	Oct 1996	53 757	4	215 028	1 950	7 800
Fitzgerald	Oct 1996	377 641	4	1 510 564	18 300	73 200
Mullalyup	Oct 1996	6 624	4	26 496	160	640
Argyle	Oct 1996	10 412	4	41 648	330	1 320
Manjimup	Nov 1996	133 011	4	532 044	4 560	18 240
Shannon	Nov 1996	312 121	4	1 248 484	14 610	58 440
Denbarker	Nov 1996	243 842	4	975 368	11 000	44 000
Millbrook	Nov 1996	1 484	4	5 936	40	160
Kalbarri	Nov 1996	180 563	4	722 252	8 600	34 400
Stirling	Nov 1996	113 331	4	453 324	6 100	24 400
Two Peoples Bay	Nov 1996	9 274	4	37 096	300	1 200
Manypeaks	Nov 1996	13 393	4	53 572	550	2 200
Porongurup	Dec 1996	2 747	4	10 988	50	200
Irwin	Dec 1996	6 177	4	24 708	230	920
Giants	Dec 1996	3 026	4	12 104	70	280
Nornalup	Dec 1996	7 979	4	31 916	260	1 040
Stokes Inlet	Dec 1996	24 948	4	99 792	1 500	6 000
Cape Le Grande	Dec 1996	33 667	4	134 668	1 750	7 000
Cape Arid	Dec 1996	213 872	4	855 488	12 100	48 400
Sunklands	July 1997	286 310	4	1 145 240	12 560	50 240
Ravsthrpe Range	Sept 1997	18 140	4	72 560	1 290	5 160
D'Entrecasteaux	Oct 1997	93 875	4	375 500	3 940	15 760
Donnelly	Oct 1997	132 987	4	531 948	5 200	20 800
Burrup Peninsular	Oct 1997	8 494	1	8 494	245	245
Scott	Mar 1998	1 053	2	2 106	100	200
Avon	June 1999	14 711	4	58 844	730	2 920
TOTAL		3 159 249		12 052 608	147 235	574 385

APPENDIX B (continued)

Fiscal Year 1999–2000

AIR CELL	DATE COMMENCED	AREA	BAITING PER YR	TOTAL AREA BAITED/YR	BAITS	TOTAL BAIT/YR
Julimar	April 1994	18 400	4	73 600	1 420	5 680
Hills Forest	April 1994	20 000	4	80 000	1 400	5 600
Batalling	April 1994	45 754	4	183 016	1 870	7 480
Gervasse	April 1994	10 200	4	40 800	440	1 760
Hadfield	April 1994	3 000	4	12 000	200	800
Kelmscott	June 1994	66 700	2	133 400	3 350	6 700
Jarrahdale	June 1994	127 800	2	127 800	6 640	13 280
Dwellingup	June 1994	116 500	4	266 800	6 000	24 000
Worsley	June 1994	14 400	2	28 800	720	1 440
Lane Poole	Jan 1995	94 000	6	564 000	3 900	23 400
Cape Range	April 1996	75 000	4	300 000	3 400	13 600
Karroun Hill	April 1996	40 000	4	160 000	2 000	8 000
Lake Magenta	May 1996	116 921	4	467 684	5 020	20 080
Dragon Rocks	May 1996	32 546	4	130 184	1 380	5 520
Jerdacuttup Lakes	Sept 1996	17 746	4	70 984	730	2 920
Corackerup	Sept 1996	4 325	4	17 300	150	600
Peniup	Sept 1996	6 318	4	25 272	200	800
Collie	Oct 1996	31 944	4	127 776	1 360	5 440
Wilga	Oct 1996	14 256	4	57 024	530	2 120
Grimwade	Oct 1996	53 757	4	215 028	1 950	7 800
Fitzgerald	Oct 1996	377 641	4	1 510 564	18 300	73 200
Mullalyup	Oct 1996	6 624	4	26 496	160	640
Argyle	Oct 1996	10 412	4	41 648	330	1 320
Manjimup	Nov 1996	133 011	4	532 044	4 560	18 240
Shannon	Nov 1996	312 121	4	1 248 484	14 610	58 440
Denbarker	Nov 1996	243 842	4	975 368	11 000	44 000
Millbrook	Nov 1996	1 484	4	5 936	40	160
Kalbarri	Nov 1996	180 563	4	722 252	8 600	34 400
Stirling	Nov 1996	113 331	4	453 324	6 100	24 400
Two Peoples Bay	Nov 1996	9 274	4	37 096	300	1 200
Manypeaks	Nov 1996	13 393	4	53 572	550	2 200
Porongurup	Dec 1996	2 747	4	10 988	50	200
Irwin	Dec 1996	6 177	4	24 708	230	920
Giants	Dec 1996	3 026	4	12 104	70	280
Nornalup	Dec 1996	7 979	4	31 916	260	1 040
Stokes Inlet	Dec 1996	24 948	4	99 792	1 500	6 000
Cape Le Grande	Dec 1996	33 667	4	134 668	1 750	7 000
Cape Arid	Dec 1996	213 872	4	855 488	12 100	48 400
Sunklands	July 1997	286 310	4	1 145 240	12 560	50 240
Ravsthrpe Range	Sept 1997	18 140	4	72 560	1 290	5 160
D'Entrecasteaux	Oct 1997	93 875	4	375 500	3 940	15 760
Donnelly	Oct 1997	132 987	4	531 948	5 200	20 800
Burrup Peninsular	Oct 1997	8 494	1	8 494	245	245
Scott	Mar 1998	1 053	2	2 106	100	200
Avon	June 1999	14 711	4	58 844	730	2 920
TOTAL		3 159 249		12 052 608	147 235	574 385

APPENDIX B (continued)

Fiscal Year 2000–01

AIR CELL	DATE COMMENCED	AREA	BAITING PER YR	TOTAL AREA BAITED/YR	BAITS	TOTAL BAITS/YR
Julimar	April 1994	18 400	4	73 600	1 420	5 680
Hills Forest	April 1994	20 000	4	80 000	1 400	5 600
Batalling	April 1994	45 754	4	183 016	1 870	7 480
Gervasse	April 1994	10 200	4	40 800	440	1 760
Hadfield	April 1994	3 000	4	12 000	200	800
Kelmscott	June 1994	66 700	2	133 400	3 350	6 700
Jarrahdale	June 1994	127 800	2	127 800	6 640	13 280
Dwellingup	June 1994	116 500	4	266 800	6 000	24 000
Worsley	June 1994	14 400	2	28 800	720	1 440
Lane Poole	Jan 1995	94 000	6	564 000	3 900	23 400
Cape Range	April 1996	75 000	4	300 000	3 400	13 600
Karroun Hill	April 1996	40 000	4	160 000	2 000	8 000
Lake Magenta	May 1996	116 921	4	467 684	5 020	20 080
Dragon Rocks	May 1996	32 546	4	130 184	1 380	5 520
Jerdacuttup Lakes	Sept 1996	17 746	4	70 984	730	2 920
Corackerup	Sept 1996	4 325	4	17 300	150	600
Peniup	Sept 1996	6 318	4	25 272	200	800
Collie	Oct 1996	31 944	4	127 776	1 360	5 440
Wilga	Oct 1996	14 256	4	57 024	530	2 120
Grimwade	Oct 1996	53 757	4	215 028	1 950	7 800
Fitzgerald	Oct 1996	377 641	4	1 510 564	18 300	73 200
Mullalyup	Oct 1996	6 624	4	26 496	160	640
Argyle	Oct 1996	10 412	4	41 648	330	1 320
Manjimup	Nov 1996	133 011	4	532 044	4 560	18 240
Shannon	Nov 1996	312 121	4	1 248 484	14 610	58 440
Denbarker	Nov 1996	243 842	4	975 368	11 000	44 000
Millbrook	Nov 1996	1 484	4	5 936	40	160
Kalbarri	Nov 1996	180 563	4	722 252	8 600	34 400
Stirling	Nov 1996	113 331	4	453 324	6 100	24 400
Two Peoples Bay	Nov 1996	9 274	4	37 096	300	1 200
Manypeaks	Nov 1996	13 393	4	53 572	550	2 200
Porongurup	Dec 1996	2 747	4	10 988	50	200
Irwin	Dec 1996	6 177	4	24 708	230	920
Giants	Dec 1996	3 026	4	12 104	70	280
Nornalup	Dec 1996	7 979	4	31 916	260	1 040
Stokes Inlet	Dec 1996	24 948	4	99 792	1 500	6 000
Cape Le Grande	Dec 1996	33 667	4	134 668	1 750	7 000
Cape Arid	Dec 1996	213 872	4	855 488	12 100	48 400
Sunklands	July 1997	286 310	4	1 145 240	12 560	50 240
Ravsthrpe Range	Sept 1997	18 140	4	72 560	1 290	5 160
D'Entrecasteaux	Oct 1997	93 875	4	375 500	3 940	15 760
Donnelly	Oct 1997	132 987	4	531 948	5 200	20 800
Burrup Peninsular	Oct 1997	8 494	1	8 494	245	245
Scott	Mar 1998	1 053	2	2 106	100	200
Avon	June 1999	14 711	4	58 844	730	2 920
TOTAL		3 159 249		12 052 608	147 235	574 385

APPENDIX B (continued)

Fiscal Year 2001–02

AIR CELL	DATE COMMENCED	AREA	BAITING PER YR	TOTAL AREA BAITED/YR	BAITS	TOTAL BAIT/YR
Julimar	April 1994	18 400	4	73 600	1 420	5 680
Hills Forest*	April 1994	20 000	4	80 000	1 400	5 600
Kelmscott*	June 1994	66 700	4	133 400	3 350	6 700
Batalling	April 1994	45 754	4	183 016	1 870	7 480
Gervasse	April 1994	10 200	4	40 800	440	1 760
Collie	Oct 1996	31 944	4	127 776	1 360	5 440
Hadfield	April 1994	3 000	4	12 000	200	800
Jarrahdale***	June 1994	127 800	4	511 200	6 640	26 560
Dwellingup	June 1994	116 500	4	266 800	6 000	24 000
Worsley***	June 1994	14 400	4	57 600	720	2 880
Lane Poole***	Jan 1995	94 000	4	376 000	3 900	15 600
Cape Range	April 1996	75 000	4	300 000	3 400	13 600
Karroun Hill	April 1996	40 000	4	160 000	2 000	8 000
Lake Magenta	May 1996	116 921	4	467 684	5 020	20 080
Dragon Rocks	May 1996	32 546	4	130 184	1 380	5 520
Jerdacuttup Lakes	Sept 1996	17 746	4	70 984	730	2 920
Corackerup	Sept 1996	4 325	4	17 300	150	600
Peniup	Sept 1996	6 318	4	25 272	200	800
Wilga	Oct 1996	14 256	4	57 024	530	2 120
Grimwade	Oct 1996	53 757	4	215 028	1 950	7 800
Fitzgerald	Oct 1996	377 641	4	1 510 564	18 300	73 200
Mullalyup	Oct 1996	6 624	4	26 496	160	640
Argyle	Oct 1996	10 412	4	41 648	330	1 320
Manjimup	Nov 1996	133 011	4	532 044	4 560	18 240
Shannon	Nov 1996	312 121	4	1 248 484	14 610	58 440
Denbarker	Nov 1996	243 842	4	975 368	11 000	44 000
Millbrook	Nov 1996	1 484	4	5 936	40	160
Kalbarri	Nov 1996	180 563	4	722 252	8 600	34 400
Stirling	Nov 1996	113 331	4	453 324	6 100	24 400
Two Peoples Bay	Nov 1996	9 274	4	37 096	300	1 200
Manypeaks	Nov 1996	13 393	4	53 572	550	2 200
Porongurup	Dec 1996	2 747	4	10 988	50	200
Irwin	Dec 1996	6 177	4	24 708	230	920
Giants**	Dec 1996	3 026	4	12 104	70	280
Nornalup**	Dec 1996	7 979	4	31 916	260	1 040
Stokes Inlet	Dec 1996	24 948	4	99 792	1 500	6 000
Cape Le Grande	Dec 1996	33 667	4	134 668	1 750	7 000
Cape Arid	Dec 1996	213 872	4	855 488	12 100	48 400
Sunklands	July 1997	286 310	4	1 145 240	12 560	50 240
Ravsthrpe Range	Sept 1997	18 140	4	72 560	1 290	5 160
D'Entrecasteaux	Oct 1997	93 875	4	375 500	3 940	15 760
Donnelly	Oct 1997	132 987	4	531 948	5 200	20,800
Burrup Peninsula	Oct 1997	8 494	1	8 494	245	245
Scott	Mar 1998	1 053	2	2 106	100	200
Avon	June 1999	14 711	4	58 844	730	2,920
Nambung	Mar 2001	113 282	4	453 128	6 000	24,000
TOTAL		3 272 531		12 729 936	153 235	605 305598 385

* Amalgamated to Perth Hills March 2002 & converted to 4X per year

** Amalgamated to Walpole Sept 2001

*** Converted to 4X per year from March 2002.

APPENDIX B (continued)

Fiscal Year 2002–03

AIR CELL	DATE COMMENCED	AREA	BAITING PER YR	TOTAL AREA BAITED/YR	BAITS	TOTAL BAIT/YR
Julimar	April 1994	18 400	4	73 600	1 420	5 680
Hills Forest*	April 1994	20 000	4	80 000	1 400	5 600
Kelmscott*	June 1994	66 700	4	133 400	3 350	6 700
Batalling	April 1994	45 754	4	183 016	1 870	7 480
Gervasse	April 1994	10 200	4	40 800	440	1 760
Collie	Oct 1996	31 944	4	127 776	1 360	5 440
Hadfield	April 1994	3 000	4	12 000	200	800
Jarrahdale***	June 1994	127 800	4	511 200	6 640	26 560
Dwellingup	June 1994	116 500	4	266 800	6 000	24 000
Worsley***	June 1994	14 400	4	57 600	720	2 880
Lane Poole***	Jan 1995	94 000	4	376 000	3 900	15 600
Cape Range	April 1996	75 000	4	300 000	3 400	13 600
Lake Magenta	May 1996	116 921	4	467 684	5 020	20 080
Dragon Rocks	May 1996	32 546	4	130 184	1 380	5 520
Jerdacuttup Lakes	Sept 1996	17 746	4	70 984	730	2 920
Corackerup	Sept 1996	4 325	4	17 300	150	600
Peniup	Sept 1996	6 318	4	25 272	200	800
Wilga	Oct 1996	14 256	4	57 024	530	2 120
Grimwade	Oct 1996	53 757	4	215 028	1 950	7 800
Fitzgerald	Oct 1996	377 641	4	1 510 564	18 300	73 200
Mullalyup	Oct 1996	6 624	4	26 496	160	640
Argyle	Oct 1996	10 412	4	41 648	330	1 320
Manjimup	Nov 1996	133 011	4	532 044	4 560	18 240
Shannon	Nov 1996	312 121	4	1 248 484	14 610	58 440
Denbarker	Nov 1996	243 842	4	975 368	11 000	44 000
Kalbarri	Nov 1996	180 563	4	722 252	8 600	34 400
Stirling	Nov 1996	113 331	4	453 324	6 100	24 400
Two Peoples Bay	Nov 1996	9 274	4	37 096	300	1 200
Manypeaks	Nov 1996	13 393	4	53 572	550	2 200
Porongurup	Dec 1996	2 747	4	10 988	50	200
Irwin	Dec 1996	6 177	4	24 708	230	920
Giants**	Dec 1996	3 026	4	12 104	70	280
Normalup**	Dec 1996	7 979	4	31 916	260	1 040
Stokes Inlet	Dec 1996	24 948	4	99 792	1 500	6 000
Cape Le Grande	Dec 1996	33 667	4	134 668	1 750	7 000
Cape Arid	Dec 1996	213 872	4	855 488	12 100	48 400
Sunklands	July 1997	286 310	4	1 145 240	12 560	50 240
Ravsthrpe Range	Sept 1997	18 140	4	72 560	1 290	5 160
D'Entrecasteaux	Oct 1997	93 875	4	375 500	3 940	15 760
Donnelly	Oct 1997	132 987	4	531 948	5 200	20 800
Burrup Peninsular	Oct 1997	8 494	1	8 494	245	245
Scott	Mar 1998	1 053	2	2 106	100	200
Avon	June 1999	14 711	4	58 844	730	2 920
Nambung	Mar 2001	113 282	4	453 128	6 000	24 000
		3 231 047		12 564 000	152 195	597 145

* Amalgamated to Perth Hills March 2002 & converted to 4X per year

** Amalgamated to Walpole Sept 2001

*** Converted to 4X per year from March 2002.

APPENDIX C

Summary of aircraft baiting by fiscal year.

FISCAL YEAR	CELL AREA (HA)	TOTAL AREA PER YEAR (HA)	BAITS	TOTAL BAITS/YR
1993-94	422 754	946 216	22 040	66 740
1994-95	516 754	1 510 216	25 940	90 140
1995-96	781 221	2 568 084	37 740	137 340
1996-97	2 603 679	9 857 916	123 170	479 060
1997-98	3 144 538	11 993 764	146 505	571 465
1998-99	3 159 249	12 052 608	147 235	574 385
1999-00	3 159 249	12 052 608	147 235	574 385
2000-01	3 159 249	12 052 608	147 235	574 385
2001-02	3 272 531	12 729 936	153 235	605 305
2002-03	3 231 047	12 564 000	152 195	597 145

APPENDIX D

Total aerial baiting costs (to October 2001)

AIR CELL	DATE COMMENCED	BAITING PER YR	TIMES BAITED	TOTAL FLYING HOURS	TOTAL BAITS USED	TOTAL COST (APPROX)
Julimar	April 1994	4	30	84	43 290	\$59 000
Hills Forest	April 1994	4	30	78	43 050	\$56 500
Batalling	April 1994	4	30	90	56 910	\$71 000
Gervasse	April 1994	4	26	26	13 000	\$18 000
Hadfield	April 1994	4	30	18	6 300	\$10 500
Kelmscott	June 1994	2	16	67.2	52 992	\$60 000
Jarrahdale	June 1994	2	16	160	107 424	\$130 000
Dwellingup	June 1994	4	30	228	180 720	\$204 500
Worsley	June 1994	2	16	16	8 016	\$11 000
Lane Poole	Jan 1995	6	41	205	165 025	\$185 000
Cape Range	April 1996	4	22	68.2	74 800	\$79 000
Karroun Hill	April 1996	4	22	88	44 000	\$66 000
Lake Magenta	May 1996	4	22	101.2	110 792	\$117 500
Dragon Rocks	May 1996	4	22	52.8	30 624	\$42 000
Jerdacuttup Lakes	Sept 1996	4	21	50.4	16 863	\$32 000
Corackerup	Sept 1996	4	21	10.5	3 171	\$6 000
Peniup	Sept 1996	4	21	10.5	4 200	\$7 000
Collie	Oct 1996	4	18	43.2	25 398	\$35 000
Wilga	Oct 1996	4	21	31.5	12 852	\$21 500
Grimwade	Oct 1996	4	21	58.8	41 286	\$52 000
Fitzgerald	Oct 1996	4	21	399	376 047	\$420 000
Mullalyup	Oct 1996	4	21	8.4	3 549	\$6 000
Argyle	Oct 1996	4	21	12.6	7 014	\$10 000
Manjimup	Nov 1996	4	20	142	91 200	\$120 000
Shannon	Nov 1996	4	20	294	292 200	\$320 000
Denbarker	Nov 1996	4	20	236	214 440	\$243 000
Millbrook	Nov 1996	4	20	5	1 000	\$3 000
Kalbarri	Nov 1996	4	20	144	169 000	\$175 000
Stirling	Nov 1996	4	20	116	129 300	\$136 000
Two Peoples Bay	Nov 1996	4	20	12	7 280	\$10 000
Manypeaks	Nov 1996	4	20	18	11 420	\$15 000
Porongurup	Dec 1996	4	20	10	2 400	\$5 500
Irwin	Dec 1996	4	20	18	4 392	\$10 000
Giants	Dec 1996	4	19	9.5	1 900	\$5 500
Nornalup	Dec 1996	4	19	19	5 985	\$11 500
Stokes Inlet	Dec 1996	4	20	40	30 000	\$37 000
Cape Le Grande	Dec 1996	4	20	40	29 880	\$37 000
Cape Arid	Dec 1996	4	20	272	210 840	\$254 500
Sunklands	July 1997	4	18	216	225 342	\$246 500
Ravsthorpe Range	Sept 1997	4	17	42.5	12 325	\$26 000
D'Entrecasteaux	Oct 1997	4	17	76.5	66 980	\$78 500
Donnelly	Oct 1997	4	17	113.9	88 400	\$109 000
Burrup Peninsula	Oct 1997	1	5	12.5	1 325	\$6 000
Scott	Mar 1998	2	5	2.5	500	\$1 500
Avon	June 1999	4	10	10	5 790	\$8 500
Wellington	Dec 2000	4	4	12	8 240	\$11 500
Nambung	Mar 2001	4	3	18.6	18 000	\$22 000
Walpole	Sept 2001	4	1	1.5	392	\$1 000
Total					3 055 854	\$3 593 000